PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

FIRST ANNUAL MEETING

MAY 19-21, 1926

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PROCEEDINGS
HAWAIIAN ACADEMY OF SCIENCE

HISTORICAL SKETCH

Organizations for the discussion of topics in the field of physical science and natural history have for many years been features of the intellectual life of Hawaii. The Hawaiian Medical Society was founded in 1895; the Hawaiian Engineering Association, in 1902; the Hawaiian Chemists' Association, in 1902, enlarged to form the Hawaiian Association of Sugar Technologists in 1922; the Hawaiian Entomological Society, in 1905; the Hawaiian Section of the American Chemical Society, in 1923; and the Hawaiian Botanical Society, in 1924. As centers for the discussion of technical subjects, these organizations serve a very important purpose and have done much to advance knowledge in the fields which they cover, but their membership cannot be appropriately enlarged to include scientists at work in other fields. The increase in the number of scientists in Hawaii and the recognition of the fact that many important scientific problems require for their solution contributions from several fields of research seemed to justify the organization of a society which might enroll all professional scientists in Hawaii and which might encourage amateurs to make their observations accessible by preparing papers for presentation.

Following a consideration of methods and personnel, the Natural Science Club of Hawaii was organized in June, 1921, as a center for informal discussion of scientific topics relating to Hawaii. The seventeen interesting meetings of this Club, held under the guidance of Professor Harold S. Palmer, Secretary-Treasurer, demonstrated its usefulness and pointed the way for the founding of a more comprehensive society for the "promotion of research and the diffusion of knowledge."

With the idea in mind that the proposed organization might become a branch of the American Association for the Advancement of Science, a meeting was called (April 2, 1925) of the members of the Association resident in Hawaii and a committee appointed to formulate plans for a permanent organization.

The Council of the American Association for the Advancement of Science discouraged the plan of forming a local "Branch" or "Division" of the Association, but suggested that an Academy of Science be formed, to affiliate with the Association. At a meeting of the Hawaiian members of the Association on June 10, 1925, the suggestion of the Council was adopted; and a committee consisting of Frederick C. Newcombe (Chairman), Edwin H. Bryan, Jr. (Secretary-Treasurer), Harry L. Arnold, Harold S. Palmer, and Guy R. Stewart was appointed to draft a constitution. At a meeting held July 23, 1925, the constitution was adopted and the following officers were elected to serve until the first Annual meeting to be held in the spring of 1926:

President, Frederick C. Newcombe; Vice-President, C. Montague Cooke, Jr.; Secretary-Treasurer, Edward L. Caum; Councilor (2 years), Otto H. Swezey; Councilor (1 year), Frederick G. Krauss.

At this meeting it was voted that those eligible for charter membership must be members of the American Association, of one of its affiliated societies, or of the local botanical, or entomological societies, and that charter membership rolls be held open until October 1, 1925. During this time seventy-nine individuals signed the Constitution. From October, 1925, to July, 1926, forty-two candidates were elected, giving the Academy a membership of one hundred and twenty-one.

During the year three public meetings were held: on November 9, 1925, Dr. C. P. Berkey, Geologist of the Third Asiatic Expedition of the American Museum of Natural History, spoke on Evidence of Change of Climate in the Gobi Desert; on January 7, 1926, Dr. Edwin G. Conklin of Princeton University spoke on The Mechanism of Evolution; and on March 29, 1926, Dr. Carl M. Meyer of the Hooper Foundation spoke on Food Poisoning and Food Infection.

COMMITTEE ON PUBLICATION

CONSTITUTION

Article I. Name

The name of this society shall be The Hawaiian Academy of Science.

Article II. Objects

The objects of this Academy shall be the promotion of research and the diffusion of knowledge.

Article III. Membership

1. The members of the Academy shall be known as Members and Corresponding Members.

2. Any resident of the Territory of Hawaii, interested in science, shall be eligible for election as a Member.

3. Any person not a resident of the Territory of Hawaii, who is interested in scientific problems relating to Hawaii, shall be eligible for election as a Corresponding Member.

Article IV. Nomination and Election of Members

1. Nomination to membership in either class shall be made in writing to the Council at least two weeks before the Annual Meeting. Each nomination must be signed by three Members of the Academy.

2. The Council shall examine into the fitness of nominees and, at a business session of the Academy, shall recommend for election such nominees as it approves.

3. The Members of the Academy shall vote on the nominees by ballot. Each Member shall prepare his own ballot, and the names of all nominees may be written on one slip of paper.

4. At any time prior to two months before the Annual Meeting, the Council shall have the power to enroll as Members applicants about whose eligibility no councilor has doubt. The names of such persons shall be submitted by the Council at the Annual Meeting for confirmation by the Academy.

5. Election to membership in either class shall require a favorable vote from three-fourths (¾) of the Members present.

Article V. Officers and Committees

1. The officers of the Academy shall be a President, who shall not be eligible for re-election until one year from the end of his last incumbency, a Vice-President, and a Secretary-Treasurer. There shall also be a Council.

2. The Council shall be composed of the officers, the retiring President, and two additional Councilors to be elected by the Members of the Academy.

3. The officers shall be elected annually. The additional Councilors shall be elected, one each year, to serve for a period of two years.

4. An Auditing Committee of two shall be appointed annually by the Council. The Auditing Committee shall examine the financial accounts of the Academy and report their condition at the final business meeting of the Academy.

Article VI. Election of Officers

1. At the final session of the Annual Meeting, the Council shall present a list of nominations for officers and councilors of the Academy. Not more than two names shall be listed for any office.

2. Any Member of the Academy may nominate for any office any Member other than those named in the foregoing list, and such a nomination, if seconded, shall be added to the Council's list.

3. When the list of nominations is complete, each Member shall write on a slip of paper, as his ballot, one name for each position to be filled.

4. The person receiving the highest number of votes for a particular office shall be declared elected.

Article VII. Duties of Officers

1. The President shall preside at the meetings of the Academy, perform other duties provided for him in these rules, and carry out such functions as usually pertain to the chief officer of such a society. He shall deliver an address at the Annual Meeting.

2. The Vice-President shall perform the functions of the President in the absence of the latter.

3. The Secretary-Treasurer shall be the custodian of the records and papers of the Academy, shall keep a record of the Proceedings of the Academy, and make a written report of the year's activity of the Academy at the Annual Meeting.

The Secretary-Treasurer shall collect the dues of the Members, administer all funds, keep a detailed account of the receipts and expenditures of the Academy, and render a written report at the Annual Meeting.

4. The Council, besides performing the duties assigned in Articles IV, V, VI, VII, and IX of this Constitution, shall initiate business for the Annual Meeting, and, in the intervals between the meetings of the Academy, shall strive in every way to promote the interests and efficiency of the Academy as opportunity may be found so to do.

Article VIII. Meetings

1. The Academy shall hold a stated meeting in April or May of each year, to be known as the Annual Meeting. The Annual Meeting shall be announced by a preliminary circular, at least three months before the meeting, calling for papers for the program. Final announcement, giving date and place of meeting, shall be sent out a suitable time prior to each meeting. The program, place, and date shall be determined by the Council.

2. All members desiring to present papers at the Annual Meeting must forward to the Council, at a time which it will set, full titles of all papers which they propose to present, with a statement of the time which each will occupy in delivery. The Council reserves the right to call for an abstract of any paper offered, and to pass upon its fitness for the program.

3. Special meetings of the Academy may be called by the Council. A meeting must be called by the Council upon the written request of ten Members.

4. Stated meetings of the Council shall be held coincidently with stated meetings of the Academy. Special meetings of the Council may be called by the President at such times as he may deem necessary.

5. At stated meetings of the Academy the Members present shall constitute a quorum.

6. Four members of the Council shall constitute a quorum. The Council may appoint a substitute for any of its members absent from the Island of Oahu, for any member resigned, or for any member indefinitely incapacitated.

Article IX. Publications

The Academy shall encourage the publication of papers, presented at its meetings, in appropriate scientific journals. The Council shall give authors such aid as it may in securing publication.

Article X. Dues

1. The dues of Members shall be one dollar ($1.00) per annum, payable within one month following the Annual Meeting. Corresponding Members shall pay no dues.

2. Any Member of the Academy in arrears for eighteen months in the payment of Annual dues shall thereby forfeit his membership in the Academy, provided the Secretary-Treasurer shall have sent the delinquent Member two written notices of the existence of this rule.

Article XI. Order of Business

The order of business at the final session of the Annual Meeting shall be as follows:

a. Call to order by the presiding officer.

b. Reading of minutes of preceding meeting.

c. Announcements.

d. Recommendations from the Council.

e. Report of the Secretary-Treasurer.

f. Appointment of Auditing Committee.

g. Election of Members and Corresponding Members.

h. Reports of Committees.

i. New business.

j. Election of President, Vice-President, Secretary-Treasurer, and additional Councilor.

Article XII. Amendments

This Constitution may be amended at any Annual Meeting by a three-fourths (¾) vote of the Members present, provided that notice of the proposed amendment has been given to the Members a month previously.

MEMBERS

Charter members are indicated by a star (*)

Abel, F. A. E.
Adams, Romanzo
*Agee, H. P.
*Aitken, Robt. T.
Alexander, W. P.
Andrews, Carl B.
*Arnold, H. L.
Baker, R. J.
*Ball, S. C.
*Barnum, C. C.
*Bergman, H. F.
*Bond, Benjamin D.
*Bond, Kennith D.
Bowers, F. A.
*Brown, Elizabeth D. W.
*Brown Forest B. H.
*Bryan, Edwin H., Jr.
Burkland, A. O.
Campbell, Edw. L.
Carson, Max H.
Cartwright, Bruce
*Caum, Edw. L.
Chung, H. L.
*Cooke, C. Montague, Jr.
Cooke, D. A.
Cooke, Richard A.
*Crawford, D. L.
Das, U. K.
*Davis, Arthur L.
*Dean, A. L.
*Degener, Otto C.
Denison, Frederic C.
Denison, Harry L.
*Dewar, Margaret M.
Dickey, Lyle A.
*Dillingham, F. T.
*Donaghho, J. S.
*Edmondson, C. H.
*Ehrhorn, Edw. M.
*Fennel, E. A.
*Ford, Alexander Hume
*Fronk, C. E.
Fujimoto, Giichi
*Giffard, Walter M.
*Gregory, Herbert E.
*Hadden, Fred C.
Handy, E. S. Craighill
Handy, Willowdean C.
*Harl, V. A.
Hartung, Wm. J.
Hauck, Arthur A.
Henke, Louis A.
*Holmes, Henry
Horner, John M.
*Illingworth, J. F.
Jaggar, T. A.
*Johnson, Horace
Judd, A. F.
*Judd, Charles Sheldon
Kangeter, John H.
Katsuki, I.
*Kirkpatrick, Paul
*Kluegel, C. H.
*Krauss, F. G.
*Kutsunai, Y.
*Larrabee, Louise M.
Larrison, G. K.
*Larsen, Nils P.
*Lee, H. Atherton
Livesay, Ruth H.

*Livesay, T. M.
*Lyon, Harold L.
*Lyon, Maude Fletcher
*MacNeil, Wilbur J.
Magarian, M. C.
*Martin, J. P.
*McEldowney, G. A.
*McGeorge, W. T.
McKay, Wm.
*Miller, Carey D.
*Moir, Wm. W. G.
*Morita, Helene T.
*Muir, Fredk.
Neal, Marie C.
*Newcombe, F. C.
*Palma, Joseph
*Palmer, Harold S.
Pinkerton, F. J.
*Pope, Willis T.
Popert, Wm. H.
*Porteus, S. D.
Renton, Geo. F.
Robinson, A. E.
*Rosa, J. S.
*Sideris, C. P.
*Smith, Robt. N.
Spalding, P. E.
*Stewart, Guy R.
*Stokes, John F. G.
*Straub, George F.
*Swezey, O. H.
*Thompson, Herbert L.
*Thompson, Mrs. Herbert L.
Thurston, L. A.
*Topping, D. LeRoy
Tower, Burt Adams
*Van Zwaluwenburg, R. H.
*Verret, J. A.
*Warriner, C. E.
*Weeber, Lorle Stecher
*Weinrich, Wm.
*Weller, D. M.
Wendt, W. A.
*Westgate, J. M.
*Westervelt, W. D.
*Whitney, L. A.
*Wilder, Gerrit P.
*Willard, H. F.
*Wist, J. E.
Withington, Paul
Wood, Edgar
*Yang, Y. C.
Zschokke, T. C.

PROCEEDINGS OF FIRST ANNUAL MEETING

WEDNESDAY, MAY 19, 4:30 P.M.

Business Meeting

PRESIDENTIAL ADDRESS: F. C. Newcombe, The Field of the Hawaiian Academy of Science

WEDNESDAY, MAY 19, 7:30 P.M.

Harold S. Palmer: The form and structure of the artesian areas underlying Honolulu.

Harold L. Lyon: The source, conservation, and increase of artesian water.

G. K. Larrison: The adequacy of artesian water for future supply.

John McCombs: Natural and artificial losses of artesian water.

Max H. Carson: Available surface water.

Discussion led by Herbert E. Gregory and Fred Ohrt.

THURSDAY, MAY 20, 7:30 P.M.

F. G. Krauss: Genetic analysis of *Cajanus indicus* and the creation of improved varieties through hybridization and selection.

Willis T. Pope: Unsettled variations of *Carica papaya.*

Forest B. H. Brown: Lautea, a new genus of the Cornaceae; its probable origin and dispersal in the Pacific.

Forest B. H. Brown and Elizabeth D. W. Brown: *Lepidium bidentoides* n.sp.; a statistical study of its distribution in Polynesia.

Marie C. Neal: Some features of the New Zealand flora.

Otto C. Degener: The hermit crabs of Hawaii.

Stanley C. Ball: The introduction of foreign birds into Hawaii.

John E. Guberlet: Notes on the parasitic fauna of Hawaii.

Otto H. Swezey: The control of sugar cane insect pests in Hawaii by the introduction of natural enemies.

Edwin H. Bryan, Jr.: Insects of the Tanager Expedition.

FRIDAY, MAY 21, 7:30 P.M.

A. L. Dean: Pineapple cultivation as a field for investigation.

W. P. Alexander: Influence of potash fertilization on the sucrose content of sugar-cane.

Douglas A. Cooke: Problems of the outdoor seedling nursery in Hawaii and methods of preserving sugar-cane seed.

Clyde C. Barnum: Studies on the flowering of sugar-cane in Hawaii.

D. M. Weller: Progress report on sugar-cane pollen studies.

Upendra K. Das: Experiments in preserving the life of cut cane.

H. Atherton Lee: The distribution of the roots of sugar-cane in the soil.

Paul Kirkpatrick and M. C. Magarian: A method of direct current vibration galvanometry.

J. S. Donaghho: The duodecimal system of numbering.

Wm. J. Hartung: Repetition in field experimentation. (Read by title.)

F. C. Newcombe: Sensitive behavior of sugar-cane roots. (Read by title.)

SATURDAY, MAY 22, 2:30 P.M.

Herbert E. Gregory: Types of Pacific islands.

E. S. Craighill Handy: The island of Maupiti.

E. S. Craighill Handy: Distribution of ethnographic elements in Polynesia.

John F. G. Stokes: Mountain villages of Rapa.

John F. G. Stokes: A comparison of primitive fabric technique in Oceanica and America.

Willowdean C. Handy: String figures as ethnographic data.

Romanzo Adams: Interracial marriages in Hawaii.

Carey D. Miller: Progress in the study of the nutrition values of the old Hawaiian diet.

C. Montague Cooke, Jr.: Analysis of Samoan land snails.

C. P. Sideris: Hydrophilic colloids.

T. C. Zschokke: A land policy for Hawaii.

Edwin H. Bryan, Jr.: A clearing house for Pacific entomology.

R. H. Van Zwaluwenburg: Some sugar-cane insects of the Pacific coast of Mexico. (Real by title.)

Harold S. Palmer: The viscosity of lava. (Read by title.)

Business Meeting.

A Committee on Publication, consisting of Harold L. Lyon and Harold S. Palmer, was appointed to supervise the publication of the Proceedings of the Academy.

The Committee on Nominations (Wm. W. G. Moir, H. Atherton Lee, and J. S. Donaghho) presented a list of nominees. The balloting resulted in the election of the following officers: President, A. L. Dean; Vice-president, Frederick Muir; Secretary-Treasurer, Edwin H. Bryan, Jr.; Councilor (2 years), Charles S. Judd.

These officers, with Otto H. Swezey, the hold-over Councilor, and Frederick C. Newcombe, retiring President, constitute the Council of the Academy for the year 1926-1927.

The following resolutions drafted by the Committee on Resolutions (Edwin H. Bryan, Jr., Willis T. Pope, and Romanzo Adams) were adopted.

1.—Be it resolved, that the thanks of the Hawaiian Academy of Science be extended to the University of Hawaii in appreciation of its courtesy in allowing the sessions of the first Annual Meeting of the Academy to be held in one of its buildings.

2.—Be it resolved, that the Hawaiian Academy of Science express its thanks to the authorities of Oahu College for the use of Bishop Hall for various public meetings of the Academy throughout the year, and to Mr. W. J. MacNeil for efficient stereopticon service.

3.—Be it resolved, that the grateful thanks of the Hawaiian Academy of Science be given to the Director and Trustees of the Bernice P. Bishop Museum for their offer to publish the Proceedings and abstracts of the papers of the first Annual Meeting of the Academy.

4.—Be it resolved, that the thanks of the Hawaiian Academy of Science be extended to the Honolulu Advertiser and to the Honolulu Star-Bulletin for their press notices concerning the meetings of the Academy.

5.—Whereas, the need of a brief but authoritative handbook on the natural history features of Hawaii is keenly felt by both visitors and students, and

Whereas, there are among the members of the Hawaiian Academy of Science persons qualified to attempt the preparation of such a publication, be it

Resolved, that the Hawaiian Academy of Science heartily endorses the preparation of such a publication, that it sponsor the compilation of data for such a publication, and that it urge its members individually and collectively to cooperate in this undertaking.

ABSTRACTS OF PAPERS

THE FIELD OF THE HAWAIIAN ACADEMY OF SCIENCE

By
F. C. NEWCOMBE

Academies of science are among the oldest associations of men for the pursuit of knowledge. Their aims and activities, whether local or more general, narrow in subject or broadly inclusive, have depended on the will of the membership; and their measure of success has depended on the quality of support accorded by the men and women composing them.

As every organization is guided in its activities by the local conditions which it recognizes, it may be well, in this our first annual meeting, to attempt to recite the opportunities which our local conditions offer, and then to indicate the means by which these opportunities may be utilized.

The Constitution of our Academy states as the purpose "the promotion of research and the diffusion of knowledge." While there is nothing in the Constitution to limit the Academy's field, I shall assume that, for the present, at least, only the so-called natural sciences, including medicine, are expected to participate.

Before launching a new society, it would be well to ask whether the natural science field in Hawaii is already occupied by other organizations. The pedagogical side of science is already looked after by teachers' organizations; and, while the Academy might, at some time, wish to inquire into the adequacy of the equipment for teaching science, the methods, and so forth, would probably best be left to the teachers themselves. The presentation of popular addresses, in exposition of science, should be but occasionally, if at all, attempted by the Academy. This very useful function is now exercised by other organizations and the Academy may well leave this service to them. If we turn our thought next to the single science societies in Hawaii, we recognize the Botanical Society, the Chemical Society, the Entomological Society, the Medical Society, the Medical Association, and perhaps still other societies, all cultivating fields similar to any the Academy might choose. Yes, the fields are similar, but they are not the same, nor are they alike. The Academy of Science offers what no single science can: It offers opportunity for acquaintance and sympathetic understanding of all interested in science in general; it offers opportunity for becoming acquainted with the research going on in all sciences; it offers opportunity for service, each man in his own line willing to impart to his fellow scientists the results of his research; it holds out the prospect of accomplishing by united action what could not be attempted by an organization of narrower scope.

Thus, very briefly stated, are, as I see them, the guiding principles for the conduct of the Academy of Science. They do not constitute a program, but they indicate a field for work without interfering with existing organizations.

From what groups of workers in Hawaii may the main strength of the Academy be expected to be drawn? First of all may be mentioned that group of young workers in the University, in the experiment stations, in industrial institutions, or connected with various plantations who, under the advice of older men, have carried through important series of observations or experiments, and who, under the guidance of the heads of their departments, could prepare accounts of their work to be offered for the annual program. We have two or three such reports in our present program. In the future, the number contributing to such a program can doubtless be increased, and, to my mind, should be increased; for there is no greater stimulus to effort by a young worker than to give him the feeling that he is to be given open credit for his work.

Another group of workers who ought to find congenial association in the Academy, and give to others their stores of knowledge, is constituted by the amateurs. In olden times, the academies of science were maintained almost wholly by this group. In our present program, not more than two papers can be credited to the amateurs. There are amateurs in Hawaii who have collected and studied various parts of the flora, others have related the flora to the old Hawaiian life, still others have collected insects and land snails; and so a long list of amateur work could be enumerated. The Academy would welcome this group of workers, and a way must be found to attract them into the organization.

Consider what a body of workers is constituted by the scientific men in the industries, on the plantations, and in the departments of civic government. They probably exceed the number in all our schools and experiment stations. Their work contains many results of surpassing interest which ought to find a wider publicity than afforded by official reports.

Another group, many of whom are carrying on scientific observation and experiment, is made by the physicians. Several of these are already members of the Academy. Let us hope that future programs will find their names in the list; for much of their work is of value, not only to technical medicine, but also to general biology and other sciences.

The last group to be considered is made up of the specialists working in institutions in which research is a leading motive. In the present day, professionals are sure to constitute the larger part of the productive membership in any scientific society. If we examine our program, we shall find in the total of forty papers, five-sixths are from these professionals. If again we count the papers according to subject, we shall find that fourteen are on plant studies, eight on animal studies, five on water supply, five on ethnology, three on physics, three on physiography, and one on chemistry. The sciences represented in the program are not represented at all in the proportions of the numbers of workers in the corresponding sciences. These two-fold inequalities, just noted, are not inherent either in the scientific institutions or in the sciences, but are probably merely accidents of the time. Some of the professional scientists may feel that an academy has no claims on them, or no advantages to offer them, seeing that they already have their single science society before which their contributions may be read, or they must make their results known in their official reports to the institution employing them. To the first objection it may be replied that the Academy should make no effort to compete for papers with the single science societies, but that some papers might properly by choice come before the society of broader interest, because of their bearing on more than the single science. Considering the claim of the Academy on those who make only official reports, even though such reports are printed in the literature of the institutions concerned, it may be said that such investigators often make discoveries, or work out methods, of interest to general science, though they may not be of immediate practical value. Papers embodying these discoveries should be given by printing to the scientific world, and many such papers would find their proper place in the program of the Academy.

In addition to the foregoing arguments for the existence of an Hawaiian academy of science, is still another, the validity of which all will acknowledge. It is this: that several sciences with workers in Hawaii have no organized society. Among such are mathematics, physics, astronomy, geology, geography, general zoology, agriculture, ethnology, and psychology; yet these sciences have furnished half the papers in our present program. The Academy gives them a society.

Summarizing very briefly the argument for the existence of the Hawaiian Academy of Science, the following points may be presented:

The Academy should be so conducted as to offer congenial association for all interested in science in Hawaii.

The Academy provides a society for more than a half dozen sciences before without a society in Hawaii.

The Academy offers its facilities and solicits the adherence of the young research worker, of the large body of amateurs, of the physicians doing research, of the scientific specialists in the industries and on the plantations, of the scientific staffs of the half dozen research institutions of Honolulu, and of the investigators in government departments.

In the meetings of the Academy, all scientists in Hawaii will have an opportunity to present the results of their studies to their fellows, to state their problems, to learn of the work and problems of their fellows in other sciences, and thus to contribute to the solidarity of science in Hawaii, to the good of Hawaii, and thus also to do all that can be done to overcome the scientific isolation which our geographical isolation necessarily entails.

Besides these benefits of contact, there may be other opportunities presenting themselves to the Academy for usefulness. The natural features of the Hawaiian islands in plant and animal life, in geology and physiography, the natural resources of the islands, the development of movements now going on in agriculture, in industry, in education, in sociology, and in esthetics, in some or all of these, and in other ways not now perceived, the Academy may be called upon to bear a part.

THE FORM AND STRUCTURE OF THE ARTESIAN AREAS UNDERLYING HONOLULU

By

HAROLD S. PALMER

Artesian water is found only in bodies of pervious rock which slope from a high intake area down to a lower region where they are covered by impervious rocks. Water absorbed at the high intake area flows down through the pervious body beneath the impervious cap rock. If escape at the down-slope end of the pervious body is prevented, the water will be impounded and will develop artesian pressure. In most artesian regions the escape is prevented because the distal end of the pervious body (*a*) is turned up to a high elevation, or (*b*) thins out between impervious bodies of rock, or (*c*) changes laterally from a pervious to an impervious texture.

At Honolulu the flow lavas of the Koolau Range extend southward under the city and on seaward to great depths. They constitute the pervious water-bearing rock. Superposed on them is a body of coastal plain sediments, which, though heterogeneous in detail, as a whole act as an impervious cap. Escape of water at the down-slope edge of the cap is prevented by the back pressure of sea water, which is about one-fortieth denser than fresh water. The principle is like that by which different fluids rise to different heights in the arms of a U-tube, the heights being inversely proportional to the densities. In consequence of this principle, there is a body of fresh artesian water which extends about forty times as far below sea level as it does above sea level. Below the fresh water zone and extending under the whole of the island of Oahu is a zone in which the rock pores are filled with sea water.

When artesian wells were first drilled at Honolulu, the water rose in them about 42 feet above sea level, which implies that the fresh water zone then extended about 1,680 feet below sea level. In 1926 the water rises only about 24 feet above sea level, which implies that the salt water zone has risen so that it is now only about 960 feet below sea level. This is corroborated by the fact that certain deep wells which now yield salt water formerly yielded fresh water. Water has been drawn from the artesian system faster than it has been replenished by absorption of rain.

Curves showing the variation of artesian head from time to time show that the head is highest after heavy rains and lowest at the end of prolonged droughts.

THE SOURCE, CONSERVATION, AND INCREASE OF ARTESIAN WATER

By
HAROLD L. LYON

The upper slopes of the Koolau Mountains constitute the watersheds which gather the water that falls as rain and deliver it into our artesian basins. All of the water that soaks into the ground on these watersheds may be considered as on its way into these basins.

Under primeval conditions, the watersheds of the Koolau Mountains were covered with a heavy rain forest, protecting a dense undergrowth of ferns and moss, which held back the rain water in a most effective manner. Then the soil was kept in a loose, open condition by the many burrowing roots and a thick mulch of organic matter: in fact, the dense vegetation not only served in itself to check the run-off during heavy rains, but also kept the soil in such a condition that it, too, held back the water and at the same time absorbed it rapidly.

Now, it is well known that through the acts of man and his domesticated animals, the effective area of water-conserving forest on the Koolau Mountains has been greatly reduced; that the remaining native forest is in a diseased and decadent condition throughout its entire extent; that the forest is rapidly becoming more open through the death of native plants and their prompt replacement by Hilo grass; and that the soil is becoming more compact and less absorptive as the nature of the vegetation changes. As the inevitable result of the above conditions, the water-absorbing capacity of our watersheds has greatly lessened in recent years, and will continue to lessen until steps are taken to alter the trend of events on these watersheds.

We must realize that while we are encouraging growth and development that will make ever-increasing demands upon the water in our artesian basins, we are, at the same time, permitting, if not actually fostering, conditions that are constantly decreasing the amount of water entering these basins.

The steps which we can, and must, take to insure the maintenance of our artesian water supply at its present magnitude are obvious. We should at once take effective measures to protect and preserve the forests remaining on the Koolau watersheds; we should make every effort possible to rehabilitate these forests so as to increase their water-holding capacity, and we should add to these forests until we have all lands on these watersheds, not otherwise employed, covered with an effective rain forest.

THE ADEQUACY OF ARTESIAN WATER FOR FUTURE SUPPLY

By

G. K. Larrison

The future water requirements for Honolulu are based on 175 gallons per capita daily after the city is completely metered. The present consumption is about 275 gallons per capita daily.

Estimated Future Population		Estimated Future Water Requirements
1930	— 124,000	22,000,000 gallons daily
1940	— 180,000	32,000,000 " "
1950	— 240,000	43,000,000 " "
1960	— 307,000	54,000,000 " "
1970	— 380,000	66,000,000 " "
1973	— 400,000	70,000,000 " "

The present daily draft on the artesian basin in the area between Diamond Head and Red Hill is about 52,000,000 gallons divided as follows:

Government owned wells—		
Used by the Water Works Department	24,000,000	gallons
Privately owned wells—		
Used for industrial purposes	14,000,000	"
Used for irrigation purposes	9,000,000	"
Used for domestic purposes	3,000,000	"
Loss from leaking wells	2,000,000	"
Total	52,000,000	gallons

The estimated safe draft on all artesian wells in this area is 42,000,000 gallons daily.

Other sources of supply, including mountain springs and tunnels, stream run-off and storage and filtration of flood run-off amount to about 30,000,000 gallons daily.

The total available supply from all sources, which may be utilized before the agricultural interests located outside the Red Hill to Wailupe area will be affected, is about 72,000,000 gallons daily.

The original static head of the artesian wells in the central Honolulu area was about 42 feet above mean sea level. The present static head is about 24.6 feet.

The mean annual drop of the artesian head for the past twelve years has been 0.33 foot.

The estimated head at which the Beretania and Kalihi pumping stations will begin to pump water so salty as to be unfit for human use is 18 feet.

If the present rate of fall of the artesian static head continues, the danger point at the Beretania and Kalihi stations will be reached in about 21 years, and at the Kaimuki pumping station in less time.

The remedy is conservation in all respects, supplemented by: a, complete metering of all water works services; b, acquisition and control by the Territory of all existing artesian wells between Diamond Head and Fort Shafter and the prohibition of drilling additional "private" wells in the Red Hill-Wailupe area.

NATURAL AND ARTIFICIAL LOSSES OF ARTESIAN WATER

By

John McCombs

Natural losses are those which occur before the artesian water enters the collection and distribution system and are not under human control. The chief natural loss is that through low level springs and can only be avoided by using this water, thus relieving the direct draft through wells.

Deforestation is a second cause of natural loss by decreasing the absorption of water into the artesian system. The remedy lies in the province of the forester. A third natural loss is due to the diffusion and mixture of the underlying salt water into the fresh water lens. The contact between the two is not a surface but a zone of gradual transition. As the artesian head fluctuates, this zone rises and falls and gradually thickens. The remedy is to build up the artesian head.

Artificial losses are those which occur in the processes of recovery and utilization, and may be classified as complete and partial losses. The complete losses are those in which the fresh artesian water finds its way to the sea without having conferred any benefits, for example the loss through well casings which have corroded, thus allowing the water to escape. The Division of Hydrography has greatly reduced this loss. But the work must be continued since more wells become defective every year. A second type of complete loss is due to leaks in the city distribution system, and accounts for a considerable part of Honolulu's excessive per capita daily consumption of 270 gallons. The Honolulu Sewer and Water Commission expects to reduce this to 175 or even 150 gallons by metering every service connection and by locating leaks in the mains. This wholly avoidable loss is estimated at 9,000,000 gallons a day, of which more than 1,000,000 gallons is due to leaky reservoirs.

The partial losses are those in which high grade artesian water is used where sea water or non-potable water could be substituted. A partial loss of several million gallons a day occurs in condensing steam and in industrial plants where sea water could be utilized with complete success. Commercial irrigation is a very wasteful process. In the cultivation of rice in particular, much water is wasted because of the indifference or ignorance of the irrigators. Another waste is in swimming pools, which use a half-million gallons daily, whereas filtration and chlorination would reduce this to less than a hundred thousand gallons.

Some phases of waste prevention are being carried on well. Others are scarcely touched, but all can be carried through, provided the public can have the facts and will support proper action.

AVAILABLE SURFACE WATER

By

MAX H. CARSON

The available surface water for the Honolulu water supply falls into five classes: (1) normal flow from the valleys immediately behind Honolulu, which yields an average of about 6,000,000 gallons per day; (2) flood flow from these valleys which yields an average of about 9,000,000 gallons per day, only about half of which could probably be stored for use; (3) water which might be collected in ditches along the windward coast from Kalihi north to Waiahole and brought through a tunnel into Kalihi Valley at an elevation of 800 feet, which would yield about 7,500,000 gallons per day; (4) water which might be collected in ditches along the windward coast between Kalihi and Manoa valleys and brought through a tunnel into Manoa Valley at an elevation of 400 to 500 feet, which would yield between 2,000,000 and 3,000,000 gallons per day; (5) water already collected and now brought through the Waiahole tunnel for irrigation purposes, and which should be used only as a last resort, as its loss would cripple the plantation it now supplies. Owing to the growing population along the windward coast and their consequent need for the water, probably only about 4,000,000 gallons per day can be counted on as available from classes 3 and 4. However, considerable additional water probably could be obtained from the tunnels through which this water would be conducted to Kalihi and Manoa valleys.

More exact figures than those given here would require a detailed correlation of stream flow with plans for its conservation. The Honolulu Sewer and Water Commission is now making the necessary investigations.

Since the surface supply of water exclusive of that from the Waiahole tunnel can be expected to yield an amount little greater than that the city is now pumping, the necessity for conservation cannot be escaped through its development.

WATER SUPPLY FOR HONOLULU

By

HERBERT E. GREGORY

Regarding water supply, a popular notion prevails that Providence usually takes care of people; and if Providence fails, mankind is amply able to care for itself. But the amount, quality, and availability of water depends on rainfall and geologic structure—factors over which mankind has no control.

It is possible, however, to learn where water is, how much there is, how good it is, and what it costs to obtain it. With that knowledge Honolulu can wisely plan its future; without that knowledge, expenditure of funds is a gamble and may be definitely injurious. For many years the solution of the water problem of Honolulu has been delayed by the failure to appreciate its seriousness and by political bickering. Fortunately, the solution is now in the hands of a group of competent engineers and scientists, and the duty of the community is to support whole-heartedly the work of the Sewer and Water Commission.

GENETIC ANALYSIS OF CAJANUS INDICUS AND THE CREATION OF IMPROVED VARIETIES THROUGH HYBRIDIZATION AND SELECTION

By

F. G. KRAUSS

The tropical leguminous shrub *Cajanus indicus,* commonly known as the pigeon pea, lends itself admirably to genetic study and improvement through breeding. The species has been subdivided into *C. flavus* D. C., with yellow flowers, self-colored seeds and glabrous pods, and *C. bicolor* D. C., which has the back of the standard red, seeds and pods speckled, the pods pubescent. The varieties vary greatly in many other characters. In genetic studies with a number of pure line varieties, some characters seem to follow definitely the Mendelian Law, thus:

DOMINANT CHARACTERS	RECESSIVE CHARACTERS
Flowers with red standards	Self-colored yellow flowers
Blotched or speckled seeds	Self-colored seeds
Pods blotched with maroon	Self-colored light tinted pods
Pubescent pods	Glabrous pods
Large flat pods	Small round pods
Large seeds	Small seeds
4-5 seeded pods	3-4 seeded pods
Round seeds, slightly flattened	All other seed shapes
Axillary inflorescence	Terminal inflorescence
Perennial habit	Annual habit

Some characters appear to show a blending inheritance, as the crossing of very dwarf with very tall varieties tends to produce an intermediate type, although the crossing of two tall types almost invariably produces a form taller than either parent. Insofar as reciprocal crosses have been studied, this behavior remains constant. Dihybrid crosses appear to adhere rather closely to the 9-3-3-1 ratio.

There has been bred and established a new hybrid form which incorporates many of the desirable qualities which were definitely sought for. This has been for the present designated as New Era, Strain X. The production record of the original mother plant of this new type is as follows:

Number of pods	1430
Weight of pods and seed	1587 grams
Weight of seed	1150 grams
Ratio, weight of seeds to pod	73 percent
Average seeds per pod	4.6
Number of seeds produced	6460

In other words, one seed reproduced itself 6460 fold in one season.

We have every reason to believe that we are now entering upon a clear conception of the heriditary behavior of *Cajanus indicus* to an extent whereby we can apply the science of genetics to practical and far-reaching purposes in tropical agriculture. Should we succeed in producing a hardy type of this valuable but little-known legume from crosses between the old established pure strain New Era "D" and hardy Himalayan types which thrive up to 6000 feet altitude, and there is good reason to believe we may, then will Hawaii have contributed not only to tropical agriculture but also to the vast Temperate Zone agricultural world a field crop second to none in the diversity of its economic uses.

UNSETTLED VARIATIONS OF PAPAYA

By

WILLIS T. POPE

The papaya *(Carica papaya)* is particularly interesting because of the extreme variability of its flowering habits and its fruit forms. Horticulturists have difficulty in establishing and maintaining varieties to a fair degree of uniformity.

The papaya is normally dioecious, but monoecious plants are common, and there are many intermediate forms. Almost any block of seedlings grown from the seed of a single fruit exhibits five or six sexual forms.

Many plants bear fruit one year of a shape different from that borne the previous year. Some plants bear fruits of several different shapes at the same time. Pollination experiments gave no evidence that this change of shape of the fruit was caused by the stimulus of cross-pollination.

Another type of variation is in the color of the flesh of the fruit. The normal color is orange-yellow, but flesh colored, pink, reddish, and rich crimson fruits have been found. Seed from a red-fruited papaya has given rise to plants bearing red fruits and plants bearing the normal orange-yellow fruits. An explanation of these variations seems to be found in the discussion of Chimeras by Babcock and Clausen in their text-book, Genetics in relation to agriculture.

LAUTEA, A NEW GENUS OF THE CORNACEAE; ITS PROBABLE ORIGIN AND DISPERSAL IN THE PACIFIC.

By
FOREST B. H. BROWN

Lautea, F. Brown, new genus in lit.
Lautea stokesiana, F. Brown, new species in lit.
Lautea serrata, F. Brown, new species in lit.

LEPIDIUM BIDENTOIDES, N. SP.; ITS DISTRIBUTION IN POLYNESIA

By
FOREST B. H. BROWN and ELIZABETH D. W. BROWN

Lepidium bidentoides, F. and E. Brown, new species in lit.

SOME FEATURES OF NEW ZEALAND FLORA

By
MARIE C. NEAL

The vegetation of New Zealand is distinctly different from that of any other country. This may be explained by its wide separation from other lands, perhaps since Cretaceous times. Possibility of former connection by land with the Northern Hemisphere also offers an explanation for the character of most of its plants. Immigration by land from the north is judged to have come in two waves, the first wave bringing such primitive forms as conifers, ferns, and beeches, from which descended the present representatives of those groups, the second wave bringing higher forms from the Malay region—ancestors of many plants in the mixed forest of the present day. Besides immigrants by land, some are believed to have arrived overseas, chiefly from east and west.

Two types of forest are found in New Zealand, one type made up of trees of one species principally, the other made up of many different species. To the first type belongs the kauri forest, which exists in the northern part of the North Island and which consists chiefly of clumps of that slow-growing pine; the kahikatea forest, found on swampy ground and consisting chiefly of a taxad; and the southern beech forest. The beeches cover large areas in moist parts of both islands, particularly in the South Island. They include six endemic species. Their dense though small foliage prevents much undergrowth besides their own seedlings, mosses, and a large parasite. The beech family may have originated in North America and in ancient times emigrated by land connections to other parts of the world, developing to higher forms at the place of origin and continuing in primitive forms where it dispersed. The southern beech of New Zealand retains primitive forms. The second type of forest, the mixed forest, is located in the lowlands and includes many of the 1800 endemic vascular species listed. It is made up of a great diversity of species, genera, and families, and of trees, vines, scramblers, epiphytes, and herbs of varied forms and sizes, commonly luxuriant, in places impenetrable. With one or two exceptions, woody plants are evergreen; most of the leaves are small, and in many cases those of distantly related species have a similar appearance; and many of the flowers are small and inconspicuous. Ferns are abundant and range in size from trees to minute filmy plants.

Besides many unique genera and species and forms of plants, many peculiar plant associations exist in New Zealand.

THE HERMIT CRABS OF THE HAWAIIAN ISLANDS

By
OTTO C. DEGENER

In the literature available, eight species of hermit crabs (Paguridae) are reported as occurring in Hawaii. There is evidence to show that three of these determinations are incorrect.

Of the fourteen species of hermit crabs that have been collected in the course of these studies, nine have been identified with moderate certainty, and five are new to science. Thus it may tentatively be stated that three species hitherto reported from Hawaii probably never occurred here, that the range of four known species has been extended to include these islands, and that five new species have been discovered.

One of these undescribed species lives in spray-filled pools near high-tide level, another lives secreted among decaying coral rock, a third usually inhabits living coral heads, and a fourth, belonging to a genus that commonly carries sea-anemones on its borrowed shell, has dispensed with this habit.

Although hermit crabs are marine and pass through a free-swimming larval stage, it is interesting to note that no species found in Hawaiian waters has been reported from the coast of America. Instead, their range extends to the westward from Hawaii. This suggests the former existence of a group of "stepping stone" islands between Hawaii and the Orient, and the absence of similar islands to the eastward.

CONCERNING THE INTRODUCTION OF FOREIGN BIRDS INTO HAWAII

By

STANLEY C. BALL

The native Hawaiian birds, which were formerly numerous both in species and in numbers, are rapidly disappearing. Very few species are holding their own. In general the blame can be laid on the advance of civilization.

Several dangers attend the introduction of foreign birds: (1) they may interfere with the native species, which though not important economically or aesthetically, are invaluable from a scientific viewpoint; (2) they may change their habits, becoming economically detrimental; (3) they may so increase in numbers as to become objectionable; (4) they may consume so many beneficial insects as to offset their destruction of noxious forms.

Many kinds of birds might be brought to Hawaii. Fly-catchers might well be economically beneficial, in devouring such insects as the horn fly, the fruit fly, the melon-fly, aphids, moths, termites, and mosquitoes. The meadow-lark (Sturnella) and the bob-white (Colinus) devour such field pests as cut-worms, grubs, beetles, grasshoppers, and crickets, together with many weed seeds. Both birds are beautiful and their musical calls would be welcome. The recently introduced magpie-lark (Grallina) and willie wag-tail (Rhipidura) are well suited to play a very beneficial role. Should it seem wise to supplement the native Drepanids in coping with the insect enemies of the forest trees, several species of titmice are available. A Japanese form (*Parus varius* ?) has become established on Kauai, and has already proven useful. The downy woodpecker of North America is well fitted to supplement the native Pseudonestor in ridding the koa trees of their boring cerambycid grubs, and the tanagers would feed upon the larvae of geometrid, pyralid and tineid moths in the koa and ohia forests. A handsomer bird than the scarlet tanager (*Pyranga erythromelas*) would be difficult to find. For the gardens and door-yards of Hawaii, birds of the type of the American house wren (*Troglodytes aëdon*) would find rich fare in the abundance of scale-bugs and beetles.

Rules governing the introduction of foreign birds may be briefly summarized as follows: (1) the candidate must have shown no objectionable tendencies in its native habitat; (2) it should be of a species that is constitutionally strong; (3) it should be selected to occupy a specific place in the islands' economy; (4) it should be largely insectivorous; (5) it should not be unduly gregarious; (6) it should confine itself chiefly to lands below the forest zone; (7) the migratory instinct should not be strongly developed; (8) it should come from a country with climatic conditions similar to those of Hawaii; and (9) it should have the recommendation of the United States Biological Survey.

NOTES ON THE PARASITIC FAUNA OF HAWAII

By

JOHN E. GUBERLET

The parasitic fauna of Hawaii is little known.

Superficial investigation of frogs *(Rana catesbiana)* disclosed the fact that worm parasites are very rare; only one specimen of a larval cestode, a Dibothriocephalid, and four intestinal nematodes were secured from twenty-five frogs. Parasitological studies on fishes revealed many species of trematodes, cestodes and nematodes. Examination of several specimens each of mackerel *(Scomber japonicus)*, trigger fishes *(Balistapus sp.)*, mullet *(Mugil cephalus)* and one species of ulua *(Carangus marginatus)* revealed no worm parasites of any kind. The mahimahi *(Coryphaena hippurus)* is invariably infested with larval cestodes of the order Trypanorhyncha and the genus Aspidobothrium, species probably undescribed. This fish also possesses numerous trematodes, cestodes and nematodes. The sword-fish *(Xiphias gladius)*, aku *(Gymnosarda pelamis)*, ulua *(Carangus ignobilis)* and kahala *(Seriola purpurascens)* yielded species of trematodes, cestodes, and nematodes which are as yet undetermined.

The mynah birds *(Acridotheres tristis)* harbor two species of tapeworms of the genus Hymenolepis. Fully 75 per cent of these birds are infested. Doves are infested with a species of Hymenolepis while the English sparrows were found to be free from worms. Chickens yielded the same cestodes as found on the mainland by Guberlet in 1916. They are *Choanotaenia infundibuliformis, Davainea tetragona, D. cesticillus,* and *Hymenolepis carioca.* The nematodes found are *Ascaridia perspicillum* and *Heterakis papillosa.* Manson's eye-worm has also been reported. A trematode heretofore not reported from chickens was found in the caecum.

Dogs were found to harbor one species of tapeworm *(Dipylidium caninum)* in great abundance. This cestode is also common in the cats of Honolulu. It frequently has been reported elsewhere from children. The dogs are also infested with a hookworm *(Ankylostomum caninum)*, the roundworm *(Belascaris marginata)*, and the heart-worm *(Filaria immitis)*.

Examinations of cats showed them to be infested with two cestodes *(Dipylidium caninum* and *Taenia taeniaformis)*; the dog, hook-worm and a roundworm *(Belascaris mastax)*. The rats are infested with *Hymenolepis diminuta.*

Reports from physicians show some human beings to harbor *Ascaris lumbricoides* and *Oxyurus vermicularis*. The liver fluke *(Fasciola hepatica)* common in sheep, has been reported from man. This trematode is apparently a common inhabitant of sheep, goats, cattle, and pigs in Hawaii.

THE CONTROL OF SUGAR CANE INSECT PESTS IN HAWAII BY THE INTRODUCTION OF NATURAL ENEMIES

By

O. H. SWEZEY

Usually the commonest insect pests are not native insects, but immigrants that have arrived through the channels of commerce, and in the absence of the natural enemies present at their home places, have increased so as to become pests in their new home. The major cane pests in Hawaii, with one exception, are all foreign insects.

The entomologists of the Experiment Station of the Hawaiian Sugar Planters' Association have very successfully brought about control of cane pests by the introduction of natural enemies from either the home of the pest, or some other country where natural enemies of insects similar to the pests could be obtained. The principal cane pests and their enemies are listed as follows:

Sugar-cane leafhopper, *Perkinsiella saccharicida* Kirk.

Egg-parasites	*Paranagrus optabilis* Perk., from Queensland, 1904. *Ootetrastichus beatus* Perk., from Fiji, 1905. *Ootetrastichus formosanus* Timb., from Formosa, 1916.
Dryinid parasites of young and adult	*Haplogonatopus vitiensis* Perk., from Fiji, 1906. *Pseudogonatopus hospes* Perk., from China, 1907.
Egg-sucking bug	*Cyrtorhinus mundulus* (Bredd.) from Queensland and Fiji,

Sugar Cane Borer, *Rhabdocnemis obscura* (Boisd.)

Tachinid fly, *Ceromasia sphenophori* Vill., from New Guinea, 1910.

Anomala Grub, *Anomala orientalis* (Waterh.)

Scolia manilae Ashm., from Philippines, 1916.

Armyworm, *Cirphis unipuncta* (Haw.)

Amblyteles koebelei (Sw.), from California, date unknown.
Euplectrus platyhypenae How., from Mexico, 1923.

Tachinid flies	*Chaetogaedia monticola* Bigot, from America, date ? *Archytas cirphisae* Curran, from Mexico, 1924.

Cane Leafroller, *Omiodes accepta* (Butl.) (a native insect)

Microbracon omiodivorum (Terry), from Japan, 1895.
Chalcis obscurata Walker, from Japan, 1895.

INSECTS OF THE TANAGER EXPEDITION

By

EDWIN H. BRYAN, JR.

During the spring and summer of 1923 on the Tanager Expedition insects were collected on the chain of small islets and rocks of the Hawaiian group extending northwest from Kauai, and on Johnston and Wake islands. About 200 species of insects have been identified in the material secured; of these about 30 are described as new. A report on these insects is being published by the Bernice P. Bishop Museum.

Several degrees of insect life were encountered. On each island the insect fauna seems to have developed up to the limit of its environment, the limiting factors being variety and extent of the flora, presence or absence of fresh or brackish water, and number and character of other animals present. Insect life was poorest on the low sand islets. That on the higher rocky islets included native remnants in addition to the common, wide-spread species. All endemic species seemed to be more or less closely allied to the insects of the larger Hawaiian islands, except that Wake Island with respect to both fauna and flora is a typical south Pacific atoll. Fewer species were found on Laysan Island in 1923 than in 1912, by the same collector. Between these years this island had become nearly denuded by the ravages of rabbits.

PINEAPPLE CULTIVATION AS A FIELD FOR INVESTIGATION

By

A. L. DEAN

There are several important problems connected with the pineapple industry for which solutions may be found through scientific study. In the field of genetics two lines of work are in progress, making use of vegetative and sexual reproduction respectively. In the first we may hope for a general improvement in the character of all planting material and for distinctive improved strains of the Smooth Cayenne variety. Pineapples grown from seed show exceedingly wide variations both in plant and fruit and it should prove possible to develop new varieties. Fundamental studies on the morphology and physiology of the plant are required as the basis for improvements in agricultural practice. Field experiments are in progress on a fairly extensive scale directed to obtaining necessary information on crop rotations and methods of cultivation and of fertilization.

The pineapple is subject to attacks by fungi and nematodes, and to some extent by insects. The control of disease is the most serious problem confronting the industry and the intensive work on methods of protection is imperative.

INFLUENCE OF POTASH FERTILIZATION ON THE SUCROSE CONTENT OF SUGAR CANE

By

WM. P. ALEXANDER

Applications of potash fertilizer improve the cane yields and also increase the sucrose content, under certain conditions on Ewa Plantation where deficiencies of potash are found. Twenty-one experiments, harvested during the past four years, tend to verify such a conclusion. These tests comprised a total of 453 watercourse-sized plots. The juice data are based on continuous samples of crusher juice obtained from all the cane from each plot. Sucrose content has been expressed as quality ratio, that is, the theoretical number of tons of cane required to make one ton of sugar. The first indication, in 1922-23, that the quality ratio was better on the potash plots was questioned, as it was contrary to published data on the subject. Further results, however, substantiated the original deductions.

The tests do not show that potash will improve sucrose on all types of soil. The improvement is mainly confined to a heavy clay adobe soil, poorly drained, deficient in potash and having a high salt content.

In twenty-one experiments where the potash increased the quality ratio 1.1 per cent to 5.6 per cent, 189 out of 290 plot to plot comparisons showed cane from the potash plots to have a higher sucrose content. In thirteen of these, where the quality ratio was improved from 1.5 per cent to 5.6 per cent, the cane yields increased on an average 3.1 per cent, while in 24 experiments showing no appreciable gain in sucrose for the potash treatment, the increase in cane yields were within experimental error.

In the first group of tests, those where potash gave gains in sucrose content as well as in cane yield, soil analyses of seven tests showed an average of 0.016 per cent citrate-soluble K_2O and 0.21 per cent hydrochloric acid-soluble K_2O, against 0.028 per cent and 0.34 per cent for the second group.

The juice was analyzed for potash in 22 tests and showed 0.44 per cent K_2O in the first group and 0.81 per cent in the second group.

To summarize, the results from 38 plant food experiments harvested on Ewa Plantation from 1922 to March, 1926, tend to show that, where there is a deficiency of potash in the soil as recorded by soil analyses and crusher juice analyses, the increase in yield of cane due to potash fertilization is accompanied by an improved sucrose content of the cane juice.

PROBLEMS OF THE OUTDOOR SEEDLING NURSERY IN HAWAII AND METHODS OF PRESERVING SUGAR-CANE SEED

By
DOUGLAS A. COOKE

The development of new varieties by the growing of seedlings is of great importance to the sugar-cane industry. At present seedling work is hampered by adverse weather conditions. The sugar-cane plant tassels from November to January. Because of the rapid loss in vitality of the seed, it must be planted at once. The large number of germination flats to be handled necessitate an outdoor nursery.

The weather conditions during December, January and February which hamper seedling germination and growth are insufficient sunlight, excessive moisture, heavy winds, and drops in temperature below 65° F. If the seed could be preserved until the summer months the weather conditions would be ideal.

In the fall of 1924, four methods of seed preservation were tried. 1. Calcium Chloride: Seed was kept in moisture-proof jars with $CaCl_2$ as a drying agent. 2. Vacuum: Seed was kept in a vacuum of about 28″ in a dessicator with $CaCl_2$. 3. Hydrogen gas: Seed was kept in bottles in an atmosphere of hydrogen gas. 4. Carbon dioxide: Similar to No. 3, except that CO_2 was used instead of hydrogen. Untreated samples of seed were found to lose all vitality after 80 days. After 145 days, method No. 1 gave a germination of 70 per cent; No. 2 gave 90 per cent; methods No. 3 and No. 4 gave no germination. Moisture determinations indicated that the gas methods failed because of a too high moisture content. In this test the original germination was so low (about two plants per flat) that the results were felt to be inconclusive.

In the fall of 1925 the experiments were repeated, using seed which was known to be viable. The bottles were kept at a constant temperature of 68° F.

In order to reduce the moisture content of the seed to be kept in gas, two methods were used. Part of the seed was sun-dried for two and one-half hours before bottling; with the rest, $CaCl_2$ was placed in the bottles. Tassels were cut December 7, 1925, and bottled December 17-21. On May 10, 1926, two flats with 25 grams of fuzz each were planted from each treatment. The original germination of fresh seed gave 1,311 plants per 25 grams of fuzz. After five months the untreated seed gave 1 germination to 50 grams; the results with the treated seed were as follows: $CaCl_2$ alone, 56.6 per cent; vacuum untreated, 3.3 per cent; vacuum sun-dried, 9.0 per cent; H gas with $CaCl_2$, 44.2 per cent; H gas sun-dried, 74.2 per cent; CO_2 gas with $CaCl_2$, 58.3 per cent; CO_2 gas sun-dried, 80.2 per cent.

The use of calcium chloride alone, because it gives a high percentage of germination, and because of its simplicity, is probably the most practical method. Moisture seems to be the limiting factor in loss of vitality of cane seed. Possibly a smaller amount of calcium chloride, which would not be so severe in its drying action, would prove even more successful.

THE FLOWERING OF SUGAR CANE IN HAWAII

By

CLYDE C. BARNUM

The breeding of new high-yielding commercial cane varieties is one of the major projects in sugar cane experimental work. Disease resistance is an essential quality in such of these new varieties as may be adopted for plantation culture. Inbreeding in some varieties and hybridization of others is the present means of propagation. The results of investigations made in the tasseling seasons of 1924 and 1925 indicate which varieties can be used most advantageously for crossing, which varieties can be used in selfing and at what time the flowers are found to be in the most receptive condition. Special technique was developed in carrying on the work which permitted verification of all studies, and observations were made on large numbers of tassels of each variety.

No varieties under study opened new flowers between noon and midnight. The first open flowers on tassels appeared shortly after midnight each day. High relative humidity during the hours from sundown to midnight is apparently essential to normal flowering. When the relative humidity during these hours reached 80 to 90 per cent, the tassels were observed to open the average number of flowers. Open-flower counts were made at regular intervals on several commercial varieties thereby determining the hour of maximum flower emergence.

A single flower on a living tassel of D 1135 cane was observed under the microscope to open, distend the floral parts and extrude pollen from the anthers, which pollen in turn germinated on the stigmatic surface and penetrated the stigmatic tissues, all in 15 minutes. Repeated observations indicated similar brief periods for this complete process.

Strong self-fertile characteristics were observed in the varieties D 1135, H 109, and Badila. In flowers of these varieties the anthers are bright red, from which pollen is discharged concurrently with flower opening, less so, however, with H 109 than with the other two varieties. Some H 109 tassels did not discharge pollen until 7 to 9 a. m. Marked evidence of self sterility was observed in Tip, Lahaina, Striped Mexican, and Yellow Caledonia. These canes all produce yellow anthers which do not dehisce under Hawaiian conditions. No mature pollen grains were observed on these varieties.

The heavy flowering of D 1135, Badila, Lahaina, Striped Mexican, and Tip canes occurred between the hours of midnight and 3 a. m. each night during the six to eight day period of flowering.

Steady rain does not appreciably inhibit the normal flowering of sugar cane tassels. It does, however, inhibit pollen discharge. Large numbers of D 1135 tassels were experimentally restrained from discharging pollen when placed in moisture cages where they were sprinkled at short intervals during the flowering period. Flower opening was normal, but pollen discharge was inhibited until 9 a. m. or until sun and wind dried the tassels between sprinklings. Two strongly self-fertile cane varieties could probably be crossed by this means, provided they were both in tassel simultaneously.

PROGRESS REPORT ON SUGAR-CANE POLLEN STUDIES

By

D. M. WELLER

A knowledge of the amount of pollen shed, the viability of such pollen, the length of time during which viable pollen is shed, and the environmental factors influencing such pollen formation and viability, has a direct and immediate application in the technique of cross-pollination in horticultural varieties of sugar-cane (*Saccharum officinarum*).

Methods previously used for determining viability in pollen have not proven satisfactory because they do not discriminate between viability and maturity (for example, the iodine method), and they are not adapted mechanically for securing proper counts so that viability may be determined upon a quantitative basis, as, for example, the method of using the stigmatic surfaces of such plants as Hibiscus, Ipomoea, and Datura. These stigmatic surfaces are not standardized but are themselves distinctly variable. The failure of pollen to germinate on them can be as easily ascribed to the character of the stigma used as to the non-viability of the pollen grains.

Nutrient media such as agar and sugar solutions are adapted to obtaining quantitative data, as in them the factors of temperature, light, and composition can be controlled, but because the factor of humidity is uncontrolled, comparative data are not obtainable.

The use of different concentrations of sulphuric acid in sealed vials to secure known humidities is a convenient and satisfactory method of securing quantitative data because the factors of humidity, temperature, and light are known.

Temperature and humidity have a definite effect upon the percentage of germination of sugar-cane pollen. The optimum temperature is 22 C., at which temperature the maximum number of germinations occurred at a relative humidity of 96 per cent. If the temperature be raised, the relative humidity at which the maximum germination occurs is lowered, this maximum being correspondingly less than that occurring at 22 C., suggesting an optimum absolute humidity as well as an optimum temperature.

The percentage of pollen germinations from cut tassels decreases rapidly from 5 to 6 per cent on the first day after the tassel is cut and placed in sulphurous acid solution to a fraction of 1 per cent on the third or fourth day.

A higher percentage of viable pollen is shed from growing tassels than from cut tassels, and is shed for a greater number of days. The maximum percentage of viable pollen from growing tassels was 15 per cent, as compared with 5.7 per cent from cut tassels; a 6 per cent germination was obtained with pollen from a growing tassel on the ninth day as compared with a 5.7 per cent germination from cut tassels on the first day.

EXPERIMENTS IN PRESERVING THE LIFE OF CUT CANE

By

UPENDRA K. DAS

An important feature of sugar-cane experimental work in Hawaii is the growing of seedlings of known parentage. This necessitates controlled pollination. Tassels of the variety selected as the male parent are cut in the field and tied to or suspended over tassels of the variety selected as the female parent.

Since tassels cut in the field live for only a short time, experiments were instituted to find some means of preserving them for a longer period. When tassels were not available the experiments were performed with leafy stalks.

It was found that cut stalks kept in water live for a time, when the water is changed and at least one internode cut off each day. This method, however, did not prolong the life of the cut stalks sufficiently.

Suspecting that the growth of micro-organisms was responsible for the death of the stalks, a large number of disinfectants and preservatives were tried.

Of the various chemicals used, a solution of sulfurous acid in the proportion of one part SO_2 in 3,366 parts of water gave the best results. Most stalks kept fresh for two to three weeks in this solution. In some plants an elongation of a foot a month was recorded. Other chemicals, such as sulphuric acid, sodium sulphite, sodium hyposulphite, sodium bisulphite, and mercuric chloride proved to be not nearly so effective as sulphurous acid in their preservative qualities. It was observed that tap water is better than distilled water, and that nutrient solutions together with sulphurous acid are better than the acid alone.

This method of preserving the life of cut cane has already proven useful, and many seedlings have been germinated from seed matured on tassels which have been kept in this solution.

Some varieties of flowers, such as Hydrangea, which will not keep well in water, may be kept fresh for several days in this solution.

THE DISTRIBUTION OF SUGAR-CANE ROOTS IN THE SOIL

By

H. Atherton Lee

Although excellent studies have been made on the character and distribution of roots, the writer knows of no quantitative data on the extent or distribution of cane roots. Attempts to obtain these data by linear measurement have been unsuccessful. In the present studies these data were obtained by weighing the roots.

With cane planted in wooden boxes having wire netting spread horizontally at 6-inch levels, weighing with 5 months old plants of D-1135 cane showed that in loose Honokaa soil 62.6 per cent of all roots were in the topmost 6 inches and 10 per cent in levels below 22 inches, and that in more compact Makiki soil 64.6 per cent were near the surface and 9.5 per cent below 22 inches. A similar test with 1 month old H-109 cane showed that 85.2 per cent of the roots, weighing 1.133 grams, were in the topmost 8 inches of soil, with only 0.2 per cent, weighing .003 grams, below 24 inches. In this experiment the roots arising from the seed piece and from the shoot were handled separately, and it was found that only 3 per cent of the total weight of roots arose from the shoot. One month later this percentage had risen to 76.3, showing that the cane plant begins to form its own root system extensively during the second month after planting.

This method was then modified to permit the study of roots under plantation field conditions. This consisted simply of stalking off a given area of cane row, excavating the soil in 8-inch layers and screening out the roots, which were then washed, oven-dried and weighed. This method, applied to five plants of H-109, 10½ months old, showed that 70.14 per cent of the roots, weighing 976.16 grams, lay in the topmost 8 inches of soil, with 1.18 per cent, weighing 11.47 grams, below 24 inches. The total weight of roots per plant averaged a little over 250 grams. Three month old Lahaina and H-109 cane, five stools each, showed that Lahaina had 80.6 per cent of its roots, weighing 38.3 grams, in the upper 8 inches, and 1.3 per cent, weighing .62 grams, below 16 inches. H-109 had 65.4 per cent, weighing 78.7 grams, in the upper 8 inches and 2.1 per cent, weighing 2.5 grams, below 16 inches. This shows that the H-109 variety roots more deeply than the Lahaina, and also forms about twice as many roots.

Two lots of Yellow Tip cane, 26 months old, were taken; one from a field averaging 35 tons of cane per acre, the other from a field averaging 75 tons. A tabulation shows that, while the root distribution was about the same, the total weight of roots was very different, the latter field having plants with half again as many roots as the former field.

Detailed conclusions cannot be drawn from so few experiments; however, it is felt that the experiments thus far completed show that methods for quantitative study of root distribution, under both laboratory and field conditions, have been developed, and that the sugar-cane plant, at least under Hawaiian conditions, is very shallow rooted.

A METHOD OF DIRECT CURRENT VIBRATION GALVANOMETRY

By

PAUL KIRKPATRICK and M. C. MAGARIAN

If a d'Arsonval galvanometer and a suitable source of current be furnished with a key which is opened and closed at correctly chosen intervals the suspended system will oscillate with increasing amplitude, attaining a maximum which may be many times larger than the steady deflection which the same current would produce. This fact provides a means of extending the range of measurement of galvanometers to much smaller currents than those ordinarily measured.

The maximum deflection attained can be theoretically shown to depend in a certain way upon the constants of the galvanometer and its circuit. The particular relations deduced have been subjected to extensive experimental tests and found correct. (An account of these is to appear in the

Journal of the Optical Society of America and in the Review of Scientific Instruments.)

For the practical application of this method a spring-driven commutator has been devised and constructed. This device serves the function of reversing the current to the galvanometer at intervals equal to one-half the period of the latter. The commutator is adaptable to any galvanometer whose period lies between two and twenty seconds.

The use of this galvanometer confers the greatest advantage when the resistance of the galvanometer circuit is high, under which conditions an increase in sensitivity of from five to eighty fold is to be expected, depending upon the type of galvanometer employed.

THE DUODECIMAL SYSTEM OF NUMBERING

By

J. S. Donaghho

The character for ten, resembling the Greek *phi,* is made by passing the stroke of 10 through the cipher; that for eleven, a V, by bringing the two strokes of 11 together at the bottom. Then twelve is written 10, that is, displacing a digit one place to the left multiplies it by twelve. So twelve and one, twelve and ten, two twelves, two twelves and eleven are written 11, 1φ, 20, 2V, and might be read, in computing, one-teel, ten-teel, twentel, twentel-eleven. Also, three twelves and four, five twelves, eleven twelves and ten, twelve twelves, written 34, 50, vφ, 100, might be read thirtel-four, fiftel, eleventel-ten, and one gross. The rest of the notation, without limit, may be borrowed from the decimal without danger of confusion.

MULTIPLICATION TABLE

1	2	3	4	5	6	7	8	9	φ	V	10	11	12
2	4	6	8	φ	10	12	14	16	18	1φ	20	22	24
3	6	9	10	13	16	19	20	23	26	29	30	33	36
4	8	10	14	18	20	24	28	30	34	38	40	44	48
5	φ	13	18	21	26	2V	34	39	42	47	50	55	5φ
6	10	16	20	26	30	36	40	46	50	56	60	66	70
7	12	19	24	2V	36	41	48	53	5φ	65	70	77	82
8	14	20	28	34	40	48	54	60	68	74	80	88	94
9	16	23	30	39	46	53	60	69	76	83	90	99	φ6
φ	18	26	34	42	50	5φ	68	76	84	92	φ0	φφ	V8
V	1φ	29	38	47	56	65	74	83	92	φ1	V0	VV	10φ
10	20	30	40	50	60	70	80	90	φ0	V0	100	110	120

The duodecimal system shows superiority over the decimal in several respects: (1) the multiplication table up to fourteen can be memorized more easily than the decimal table up to twelve; (2) the tests for divisibility of numbers are much easier; (3) less digits are needed to express large numbers; (4) fractions in frequent use, as 1/2, 1/3, 1/4, 1/6, are expressed with a single digit, and 1/8 and 1/9 with two only; (5) as the month is 1/12 of a year, the computation of interest would be simpler; (b) irrational numbers, like /2, /3, 11, e, and logarithms, when carried to four or more places, give more accurate results.

REPETITIONS IN FIELD EXPERIMENTATION

By

W. J. Hartung

Field trials conducted to test such factors as the effects of different fertilizers, of different varieties of the same crop plant, and of variation in culture, have been a part of agricultural science from the time of its inception. The method pursued in the earlier field trials required that the experiment be repeated on the same plot over a long period of years. There were very few duplications or repetitions of the tests conducted simultaneously. Thus it may be seen why harvests covering so many successive years were necessary when matters dealing with slight differences in crop yields were under consideration. There being but a single test plot, the experimental error was at a maximum, and the results were not conclusive.

The only way to reduce the experimental error and to obtain closer results is by multiplying the experiments, either by repeating them year after year or by increasing the number of plots, preferably both. It is useless to try to measure differences of less than about 20 per cent by comparing single plots, regardless of the size of the plots. The experimental error diminishes with the size of the plot, but the decrease is small when the plot grows above one-fortieth of an acre, and there is not much to be gained by increasing the number of plots above five for each treatment studied. Five plots of one-fortieth of an acre each for each unit of comparison will reduce the experimental error to within 2 per cent of the result. These plots should be arranged in a checker-board fashion. The step from experimental to regular practice may be taken with confidence in the ultimate result, because of the accuracy attained through repetition.

The method is speedy but accurate. It requires more labor and application, but the results attained are sufficient to compensate in full for the additional effort expended.

SENSITIVE BEHAVIOR OF SUGAR CANE ROOTS

By
F. C. Newcombe

Everyone who has made cultures of sugar-cane in water or nutrient solutions, from cane pieces, sprouts, or seedlings, has noticed that the lateral roots from the large descending roots grow upward instead of downward. This unusual direction of growth is noticed whether the jar containing the culture admits light or is covered, as is usual, with a cylinder of black paper. The experimenter, at once suggests to himself several hypotheses to account for the phenomenon; possibly these roots in the cane, in normal conditions, grow upward; or, it may be a chemico-respiratory effect, the oxygen diffusing downward causing the roots to grow toward the greater supply of oxygen; or, it may be a light effect, if the light is not wholly excluded from the containing jar.

If the plant used is allowed to grow its roots in a damp chamber, so that there is an environment of air, the roots turn up just the same. This behavior shows that it is not a chemico-respiratory effect. If the jar containing the base of the plant and the roots is buried in earth while the roots are developing, the roots grow downward. This shows that light has something to do with the unexpected behavior. Are the roots positively phototropic, that is, do they bend toward light? If we are very careful to wrap the jar enclosing the roots of the plant in several thicknesses of opaque paper, and use particular care to see that the top of the jar excludes all light, leaving the bottom of the glass jar uncovered, the roots bend upward just the same. Possibly the roots are negatively phototropic. So an experiment is set up, leaving a narrow slit uncovered on one side of the jar. When, after three or four days, the preparation is examined, it is found that the roots still bend upward and slightly away from the light. The roots are, therefore, slightly negatively phototropic. If next, a culture with roots has the glass jar surely made opaque to light everywhere except in an even ring at the top of the jar, the roots grow upward as before. The response giving the upward curving of the roots, must, therefore, overcome the slight tendency of the roots to turn away from the light. This leads, apparently unmistakably, to the conclusion that the usual positive geotropism of the lateral roots in the dark is changed to negative geotropism in the light. The amount of light required to effect this reversal of response is exceedingly small; so that in ordinary covering of the culture jars enough light enters to give the necessary condition for this reversal. It is not light that causes the bending upward. This is due to gravitation, to which the plant responds differently in light and in darkness. Such behavior is not unknown with other plant members, but this is the only case I know in which the roots reverse their response, by such a change in environment.

TYPES OF PACIFIC ISLANDS

By

Herbert E. Gregory

The topographic features of Pacific islands record the changes experienced by the islands throughout geologic time. These features are evidence of origin, of structure, and of age, and bear on the question of former connections of island with island and of island with continental masses. In the absence in the Pacific region of adequate evidence based on fossils and on rocks, the nature and duration of cycles of erosion furnish material for writing geologic history.

THE ISLAND OF MAUPITI AND THE DISTRIBUTION OF ETHNOGRAPHIC ELEMENTS IN POLYNESIA

(Two papers combined in one)

By

E. S. Craighill Handy

The island of Maupiti, Society Islands, is a favorable place for many types of study. Geologically the island is interesting. It is a coral atoll having in the midst of its lagoon an eroded peak of basalt, with an outcropping dike projecting 800 feet above sea level. The rock on the northwest side of the peak closely resembles granite, has been described as such by early writers, thus suggesting great antiquity for the island. Samples of this rock examined by Dr. Herbert E. Gregory were found to be dense basalt.

For biological study of various kinds, this island should be a favorable spot, because of the close and convenient juxtaposition of low coral island and high volcanic island conditions. It is isolated, not by distance, but by difficulty of access. Its lagoon can be entered only through one narrow crooked pass, navigable by small boats, and by them with assurance of safety only when a gentle east wind is blowing.

The archaeologist finds much of interest on Maupiti. There are remains of the old temples of the eight clans, and of the site of the chief's establishment; and pictographs consisting of turtles carved on boulders of basalt.

Anciently, this small speck of land six miles in circumference and probably never supporting more than a thousand inhabitants, was a small world in itself. There are now about a hundred natives, two Chinamen, and no whites. The old culture was fundamentally one with that of the Society Islands, in its religious, political, social, and industrial systems, and in material culture. But there were certain traits that are distinctive and significant: notably a round house form; the use of the bow and arrow, shield, and club as weapons; the warrior's house; and ceremonial cannibalism. It was observed that *k* is frequently substituted for *t* in the dialect.

Maupiti anciently had four types of houses: (1) rectangular; (2) round; (3) round-ended; and (4) arch-ended. The form and construction of these houses and also a study of the distribution of house types in the Society Islands and throughout Polynesia, indicate that type No. 1, which is characteristic of the marginal region of Polynesia, including Hawaii, the Marquesas, and New Zealand, is the oldest; that type No. 2 is of recent introduction, and that types Nos. 3 and 4, found only in the nuclear area (Society Islands, Tonga, and Samoa) represent later forms that were evolved by combining types No. 1 and No. 2.

MOUNTAIN VILLAGE OF RAPA

By

JOHN F. G. STOKES

Prior to 1800 A. D. the population of Rapa lived in villages artificially terraced on ridge peaks at elevations of from 500 to 1,500 feet. These sites have been referred to in literature as "forts." Though arranged for defense, they were primarily settlements. There are a few other and older sites—natural and very difficult of access—which may be regarded as refuges, and still others which suggest transitions from refuges to villages.

Twenty-five of the sites may be regarded as villages, which had populations estimated as from 25 to 300 or 400 people. Most of them were situated at the junctions of the main and lateral ridges, which, to describe one as an example, were deeply terraced by cutting and filling, until two to four tiers surrounded the adjacent and flattened peak. The peak, somewhat like a pill box in profile, was the house site of the chief of the clan and commanded a view, not only of the rest of the village, but of its approaches and of other villages on the island. The lower terraces, divided by walls into compartments about 20 by 25 feet, housed in descending order the chief's near relations and the rest of the clan.

Separated from the village unit and extending along the main ridge and down the laterals are small isolated house sites—probably outposts. Where the lateral ridges adjoin the sea, larger platforms are found—said to accommodate the warriors. These terraces are well situated for the protection of the cultivated fields and for the defense of the natural approaches to the village.

The system of defense included pitfalls in the more advanced types of villages, but most of the villages depended on such natural defense features as precipices on one or more sides. In addition, the terraces were almost vertically cut to depths of 15 to 40 feet, the banks being in subsoil with a vertical upper facing of closely laid dike prisms.

The water supplies are near, but outside the villages; but as rain is abundant these supplies probably were not important. However, traditions refer to the capture of the water supply as part of the strategy of offense. A system of preserving food for long periods was highly developed.

It is obvious that frontal attacks were seldom successful. Night and surprise attacks are recorded as having been commonly practiced.

Local tradition records that formerly the people lived in peace along the shore. Later, wars arose among themselves, after which they hid in the mountains, hence the mountain villages. Local studies suggest a local development. On this account, comparisons with forms of mountain villages in other oceanic areas can only be of secondary value. There are no close comparisons to be found among the other Polynesians. There is much to suggest that the mountain refuge was an older Polynesian feature. Although the mountain village was most highly developed in New Zealand, its types are not closely similar to those of Rapa. It is possible that the mountain villages of the larger islands of Fiji may resemble those of Rapa.

COMPARISON OF PRIMITIVE FABRIC TECHNIQUE IN OCEANICA AND AMERICA

By

JOHN F. G. STOKES

The figures for illustration and reference include three groups of technique suggesting transitions from (1) wrapped to proto-loom weaving; (2) knotted twined weaving to twined weaving; and (3) macramé to netting. Various examples are to be found in Melanesia, Australia, and the Andaman Islands on the one side, and the Americas on the other, and rarely the more primitive phases are found in Polynesia.

In the higher types of loom work, marked resemblances between Asia and America, both in technique and design, have been noted by others.

Primitive fabric technique is an unsettled question of community of influence or parallel development.

STRING FIGURES AS ETHNOGRAPHIC DATA

By

WILLOWDEAN C. HANDY

String figures, known among us as "cat's cradle," are probably as valuable as ethnographic data as any single element in a material culture. Played in every part of the world and handed down from generation to generation, they are the kind of tribal and racial property which might be expected to furnish clues to the movements and contacts of peoples.

Those so far collected fall into two groups known as the "Asiatic" and the "Oceanic": the Asiatic distributed not only over Asia but also over Europe; the Oceanic common not only to the Pacific Islanders but also to the American Indians. The classification has been made upon the basis of the manner in which the loop is placed upon the hands and the start is made, the two methods differing widely; but the two groups are also characterized by other peculiarities. The Asiatic method requires two players; the Oceanic but one. The familiar "cat's cradle" with its seven sequences are the whole of the Asiatic group; while there are hundreds of complicated figures in the Oceanic group. The Asiatic figures are simply named for common objects; the Oceanic figures are named in allusion to mythological characters, events or objects, and there are often chants and stories connected with their making.

So uniform are the figures of the Asiatic group within their area, that the opportunity for comparative study lies within the Oceanic group. Here, while completed figures may be compared for type, only a thorough comparison of the different stages in the making of the figures will establish identities. Hence the impetus given to collecting by the publication of the Haddon-Rivers vocabulary of descriptive terms. Another element offering itself for comparative study is the significance attached to the playing of the game, whether it be magical, as among the Eskimos and Papuans, or for practical application as patterns in crafts, as among the Marquesans, or for some other purpose. Unexpected connections may sometimes be unearthed by a comparative study of the names, chants and stories accompanying the figures.

It is too early to say that any definite ethnographic contribution has been made by string figure data; but a fuller collection of material accurately recorded may permit of mapping the geographical distribution of figures so as to offer definite suggestions as to racial affiliations and migrations.

INTERRACIAL MARRIAGES IN HAWAII

By

ROMANZO ADAMS

Because of the large and increasing number of marriages between persons of different race in Hawaii, there is coming into existence a rather large number of people of mixed racial origin. All races represented in the Territory are contributing in considerable measure to the mixture. From the standpoint of numbers and variety of mixture, Hawaii is one of the best places in the world for a scientific study of the biological affects of race mixture.

The following facts are cited in support of this thesis. There are in the Territory about 13,000 people of Caucasian-Hawaiian blood and about 8,000 of Asiatic-Hawaiian blood. Together these groups constitute about 7 per cent of the population, but the marriages of recent years have been of such a character that, on the assumption of equal fertility, over 16 per cent of the children will be part Hawaiian. The Chinese have made insignificant contributions to the race mixture for a generation. Now the Japanese are beginning to marry out of their own race in increasing numbers. The Portuguese are marrying out very largely, 20 per cent of the men and 40 per cent of the women in the years 1920-1924. Over 44 per cent of the men of American and North European ancestry marry women of other races. The Filipinos are marrying out in large numbers.

Insofar as certain racial groups such as the Japanese have in times past married more closely within their own group than have others, the cause seems to lie not in any innate racial trait, but rather in cultural traits and in practical circumstances. As all the peoples acquire the English language and common manners and customs, intermarriage is increasing.

In Hawaii there is no law against marriage on account of race. There is little or no discrimination against persons of mixed race. They occupy positions of leadership and dignity in the community. Consequently the biological effects can be studied the more advantageously. Practical achievement depends more on personal qualities and less on social stratification based on race.

A study such as is here advocated should concern itself largely with the Mendelian laws of heredity as applied to persons of mixed race. Are persons of mixed race equal to, or stronger or weaker than the average of their ancestral lines? What are unit traits in the Mendelian sense and which are dominant and which recessive?

Since a study of this sort will require many years and since some of the data will be less available after a few years, it is highly desirable that provision be made for adequate research at an early date.

PROGRESS IN THE STUDY OF THE NUTRITIVE VALUE OF THE OLD HAWAIIAN DIET

By

CAREY D. MILLER

When the Hawaiian islands were discovered, the native people were eating the same foods they had undoubtedly eaten for centuries. The kinds of food they ate and the methods of preparation are rather definitely known. Scientists have given convincing proof of the effect of food on the physical well being of people when that food is eaten for generations. Since the Hawaiians were an unusually fine race of people physically, the nutritive value of their food offers a fertile field for investigation.

Taro (*Colocasia antiquorum esculenta*), previously analyzed for organic nutrients, has been shown to be a good source of vitamins A and B. Making taro into poi does not destroy the vitamin A or B content. The basal food consumption of rats given sour poi daily was greater than that of rats fed fresh poi. This was probably due to the organic acids. Taro is a poor source of the antiscorbutic vitamin. Whether making taro into poi further reduces it, is being determined.

Limu eleele (*Enteromorpha intestinalis*) and limu lipoa (*Haliseris plagiogramma*) have no antiscorbutic value. Limu eleele is a fairly good source of vitamin A, but limu lipoa is a poor source.

The Hawaiians exposed constantly to the ultra-violet rays of the sunshine, were undoubtedly furnished with an abundance of the anti-rachitic factor.

AN ANALYSIS OF SAMOAN LAND SNAILS

By

C. MONTAGUE COOKE, JR.

The Samoan archipelago is not as isolated as the Hawaiian, and if these two groups are of equal age and both populated by drift material, the Samoan should have the larger number of species and genera of land snails. The Samoan Islands have representatives of six families and ten genera of Pulmonata, none of which are peculiar to this group of islands. Hawaii has representatives of seven families and at least thirty-three genera of

Pulmonata, of which two families and twenty-one genera are found in no other part of the world. More than 600 species have been described at present from the Hawaiian islands, and if the whole collection in the Bishop Museum were worked up the record doubtless would show from 900 to 1100 species occupying this region. Samoa has between twenty-five and thirty endemic species of Pulmonata. The probable explanation of these figures is that Hawaii is of far greater age than Samoa, as is shown by the much more diversified evolution that has taken place in Hawaii.

As an aid to the study of the ages of small isolated areas, it appears that the indigenous evolution, which can be fairly accurately determined, that has taken place on each of these areas, furnishes a clue to their relative ages.

HYDROPHILIC COLLOIDS

By

C. P. SIDERIS

Hydrophilic colloids, obtained from soils, pineapple plant tissues and synthetically prepared, were studied for a number of physicochemical properties.

Both the synthetic and natural soil colloids were found to behave very much alike in the adsorption and replacement of various ions. Polyvalent anions were found to be adsorbed more strongly, and also to replace, monovalent anions, the rate being almost in direct proportion to their valence. The rate of adsorption and replacement was not as definite with cations.

Adsorption and replacement were determined by a quantitative chemical analysis and a determination of the electrical conductivity of the solution. Aliquot parts of solutions were obtained by treating the colloids with a number of separate applications of distilled water, each application being allowed to stay in contact with the colloids for a certain interval, then the supernatant liquid removed, and a second added. The salt concentration of these leachings were found to decrease almost in proportion for the first four or five applications, but to increase very suddenly in the one following, and again assume the same role for the second cycle. During the first four or five leachings the pH value decreased, but with the next leaching, concurrently with the increase in salt concentration, the pH was also increased.

The evidence so far obtained indicates that the release of ions from colloids is of a cyclic type. It shows that the concentration curve falls back to almost its original position after a few leachings.

Certain features of the colloid particle are revealed. The results indicate that the anions are adsorbed on the surface while the cations are adsorbed within the structure of the particle, probably held between the interstices of the micellar. This idea is supported by the electric charge displayed by this group of hydrophilic colloids, and the demonstrated fact that the various hues of reddish color in some of the synthetic colloids are due entirely to the anions and not to the cations.

The changes in pH value, caused by treating aqueous colloidal suspensions with alcohol, furnished a reliable test of the position occupied by the anions or cations in the colloidal particle. Besides flocculating these colloids, alcohol increases the acidity of the resulting solution. This is believed to be due to the release of adsorbed anions and their reaction with the water of the solution. Through the dielectric properties of the water, the enclosed cations convey their electric and magnetic attraction to the surface layer, which in turn adsorbs only ions of an opposite electric charge. Replacing water by alcohol inhibits this conductance and releases the adsorbed anions, which react with the water of the solution and increase the acidity.

When an aqueous suspension of soil colloids is filtered through a Chamberlain filter, the resulting flocculate possesses a considerably less acid reaction. The explanation of this phenomenon is that the adsorbed anions do not pass through the filter, but are retained by the colloids. The filtrate, containing the free cations of the solution, is considerably changed in acidity by the reaction of these cations with the water of the solution. This test also indicates the position occupied by the anions in the colloid particle.

The evidence presented above applies only to inorganic colloids. Organic colloids, such as pentosans and proteins of the pineapple plant, will be discussed in a future publication.

A LAND POLICY FOR HAWAII

By

THEO. C. ZSCHOKKE

So long as agricultural land was abundant, it was permissible for each land owner to use his land as he thought best. When such land is scarce, however, ignorant or unduly optimistic persons clear and cultivate land that is not truly agricultural. Rain and wind cause severe erosion in such areas, and fields covered with rocks, fish-ponds silted up, destructive annual floods, and mountain sides eroded to bed rock are the result of attempting to cultivate what should have been forest land.

The various kinds of land may be defined as follows. Agricultural—land which, for a long term of years, will produce agricultural crops at a profit by ordinary farming methods. Grazing—agricultural land which, because of lack of water, roads, or markets cannot be profitably cultivated, or land of moderate slope upon which cattle cannot start erosion. Forest—all other land capable of supporting tree growth regardless of whether it is forested or not.

In France and Switzerland the owner of steep land cannot do anything which might start erosion or cause slides. Our inherent respect for the sacredness of property rights makes it difficult to establish the principle that no man has a right to use his land to the injury of his neighbor, but such misuse might well cause inexcusable and irreparable injury of which the courts should take cognizance.

Good results probably could be obtained by the appointment of a committee consisting of a geologist, a professor of agriculture, representatives of the stockmen, the pineapple growers and the sugar planters, and the Superintendent of Forestry, which committee would consider each case on its merits, consulting with the land owner at fault, and showing him wherein his acts were injurious to the community. Such a committee should be very influential in reducing the misuse of land to a minimum. If a land owner should persist in using his land to the detriment of the community as a whole, condemnation proceedings could be instituted.

A CLEARING HOUSE FOR PACIFIC ENTOMOLOGY

By

E. H. BRYAN, JR.

The divisions of entomology of special interest in the Pacific are classification, distribution, and the economic relations of insects. Economic relations are much dependent upon classification and distribution. It is necessary to adequately characterize insects in order that they may be recognized by other investigators. And it is important to know their distribution in order to guard against undesirable immigrants, and to know where to seek for natural enemies of species which have already gained entrance into any locality.

Entomology in the Pacific is in its infancy. In contrast to the accumulation of data upon European and North American entomology, scarcely anything is known about the insects of the Pacific islands, excepting Hawaii and New Zealand. The collections made during the past hundred years have been haphazard. The material is scattered through the collections of Europe and America.

Because of the difficulty of obtaining accurate or detailed information on either the identity, distribution, or economic importance of a Pacific insect, there is need of building up a collection of Pacific material, and of forming a local clearing house for Pacific entomology. This plan falls within the scope of the Bishop Museum, which already has extensive collections from various Pacific groups. As a clearing house, that institution hopes by expeditions and cooperation with residents of various islands to procure as complete collections as possible; by contact with systematic workers throughout the world, to see that this material is worked up; and to publish the results in a series of bulletins, which will eventually constitute an insect fauna of the Pacific. To do this successfully will require the cooperation of all persons interested in Pacific entomology.

SOME SUGAR-CANE INSECTS OF THE PACIFIC COAST OF MEXICO

By

R. H. VAN ZWALUWENBURG

The west coast of Mexico, especially that part included in the states of Sonora and Sinaloa, is less well known entomologically than other parts of that country.

Sinaloa is the leading sugar producer in the Mexican Republic and has some 30,000 acres of cane under cultivation, all of it irrigated.

The only serious enemies of the cane are two pyralid moth borers, neither of which occurs in Hawaii. One of these, *Chilo loftini* Dyar, attacks about 85 per cent of all the cane stalks. It bores usually a transverse course just under the rind, with the result that much breakage occurs in high winds. It breeds throughout the year, in a number of members of the grass family, but principally in sugar-cane and rice. It requires about sixty days for a complete generation. Only one native parasite, the braconid *Chelonus sonorensis* Cam., is at all effective, and then only when its host is in rice stalks. Chelonus attacks the egg and issues from the half-grown larva; it completes a life-cycle in about thirty-five days.

The second species of borer is *Diatraea lineolata* Walker. It feeds throughout the year, but lays eggs from May to October only. It probably has less than three generations annually. It attacks principally plant cane, about 60 per cent of the stalks being damaged; in ratoon cane the infestation drops to about 35 per cent. The probable reasons for this drop are: (1) most of the caterpillars are killed when the bulk of the plant crop is milled in mid-winter; and (2) in planting new fields, cuttings of plant cane are used instead of the less infested ratoon cane. Diatraea eggs are heavily parasitized by *Trichogramma minutum* Riley, the only native parasite of any consequence attacking this species.

Of minor importance are: (1) the cane lace-wing bug *Leptodictya tabida* H-S, which is present wherever cane occurs in Mexico; (2) a new noctuid pest *Saccharaphagos mochisa* Schauss, the caterpillar of which makes shallow excavations in the butt of the stalk; (3) the cercopid *Tomaspis postica* Walker; and (4) two armyworm moths, *Cirphis cholica* Dyar and *Cirphis latiuscula* H-S., the larvae of which eat the leaves, particularly of ratoon cane. These two pests are well parasitized by the tachinid flies Archytas and by the chalcid Euplectrus. The large tachinid armyworm parasite, *Archytas cirphisae* Curran (ms.), which has become so firmly established on Oahu, Molokai, Maui, and Hawaii was introduced from Sinaloa in 1924.

THE VISCOSITY OF LAVA

By

HAROLD S. PALMER

Very few data exist as to the viscosity of lava, and therefore any approximate estimate is of value. Laboratory experiments give little hope because of the difficulty of reproducing the effect of evolving gases in actual lava flows.

Engineers measure the viscosity of a fluid by comparing its rate of flow with the rate of flow of water through a standard tube. The laws of hydraulics show that the same method is applicable to the flow in open channels.

At one stage of the Alika Flow of 1919, Dr. T. A. Jaggar observed a velocity of 16 feet per second in a channel 40 feet wide and 20 feet deep, with a slope of 12.5 per cent. The Chezy and Kutter formulas indicate that water filling a channel of these dimensions would have an average velocity of about 155 feet per second. The fastest surface thread, however, would flow about 170 feet per second, or about eleven times as fast as the lava actually flowed. The lava probably had a specific gravity about 1.4, and therefore had 1.4 times as much force driving each unit volume down the slope as would a water stream. It is assumed that the flow was steady, which means that all the force was consumed in overcoming viscosity and none of it was expended to accelerate the lava. Yet it produced a velocity only one eleventh as great as water would have produced. The kinetic viscosity is the quotient of the relative velocity into the specific gravity ($1.4 \div 1/11 = 1.4 \times 11$), or about 15 times that of water.

Six sources of error make this value of the viscosity doubtful, but it seems safe to say that the kinetic viscosity of the lava on this occasion was between 11 and 20 times the kinetic viscosity of water at ordinary temperatures.

PROCEEDINGS
HAWAIIAN ACADEMY
OF SCIENCE

SECOND ANNUAL MEETING

MAY 4-7, 1927

BERNICE P. BISHOP MUSEUM

SPECIAL PUBLICATION 12

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1927

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, "for the promotion of research and the diffusion of knowledge."

During the year 1925-26, three special public meetings of the Academy were held to hear noted speakers, and at the First Annual Meeting, May 19 to 21, 1926, forty papers were presented. The Proceedings of this First Annual Meeting, including abstracts of papers, were published by the Bernice P. Bishop Museum, as Special Publication 11, 1926.

The Second Annual Meeting was held at Gartley Hall, University of Hawaii, May 4 to 7, 1927, ending with a banquet at the University Club.

OFFICERS

1925-1926

President, Frederick C. Newcombe
Vice-President, C. Montague Cooke, Jr.
Secretary-Treasurer, Edward L. Caum
Councilor (2 years), Otto H. Swezey
Councilor (1 year), Frederick G. Krauss

1926-1927

President, Arthur L. Dean
Vice-President, Frederick Muir
Secretary-Treasurer, E. H. Bryan, Jr.
Councilor (2 years), Charles S. Judd
Councilor (1 year), Otto H. Swezey

1927-1928

President, Guy R. Stewart
Vice-President, John F. G. Stokes
Secretary-Treasurer, Paul Kirkpatrick
Councilor (2 years), Nils P. Larsen
Councilor (1 year), Charles S. Judd

PROCEEDINGS OF SECOND ANNUAL MEETING

WEDNESDAY, MAY 4, 7:30 P. M.

Business Meeting

The meeting was called to order by the President, Arthur L. Dean. The first item of business was the election of members. Ballots were distributed, containing the names of persons recommended by the Council, to which the name of W. Ward Nichols was added. The vote resulted in the confirmation of the thirteen names already elected by the Council, and the unanimous election of the twenty-seven new candidates.

The president appointed a committee, consisting of C. Montague Cooke, Jr., Frederick C. Newcombe, and Charles H. Edmondson, to nominate officers for the coming year.

Symposium: Some Natural Resources of Hawaii:

- Soils: by Guy R. Stewart.
- Water: by Max H. Carson.
- Forests: by Charles S. Judd.
- Marine food: by H. L. Kelly (omitted, owing to the absence of the speaker).

THURSDAY, MAY 5, 7:30 P. M.

Symposium: What do we know of the Natural History of Hawaii?

- Botany: Harold L. Lyon.
- Forestry: Charles S. Judd.
- Ornithology: George C. Munro (read by the Secretary).
- Entomology: Otto H. Swezey.
- Marine Zoology: Charles H. Edmondson.
- Anthropology and Ethnology: John F. G. Stokes.

Following the paper by Mr. Judd, which was on "Some Factors Deleterious to the Hawaiian Forest," a discussion was started by the statement of John F. Voorhees that in eastern Tennessee, grassland had been found to be a better water holder than forested areas.

FRIDAY, MAY 6, 7:30 P. M.

Paul Kirkpatrick: Simple earthquake measurements. (Illustrated.)

Nils P. Larsen: The "Oriental Mark," a sacral pigment spot of early infancy.

Charles H. Edmondson: Some factors in the growth of Hawaiian shallow water corals. (Illustrated.)

Frederick C. Newcombe: Comparative growth of the stem and leaf of the sugar-cane.

C. P. Sideris: Similarity between physico-chemical and biological reactions.
John F. Voorhees: Use of the motion picture in teaching meteorology. (Illustrated.)

SATURDAY, MAY 7, 2 P. M.

John F. G. Stokes: The Kauai poi pounder.
C. Montague Cooke, Jr.: A curious habit of an herbivorous snail.
Beatrice H. Krauss: The catalase content of soils and their fertility.
George H. Godfrey: Control of the root knot nematode by trap crops.
Gwendolyn C. Waldron: Certain bacterial reactions.
Louis A. Henke: Pineapple bran: a new feed in Hawaii.

SATURDAY, MAY 7, 1927, UNIVERSITY CLUB, 7 P. M.

Following the Academy dinner, attended by about fifty members and their wives, Arthur L. Dean gave the annual Presidential Address, which was a plea for the teaching of philosophy of an interesting and broadening type.

Reports were read by the Secretary-Treasurer showing an increase in membership, and a substantial balance in the bank. During the year 1926-27, three special public meetings were held. On July 26, 1926, Dr. Lester R. Jones, Professor of Plant Pathology at the University of Wisconsin, spoke on "Disease Resistance in Plants." Two addresses on "Tissue Culture" were delivered, August 18 and 25, 1926, by Dr. Alexander A. Maximow, Professor of Anatomy at the University of Chicago. These meetings were held at Gartley Hall, University of Hawaii, and were well attended.

It was voted that these reports be accepted and placed on file.

The following persons were elected to membership: Arthur R. Keller, Lucy J. Kohler, Doris Mossman Keppeler, Bernice Warner, and Mrs. Paul A. Gantt.

The following votes were passed:

That the Council consider the advisability of holding more than one meeting a year.

That the Academy extend a vote of thanks to the Trustees and Director of the Bernice P. Bishop Museum for having published the Proceedings of the first annual meeting of the Academy.

That the thanks of the Academy be expressed to the University of Hawaii for having provided a meeting place for the annual and special meetings.

That the President, Secretary and Council be thanked for their work.

On recommendation of the Nominating Committee the following officers were elected: President, Guy R. Stewart; Vice-President, John F. G. Stokes; Secretary-Treasurer, Paul Kirkpatrick; Councilor, Nils P. Larsen.

ABSTRACTS OF PAPERS

PRESIDENTIAL ADDRESS

By
ARTHUR L. DEAN

In the December, 1926, number of Harper's Magazine appeared an article by Will Durant on the "Failure of Philosophy." In a recent copy of Science, Professor Davis of Harvard comments on Durant's paper under the title of "The Fortunate Failure of Philosophy." The gentlemen agree that in this modern world philosophy is a failure; Durant with sorrow, Davis with satisfaction.

Accepting a definition of philosophy as the knowledge of human experience seen as a whole or as parts of human knowledge seen in their relation to the whole, I cannot but feel regret that such knowledge is not emphasized in our modern education. As science is the modern and vigorous pursuit of the human mind, is it not the business of those interested in Science to revive philosophy as defined above? Cannot the men of Science bring back into a new system of philosophy the vigorous children of the old philosophy which have left their home and are now inclined to spurn their ancestry? There is need to comprehend the interrelations of the domains of human knowledge and experience. The naive minds encountered among students, theologians, men of business and even students of science emphasize the need of the comprehensive view.

Without attempting the ungracious task of criticizing those in other walks of life, it seems appropriate to at least point out some of the reasons why the man of science needs the discipline of a new philosophy.

1. He is often the victim of his own excellence and as the specialist at the apex of the advancing wedge of knowledge, he is out of touch and sympathy with others and with what they are doing.

2. He fails to realize the relativity of his own knowledge and that it rests on assumptions which he has not and cannot verify. This leads to an unjustified intellectual arrogance.

3. He fails to attempt the answer to the third of the trinity of questions which the proponant of any scientific fact must answer: What is the fact? How do you know it? What of it?

Each scientist needs to ascend the hill top and get that panoramic view of the universe which will allow him to see his own field of work in its true light.

I would that every senior in college might pass through the discipline of a study of philosophy. And what should that philosophy include?

In the first place, I would spend a brief time in facing certain fundamental questions, not to wander in the mazes of epistomology and metaphysics, but to ask the questions and know that men have wrestled with them. What is reality? How do we know or prove the truth of anything? We should know the answers which the advocates of authority have given, the answers of the church and the law, and the answers of men of science, the workers with knowledge based on the evidences of the senses. The student should note the limitations of human knowledge based on the evidences of the senses. The student should note the limitations of human knowledge based on the inabilities of man's intellect to understand certain words which he glibly uses—time, the beginning, nothing, space, energy. The student should face the problems of the human being, the relations of the ego to the material universe, the problems of freedom of choice. Nor can we neglect the questions of religion, in which men seek kinship with an unseen and intangible universe and grope toward a future existence. What is the purpose of the individual and collective human life, and what must be our relations to one another?

As I say, I would not devote too much time to this facing of the unanswered, and in large measure unanswerable problems; but certainly no man can call himself intellectually mature until he has met them and derived therefrom that measure of humility which is the mark of the educated man.

The student would devote the major part of his time to a survey of the great domains of human interest. These would include:

1. Industry. The ways in which men have attempted to satisfy their physical needs and desires.

2. Social relations of men, including political relations.

3. Science, the body of verified and classified knowledge, its method, aim, diversions and accomplishments.

4. The human being, his characteristics and relations.

5. Art, the search for the beautiful and the passion to make and do beautiful things.

6. Religion, the ways in which men have aspired to spiritual knowledge.

I believe that much of our modern university education is incomplete and fragmentary, just because the student rarely pauses to get a view of knowledge as a whole and to see the relation of its parts. Such a sincere attempt would aid in getting rid of littleness and of cocksureness. It might lead toward wisdom, which is the knowledge of the best thing to do.

We are weak, insignificant, short lived; yet humanity is, after all, the most important thing to us. I believe that if we could build up a new interest in a philosophy which is not a fruitless search for impossible definitions, but an ordered review of the whole range of human knowledge and experience, it might point us toward that goal of the great philosophers—the good life lived by the happy man in a perfected social order.

THE SOIL AS A NATURAL RESOURCE OF HAWAII

By
GUY R. STEWART

Hawaii is a country which is peculiarly dependent for its prosperity upon the products of the soil. With the exception of small amounts partly derived from the disintegration of coral rock, all the Hawaiian soils are formed from the weathering and decomposition of a closely related group of basaltic lavas, ash and cinder. Geologically speaking, they are very young; only the first stage of weathering and decomposition of the original lava or cinder has had time to take place. I have found the lava flows on the island of Hawaii constitute a most fascinating laboratory in which to study the change from a primitive rock mass into the beginnings of an elementary soil. In the drier portions of the islands some oxidization and weathering takes place, but there is practically no plant growth. Where rainfall is abundant, mosses and lichens first appear upon the lava. I have found the roots of small mosses which were less than an inch in height penetrating to a depth of six inches or more through minute crevices in the pahoehoe. The mosses are succeeded by larger ferns, sedges and grass. All of these plants leave some organic residues which mix with the small fragments of rock loosened by wind erosion, by root expansion and by the action of water constituting the beginnings of soil in the cracks of the lava. The process of soil formation is very slow; even in the flows of 1840 and 1855 only a few inches of primitive soil material has accumulated in the rock crevices. Many years will elapse before plantations are laid out on the lava flows of the known historic periods.

As the soils of Hawaii have all a similar origin, they have a number of chemical and physical characteristics in common. Contrasted with the average soils of the mainland, they are unusually low in silica—there are very few sandy soils; they contain large quantities of iron and aluminum oxides which have become hydrated by weathering and oxidization. There are no true clays in Hawaii but these oxides give a colloidal clayey texture to many soils and have the same effect upon soil texture that clay would have. They give the soils their loose open porous structure that prevents most soils from packing and forming plow sole. Hence Hawaiian soils, if properly handled, will stand very heavy rainfall without erosion or puddling. Because of the manner of original formation of most of these soils there is an excellent content of organic matter in virgin fields, which helps to preserve a good physical texture and to maintain a normal biological balance.

The present prosperity of Hawaii rests largely upon its crops of sugar and pineapples. These in turn evidently depend upon the maintenance of the present fertility of the soils. Both industries desire to grow the same crop in continuous succession with short intervals for plowing and replanting. Clearly, the first endeavors should be devoted to the prevention of the loss of soil by erosion. If the actual soil mass is reduced, no agricultural measure can avail to maintain fertility. Proper contouring of the land, refraining from planting land that is unduly steep and the prevention of erosion by proper forestation are among the most important considerations.

In the sugar industry it has been possible to grow crops continuously upon land which has been in cultivation steadily for the last fifty years. By careful fertilization this land is now producing the largest crops in its history and there is no present evidence of exhaustion of fertility. At the same time, the lessons of work at Rothamstead teach the value of long time agricultural experiments. I feel that we should have more long time field experiments designed to test the soundness of Hawaiian agricultural practices. Such experiments should be laid out on fields which were first cropped uniformly and the variability of the land determined by statistical methods. [The paper by Mr. Stewart included a sketch of the history of Hawaiian agriculture.]

WATER RESOURCES OF HAWAII

By

MAX H. CARSON

Although in general the rainfall of Hawaii is relatively large, the fresh water available for domestic use, for irrigation, and for power is not abundant. The topography favors torrential run off and the highly pervious lavas permit downward percolation to zones beyond the reach of economical recovery.

The U. S. Geological Survey, cooperating with the Division of Hydrography of the Territory, has been obtaining stream flow records for the past 17 years which are of value in the study of flood waters. No general ground water investigation has as yet been made though certain kinds of ground water have been studied in some sections of the islands.

On all the islands of the group except Molokai, nearly all of the low water flow and much of the medium stage flow of the surface streams have been collected by means of ditches and diverted chiefly for irrigation; on Oahu the artesian supply has been fully developed and it is being overdrawn in the Honolulu area; on Molokai at least a part of the artesian supply has been seriously damaged by overdraft. Large low level springs have been partially developed on Molokai, Maui, and Hawaii; high level water from springs and tunnels has been developed to some extent in sections of Oahu and Hawaii; and extensive ground water development has been made in Maui. Resources still not fully developed are flood flows and ground water, both of which will offer large supplies if methods for their economical utilization can be devised. However, the development of ground water will require a high operation cost and of flood water a high capital cost.

HAWAIIAN FOREST REGIONS AND THEIR CONSERVATION

By
Charles S. Judd

The history of Hawaiian forests may be divided into four periods: (1) the pre-discovery period, (2) the sandalwood period, (3) the cattle period, and (4) the period of water conservation. Hawaii has almost emerged from the third, and is entering upon the fourth of these periods.

The natives divided their land so that each *ahupuaa* should extend from sea to ridge top, and include a section of the native forest, which supplied so many of their wants. The forests during this first period were essentially "supply forests."

The damage done to the forests during the period of sandalwood trade and by the cattle which were allowed to run wild, together with the clearing and cultivation of large tracts of land, have reduced the forests to a point where they are not even adequate to protect our water supply. Efforts are being made, by the formation of forest reserves, the reforestation of denuded areas, and the study of many problems, to save the remnant as a "water-bearing forest."

Certain areas, such as those not needed to protect the watershed, and the lowland algaroba forests, may be classed as "commercial forests."

[This paper is published in full in the Hawaiian Forester and Agriculturist, vol. 24, no. 2, pages 40-47, 1927.]

BOTANY IN HAWAII

By

HAROLD L. LYON

(ABSTRACT BY EDWARD L. CAUM)

Hawaii has received more critical attention, botanically, than any other island group in the Pacific and Hillebrand's Flora of the Hawaiian Islands, although the work on which it was based terminated fifty-six years ago, stands as the most intensive and accurate analysis of any Pacific insular flora. Since Hillebrand's time, other capable botanists have detected many new species, and have added much to the knowledge of the relationships and geographic distribution of the plants within the Territory.

Hillebrand recognized 860 indigenous vascular plants, of which he considered 653 to be endemic. The discovery of additional species brings the number of Hawaiian indigenous species to an even 900, of which 720 should be considered as peculiar to the island flora.

With its 900 species of vascular plants, distributed over 270 genera, the Hawaiian flora exceeds in complexity and richness the floras of most regions of equal area on the continents of the globe.

The land area occupied by the native flora has been much reduced during the past century. Man, with his clearings, fires and stock, has constantly pressed back the native vegetation or swept it away completely, while aggressive introduced plants have quickly taken possession of the land and held it against reclamation by the native species. Many species, never noted and never described, have undoubtedly been exterminated by this process, and it is therefore imperative that a critical study of the Hawaiian flora be made as soon as possible, to preserve for future botanists a correct picture of our indigenous flora.

While a fairly accurate and extensive knowledge of the vascular plants has been recorded, there exists only a meager and scattered literature dealing with the mosses, lichens, liverworts, fungi and algae. Critical field studies of any of these groups would yield much of interest.

The Hawaiian flora shows well the remarkable results arrived at through the geographical isolation of several groups of individuals of the same species. For instance, the indigenous palms of the genus *Pritchardia* are now found in small groups scattered over the mountains of all the islands. The individuals in each group are alike, but those of each group almost invariably differ so markedly from those in every other group that the plants of each group must be recognized as distinct species.

The high endemism displayed by the Hawaiian flora indicates not only that the progenitors of these plants migrated to the islands in the very remote past, but also that there have been practically no additions to the flora from without since that period.

Hawaiian rain forests are extremely sensitive to invasion by stock. The reason for this is that the ancestors of the indigenous plants established themselves on raw lava soils, porous, well drained and well aerated. With the passage of years, this soil disintegrated, silting up the crevices in the rocks, thus checking the downward flow of water and keeping the surface soil perpetually saturated. The plants, finding themselves unable to root deeply in this water-logged soil, spread their roots out very near or even on the surface, where conditions approximated those to which they were accustomed. Here they were overgrown and protected by mosses and small ferns, which, in turn, were protected by the larger ferns and shrubs. But when stock was permitted to roam through the forests, conditions rapidly changed. The tender undergrowth, grazed off and trampled down, left exposed the roots of the large plants, which were in their turn barked and fractured. The trees find these conditions intolerable and soon succumb.

Reluctant as we may be to admit it, we are forced to the conclusion that the Hawaiian flora, as such, is doomed. It cannot long contend with the multitudinous adverse factors now arrayed against it.

FACTORS DELETERIOUS TO THE HAWAIIAN FOREST

By

CHARLES S. JUDD

The native Hawaiian forest is extremely delicate. It is made up of an association of trees, bushes, tender herbs, vines, ferns and mosses, living together in symbiotic relationship, each helping to protect the others. To duplicate such a forest artificially would be a well nigh impossible task, because of the peculiar inter-relationship, and elusive manner in which many of the plants reproduce themselves.

This association of plants required thousands of years to develop to its present state of balance against many odds, during which time it has not had to accustom itself to the attack of either man or beast. As it is, the tender forests were wholly unprepared for the attack of the white man and his animals. Trails, wood cutting, forest clearing and cattle have all helped to destroy the forests. First the tender undergrowth is destroyed, robbing the larger growth of its natural protection, and at last the forest tree succumbs.

Healthy native forest trees are singularly free from the attack of insects in Hawaii. But when the balance between insects and trees is upset, as when the birds are frightened away or certain fungus destroyed, the insects become detrimental to the weakened vegetation. The destruction of the protective zone on the edge of a forest by cattle or cultivation allows its invasion by introduced grass and other aggressive vegetation, such as Hilo grass and staghorn fern, against which the native forest cannot hold its own. Many thousands of acres have been thus destroyed.

The Hawaiian forest heritage is merely a fragment of what was once a magnificent, virgin forest, limited at one time only by such natural conditions as lack of rainfall, elevation, or lava flows. During the last twenty years certain 916,977 acres of this fragment have been set aside for protection. These areas will be increased to at least a million acres—the minimum safe.

Pioneer forestry work has been done, and now the ecological problems should be studied. Research must be conducted to learn more about the subordinate forest vegetation and its relationship to the forest trees. Studies must be made of the staghorn fern and other problems. It is gratifying to report that a little money has been appropriated for such research and that a modest beginning is being made.

[This paper is published in full in The Hawaiian Forester and Agriculturist, vol. 24, no. 2, pages 47-53, 1927.]

HAWAIIAN BIRD LIFE

By

George C. Munro

Important publications on Hawaiian birds include articles by Professor Alfred Newton in Nature (1892); Aves Hawaiiensis by Scott B. Wilson (1890-99); Key to the birds of the Hawaiian group by W. A. Bryan (1901); Avifauna Laysan by Walter Rothschild; Birds of the Hawaiian islands by H. W. Henshaw (1902) and the chapter Vertebrata in Fauna Hawaiiensis by R. C. L. Perkins. The results of the ornithological work of the Tanager and Whippoorwill expeditions (1923-24) have not been published.

Before man reached Hawaii, the forests were tenanted with innumerable small birds; the present list includes 6 families with 57 species. The Polynesian with his fire stick, dogs and pigs, and the European with his goats, cats, rats, cattle, sheep and rabbits upset natural conditions and sounded the death knell of many endemic species which, though structurally specialized to fit the original environment, were unfitted to withstand the changes.

Long residence under island conditions resulted in modification of probably all endemic species; certainly the goose (*Bernicla*), Laysan duck (*Aneus*), and the rails (*Pennula* and *Porzanula*). Extreme illustrations are 18 genera with 41 species of Drepanididae descended from one, perhaps two, forms of honey eating birds; peculiar food conditions and close competition resulted in the development in *Drepanorhamphus* and *Hemignathus* of long curved bills and long tongues for extracting honey from the Lobeliaceae; the development in the *Chloridops* of thick strong bills for cracking the naio nut; the adaption of the bill of *Rhodocanthis* for extracting the green seeds of the koa and the astonishing adaptation of *Heterorhynchus wilsoni* to the habits of woodpeckers and *Pseudonestor* to parrot-like action in obtaining food.

The distribution of the genera and species of Hawaiian Drepanididae is as follows, the iiwi (*Vestiaria*) apapane (*Himatione*), ou (*Psittacirostra*) range over the whole group with a modified form of *apapane* on Laysan, likely now extinct; the ulaaihawane (*Ciridops*), one on Hawaii very rare; the mamo (*Drepanis*), famous feather cloak bird, one on Hawaii very rare; oo-nuku-umu (*Drephanorhamphus*), one on Molokai very rare; *Palmeria,* one inhabiting Molokai and Maui; amakihi (*Chlorodrepanis*), two on Kauai, one on Hawaii and species or varieties on Oahu, Lanai, Molokai and Maui; *Viridonia,* one on Hawaii; *Oreomyza,* two on Hawaii and one each on Kauai, Molokai, Lanai, Maui and Oahu; *Loxops,* one each on Kauai, Maui, Oahu and Hawaii; akialoa (*Hemignathus*), one each on Hawaii, Lanai, Oahu and Kauai; nukupuu (*Heterorhyncus*) one each on Kauai, Oahu, Maui and Hawaii; *Pseudonestor,* one on Maui; *Telespiza,* one on Laysan rare and perhaps another on Nihoa; *Loxioides, Rhodacanthis* and *Chloridops* one of each on Hawaii; *Dysmorodrepanis,* one on Lanai. The peculiarities of Drepanididae are the small number of species compared with the number of genera, the confinement of species to the respective islands, and the number of restricted species on the island of Hawaii.

The honey eaters (Meliphagidae) include but 5 species of two genera, *Chaetoptila* with one extinct species being the latest arrival; oo (*Acrulocercus*) one species each on Hawaii and Molokai (both rare), Oahu, (extinct), and Kauai.

The friendly little "miller bird" of Laysan (*Acrocephalus*) has gone with the moths on which it fed. Of the thrushes (Turdidae) one genus, *Phaeornis,* is found, one species on Hawaii, two on Kauai, and one each on Lanai and Molokai. Of the flycatchers (Muscicapidae) also only one genus, *Chasiempis,* is found—the *elepaio,* three species, one each on Hawaii, Oahu, and Kauai.

The hawk (*Buteo*) and the crow (*Corvus*), complete the list of endemic land birds, both confined to Hawaii, the crow with a very restricted range.

Perkins does not admit that the *amakihi* of Oahu, Maui, Molokai and Lanai are worthy of specific rank, but are varieties of *Chlorodrepanis virens, Gmelin,* of Hawaii, and doubts the validity of the genus *Drephanorhampus* Rothschild, as separate from *Drepanis,* Temm.

The waders, *kolea, akekeke, ulili, hunakai* and *kioea,* and the pintail and shoveller duck are regular visitors, often bringing with them stragglers of both waders and swimming birds. Of the number of different species of gulls among the stragglers no species has yet made its home in Hawaii.

The European sparrow has spread with remarkable slowness, the small amount of grain culture probably account for it.

I believe the much abused mynah bird is more of a friend than an enemy. With the *kolea* and *akekeke,* which should be rigidly protected, it is of inestimable value in destroying caterpillars and wire worms, and in reducing parasites on stock.

ENTOMOLOGY IN HAWAII

By

OTTO H. SWEZEY

The study of the insect fauna of Hawaii was commenced by the Rev. Thomas Blackburn, who resided in Honolulu 1876 to 1882. He may justly be styled the "father of Hawaiian entomology," for his pioneer work revealed the highly interesting endemism of our fauna, aroused the interest of British entomologists, and eventually led to the systematic exploration by R. C. L. Perkins, and the publication of the immense monograph, Fauna Hawaiiensis.

The specimens collected by Perkins from 1892 on, worked up by a number of specialists, and published in Fauna Hawaiiensis, total about 3325 species, of which 82 per cent are considered endemic. Perkins expressed the opinion that about half of the existing species of native insects had been collected. It was his opinion that the islands have always been isolated and that the original ancestors of the native fauna had reached them as chance immigrants, by floating on driftwood, air currents, their own flight, etc. The present species have resulted by evolution during a great length of time.

Since the publication of the Fauna Hawaiiensis, no one has been working exclusively on the native insect fauna, but all the entomologists of the several institutions, working chiefly on economic entomology, have been interested in advancing the knowledge of the native insect fauna. These entomologists have been associated in the Hawaiian Entomological Society since 1905, holding monthly meetings, and have published six volumes of proceedings, amounting to 2460 pages. About 400 new species of native insects have been described therein, and much valuable data on habits and life history have been published.

The Natural History of Hawaii by William Alanson Bryan, published in 1915, devotes 20 pages to the native insects and 30 pages to important economic insects.

About 4000 species of insects are now known from Hawaii, 80 per cent of which are not known elsewhere. The fauna is made up of comparatively few families, and many groups found on all continental areas are entirely absent. Many of the genera are endemic and have a large number of species. These are so closely related as to indicate that they have only recently been evolved, and species-making is still in progress. Many of the species are flightless, so that isolation of species is readily attained, and the fauna of each island is peculiar to itself, a large proportion of species being present on but one island. Many species are very rare. Many are restricted to a single food plant, making their distribution dependent on that of the host. Progress is being made in faunistic study of particular trees.

Although much work has been done, there are still many new species to be discovered, and much to be learned concerning their distribution. More important is the study of their habits. Much has yet to be done on insect ecology. Many problems of importance arise in whatever line of entomological research one may engage. There is need of breeding work in connection with a study of species formation, necessitating a prolonged residence in the mountain forests.

MARINE ANIMAL LIFE OF HAWAII

By

CHARLES H. EDMONDSON

Although certain well known organisms are absent from Hawaiian waters and others are rare, the fauna is characterized by great variety and considerable numbers. Much of it is hidden from the casual observer. For example, a block of coralline algae about 4 by 6 inches in size recently examined included 30 species (138 specimens) of marine animals.

Because of the work of the "Albatross," certain groups of Hawaiian marine fauna below the 100 fathom line are better known than in shallow water. Of near shore forms the stony corals (124 species), the echinoderms (about 200 species), the mollusks (1400-1500 species), the annelids (about 70 species) are fairly well known and recent work has greatly enlarged the knowledge of crustaceans and fishes.

Future work of taxonomic character is especially advisable on sponges, the shallow water hydroids, the marine worms, the bryozoans, certain classes of mollusks, crustaceans and primitive chordates—groups in which very noticeable gaps should be closed up. The true taxonomist is not merely a namer of organisms but is alive to all of the complicated questions of variation and distribution.

Furthermore in almost every group of marine animals in Hawaiian waters, but especially among the coelenterates, the echinoderms, the mollusks, the crustaceans, and fishes, the ecologist may find ample material for his desires. The conditions surrounding animal life in the sea are not simple conditions. Not only the biologist but the chemist, the physicist and the geologist each must add his contribution before it is possible to unravel the complicated problems which so obviously exist among the intimate associations of organisms in the sea.

ANTHROPOLOGY IN HAWAII

By

JOHN F. G. STOKES

The literature of Hawaiian anthropology is made up of accounts by the voyagers (Cook, Kotzebue, Freycinet and others); missionaries and travelers (Ellis, Dibble, Andrews, Campbell, and others); native writers in the vernacular (Malo, Kamakau, and others); and white residents (Rae, Fornander, Alexander, N. B. Emerson, J. S. Emerson, Thrum, Brigham, Emory, Sullivan, and others). Much of this material is to be found in such serial publications as: the Kuokoa, Au Okoa, and Catholic newspapers in Hawaiian; the Sandwich Island Magazine, Hawaiian Spectator, The Polynesian, The Friend, The Hawaiian Annual, and publications of the Hawaiian Historical Society and Bernice P. Bishop Museum publications, in English.

The objective material is housed mostly in Bernice P. Bishop Museum and the British Museum. Archaeological field work is limited to a small number of village sites, to temple and burial sites protected by law, irrigation and fish pond systems. It refers more to structural work than to artifacts or stratifications.

The interpretative studies completed so far are most important in the subject of somatology. Sullivan and Dixon, using different material, have both come to the conclusion that four racial elements are present in the Hawaiian people—Sullivan intimating the possibility of two more. The establishment of the existence of racial admixtures has cleared the horizon for a better understanding of possible cultural stratification. Another worker, Frederick Wood-Jones, has lately commenced a racial study from the morphological rather than the anthropometrical viewpoint. The somatological material still available is considerable.

Topical studies have engrossed most of the writers. The greatest interest has been displayed in tradition and folklore (Fornander, Thrum, Westervelt and others). In mythology and religion, Thrum and Brigham have completed unpublished studies. Handy includes much Hawaiian material in his account of Polynesian religion. Bastian has contributed "Die heilige Sage," and J. S. Emerson has described sorcery. The chants and workings of the hula, and Hawaiian poetry by N. B. Emerson, Hawaiian music by Helen Roberts, and the Hawaiian novel Laieikawai, translated by Miss Beckwith, have been published. Hawaiian Proverbs by H. P. Judd and Hawaiian String Figures with the chants by Lyle Dickey are nearing completion. In philology, dictionaries or grammars have been prepared by Andrews (also Andrews-Parker), Hitchcock and Alexander. Of legal subjects land tenures have been treated by Dole and fishing rights by Massee. In material culture, much work has been done by the staff of Bernice P. Bishop Museum.

It is probable that more than two-thirds of the possible data regarding Hawaiian culture and available today have been recorded; but there is need for more topical studies, particularly in correlating the data in literature with the objective and archaeological material. Among these should be mentioned medicine, sports and games, war, fishing, canoes, ancient navigation, agriculture, irrigation systems, engineering and structural work, art, law and chiefly tapu. Enough material is on hand for an enquiry into the psychology of the primitive Hawaiian. In all these topics it is desirable to include comparative data, particularly from other parts of Polynesia, for the purpose of recognizing any cultural stratification which may be indicated by the different racial elements recognized by the somatologists.

At the present time conclusions regarding the localization of the racial or cultural affinities of the Hawaiians are dependent more upon general Polynesian than strictly local data. Hawaii links up closely but in varying degree with the rest of Polynesia, from which it is inseparable. However, there are proportional differences in the racial elements as well as cultural differences which will necessitate further study before it can be ascertained whether they are due to long isolation or to different racial influences.

SIMPLE EARTHQUAKE MEASUREMENTS

By

PAUL KIRKPATRICK

The mechanical problem of the overthrow of a supported, inclined column by horizontal simple harmonic motion has been solved, and the solution rigorously tested by laboratory experiments. The result obtained is concisely stated by the formula $a = g\theta\sqrt{1+\frac{4\pi^2R^2}{g\,L\,T^2}}$ where a is the maximum acceleration of the motion, g is the usual gravitational acceleration, θ the angle of inclination of the column from the vertical, R and L the radius of gyration and the effective length of the column, and T is the period of the oscillation. The movement is in the plane of the angle θ. The maximum acceleration defined as above is the maximum acceleration necessary and sufficient to bring about the overthrow of the column.

This result furnishes a simple method of measuring the horizontal intensity of earthquakes, since intensity is customarily measured by maximum acceleration. A series of similar columns of known dimensions may be mounted at various angles of inclination, such that the quake upsets some and leaves others standing. If the second term under the radical sign be made small, a condition which may be realized, the maximum acceleration becomes known with a precision depending upon the closeness of the spacing of the angles of inclination. Instruments of this kind have been constructed.

[An extended summary of this paper was published in Science, vol. 65, pages 379-380, 1927. A more complete paper appeared in the Bulletin of the Seismological Society of America, June, 1927.]

THE "ORIENTAL MARK"

By

NILS P. LARSEN AND LOIS S. GODFREY

The "oriental mark" is a skin spot of irregular size and shape occurring in the newborn child, usually in the sacral region. The authors tabulated the records of its presence or absence on 693 children in Hawaii. The data in 296 cases of interracial crossings were especially interesting, suggesting a Mendelian inheritance. The tabulated results interpretated in the light of a genetic theory which the authors propose, uphold the conclusion reached by other investigators that the factors for the "oriental mark" occur in all races, but in different degrees.

[This paper has been published in the American Journal of Physical Anthropology, vol. 10, no. 2, pages 253-274, 1927.]

SOME FACTORS IN THE GROWTH OF HAWAIIAN SHALLOW WATER CORALS

By

CHARLES H. EDMONDSON

The common Hawaiian corals grow slowly. The living cells must take the salts from the sea water and deposit them as limestone. This process takes time. The most rapidly growing coral on Hawaiian reefs is probably *Pocillopora meandrina,* some colonies of which will grow in a vertical direction more than 40 millimeters a year. Many other species grow not more than 6 or 8 millimeters annually. Corals grow faster on the windward side of Oahu than on the leeward side, and seem to grow faster during the winter months than during the summer.

The growth of corals depends upon many different conditions in their environment: Temperature and salinity of the water, silt, light, and food supply. To make good growth these and other factors must be favorable. Species of coral vary greatly in their responses to physical and chemical conditions. (Examples cited.) Among the most destructive agents of shallow water corals are seaweeds.

Coral colonies are made use of by other organisms as places of concealment. In one coral colony were found more than 50 other marine animals including 17 different species, some may actually feed upon the coral polyps.

[This paper will be published in full by Bernice P. Bishop Museum.]

COMPARATIVE GROWTH OF STEM AND LEAF OF THE SUGAR-CANE

By

FREDERICK C. NEWCOMBE

This abstract pertains only to the variety of cane known as H 109, though other varieties show the same general relations. Details as to methods of measuring are omitted for the sake of brevity. Also only the elongation of the parts is here considered.

A definite starting point for measuring may be chosen as the leaf-joint, the highest exposed leaf-joint as seen at the lower limit of the spindle. The sugar-cane leaf, like most grass leaves, has three parts: the blade, the sheath, and the joint connecting the blade and sheath.

If leaf blades are measured, those which show above the highest visible leaf-joint have an average length of about 125 cm. The blades of two to four leaves still younger, have the same length as those just mentioned, showing that the blades are fully elongated while the lower 10 to 15 cm. are concealed from view.

The leaf-sheath averages about 30 cm. long when mature. In the leaf with the highest visible joint the sheath is fully elongated; and the sheaths of two or three younger leaves are also fully elongated, although these sheaths are wholly concealed from view within the sheaths of the older leaves.

The amount of sheath that a leaf shows above the joint of the next older leaf is in most plants wholly due to the elongation of the stem of the plant. A variation from this usual behavior may be due to a change in temperature or in nutrition. From the relations given above, it follows that the length of the sheath exposed above the joint of the next older leaf is about the length of the stem internode (joint) below the insertion of the sheath of the first mentioned of the two leaves.

Thus it can be found, by measuring and dissecting, that the blade of a leaf is fully elongated when the sheath is only about one-third grown, and the stem below has hardly begun to elongate; and that the internode of the stem from which a sheath grows is only one-fifth grown when the sheath is fully elongated.

SIMILARITY BETWEEN PHYSICO-CHEMICAL AND BIOLOGICAL REACTIONS

By

CHRISTOS P. SIDERIS

An attempt is made to compare biological with physico-chemical reactions, and interpret the former in terms of the latter. To just what an extent this is feasible remains to be proven by further experimentation.

Protein A of the pineapple stem has been found to be isoelectric at pH 6.43. Solutions of this protein were treated with different volumes of 0.1 normal HNO_3 and NaOH and thus brought to different pH values ranging from 2.0 to 11.0.

Three sets of such solutions were prepared. Set (1) was inoculated with a pure culture of *Fusarium martii,* (2) *Verticillium sp.* and (3) *Penicillium sp.* Both mycelium and spores were used for the inoculation of the different cultures. The growth of the organisms at room temperature (about 27° C.) was compared with cultures of the same organisms grown on solid and liquid nutrient media.

Fusarium martii developed best in the solutions ranging between pH 6.5 and 9.9. *Verticillium* in those between pH 6.4 and 3.0; and *Penicillium* in all except at pH 6.4—the isoelectric point of the protein. Thus, none of the organisms grows in isoelectric pineapple stem protein-A. *Fusarium* will grow in solutions having pH values above the isoelectric point of the protein;

Verticillium in solutions of the protein having a pH value below the isoelectric point; and *Penicillium* in solutions with pH values either above or below the isoelectric point.

An explanation is suggested by assuming that the protein is made available for the use of the fungus by enzymes released by these organisms; that these enzymes are of protein composition; and that their chemical reactivity may be attributed to either of their two chemical radicals, NH_2 or COOH. It may further be assumed that the enzyme of *Fusarium* carries a positive charge and that of *Verticillium* a negative charge. The conditions which prevail with the enzyme of *Penicillium* are difficult to explain. There may be two enzymes, one carrying a positive charge and operating above the isoelectric point, and the other a negative charge and operating below the isoelectric point of the protein.

THE USE OF MOVING PICTURES IN METEOROLOGY

By
JOHN F. VOORHEES

There are at least three methods by which moving pictures may be used in teaching meteorology, and two of these promise much as aids in the study of that science.

The first and simplest method is illustrated by a moving cartoon showing from one side a cross section of a thunderstorm (after Humphrys) with moving arrows to represent the air currents within the storm and falling dots to represent the rain. This and similar pictures would perhaps have their greatest value in giving the beginner a clear idea of what is going on in the air under various meteological conditions. This method could also be used to good advantage in explaining and illustrating theories of meteorological movements.

The second method, not illustrated at this time, is to show the advance of high and low pressure areas, or warm and cold areas, by means of moving isobars or isotherms. If the data were taken from barograph and thermograph traces, making a map for each hour of the day, much detailed information of the movement of pressure and temperature conditions might be brought to light. The advance of the freezing line in the fall and its retreat in the spring, and many other meteorological phenomena could easily be illustrated in this way.

The third method, which should be valuable for both the beginner in meteorology and the student of cloud formation and wind movement, is to take pictures of actual clouds. The pictures shown were taken at intervals of five seconds and when run at the usual speed, multiplied the velocity of the clouds by eighty. The picture of the clouds coming over the Koolau mountains resembles more than anything else, boiling, shooting flames, except that the color is wrong. For the purpose of the study of wind currents and cloud formation, an exposure every two seconds or every three seconds would likely be best. Pictures of this kind, of thunderstorms, tornadoes, waterspouts, hailstorms, and many other phenomena would be both interesting and valuable, not only in the class room and laboratory, but also before the public.

THE FOOD-RUBBING STONES OF KAUAI, IN CONNECTION WITH CULTURAL DIFFERENCES IN HAWAII

By

JOHN F. G. STOKES

As compared with the island of Hawaii, the native culture of Kauai and Niihau presents differences in customs, artifacts and dialect. For instance, on Hawaii the vegetable staple poi was prepared by the men, except on extraordinary occasions; on Kauai, men or women did the work. Apparently, it was formerly woman's work only, and the preparation of poi by the men represented Hawaii influence.

On Kauai, the men and women used different implements in the work. The women rubbed or ground the paste with a particular type of implement, perforated in stirrup form; the men pounded it, using the conical Hawaiian form of pounder. The perforated stirrup form was evolved locally through many fine gradations, from imperforated stirrup types which in turn refer to a prototypic form, quadrangular in outline and in sections—an angularity unusual for Hawaii.

A group of seven stone grinders recovered from Kauai are of generalized type though differing in form. None of them are adaptable to a hand grip; some seem to have been adapted for lashing on a wooden hand piece. There is enough to suggest, however, that the prototype of the imperforate stirrup forms was associated with or derived from some such a grinder, as does the distribution at present known.

None of these implements is localized elsewhere in Hawaii or in Polynesia. The technic of the prototypic form and of the grinders finds its nearest analogy in implements on the deserted islands of Nihoa and Necker. In structural work, it is present, though rare, in Hawaii, although better represented in southern Polynesia. So far as known, the grinders are without analogy elsewhere. The stirrup forms are represented in Alaska and British Columbia (where the analogies are not close), in Mexico and in Costa Rica (where perforated and imperforate forms resemble the Kauai rubbers). The coincidence is at least a startling example of parallel development.

Drifts to the Hawaiian islands of human beings and objects recorded through history, tradition and observation have indicated an origin from Japan on the one side and North America on the other. There are many Hawaiian customs and artifacts not represented among the southern Polynesians, some of which find analogies in northeast Asia or northwest America.

No conclusions are possible with the data in hand, but further light may be obtained when outside analogies with the grinder may be found.

A CURIOUS HABIT OF AN HERBIVOROUS LAND SNAIL

By

C. MONTAGUE COOKE, JR.

An herbivorous snail, *Partula zebrina,* found in Tutuila, Samoa, has acquired the habit of swallowing other species of snails. From the relative size of the victims this must be accomplished with much inconvenience, if not pain, as not only the alimentary organs, but even the central nervous system are stretched to many times their normal size. As the secretions in the stomach apparently attack only the calcareous material, leaving the animal matter practically untouched, at least until some time after the shell is completely dissolved, it is presumed that these shells are swallowed solely to procure lime. This can be explained also by the relatively larger proportion of young specimens showing this habit than adults, as the growing shell needs a larger amount of lime.

[This paper is to be published in full by Bernice P. Bishop Museum.]

THE CATALASE CONTENT OF SOILS AND THEIR FERTILITY

By

BEATRICE H. KRAUSS

Enzymes are catalytic agents which both plants and animals use for the decomposition or synthesis of organic matter. The reactions accelerated by enzymes may be classed as (1) hydrolytic, (2) oxidizing and reducing, and (3) clotting or coagulating. The catalases are a group of oxidizing enzymes which accelerate the decomposition of hydrogen peroxide, evolving gaseous oxygen.

Soils rich in humus and bacterial and fungal flora are held to be fertile soils. The fertility is the result of the good physical condition that humus adds to the soil and the biochemical reactions during which various salts essential to plant life are released and nitrogenous substances are synthezied from atmospheric nitrogen. Catalase, being a constituent of living tissue, should be found in greater abundance in soil rich in humus and bacterial and fungal population than in soil containing little or none of these constituents. The catalase content of soil is thus a measure of the humus and biological activity of that soil, and hence of its fertility. Certain investigations in Europe and America have demonstrated the possibility of this assumption.

At the Association of Hawaiian Pineapple Canners' Experiment Station, a dozen soil samples were tested for their catalase content, by adding to 5 grams of the soil sample 40 cc. of distilled water and then 10 cc. of hydrogen peroxide. This mixture was shaken and allowed to react for fifteen minutes in an Erlenmeyer flask connected to an Elliot gas analysis apparatus. The volume of oxygen released from the peroxide through the action of the catalase, was an indication of the catalase content of the soil, and likewise showed the relative fertility of the soil. The results thus obtained correlated closely with the observed type and condition of the soil, and with the growth of pineapples and other plants.

CONTROL OF THE ROOT KNOT NEMATODE BY TRAP CROPS

By

GEORGE H. GODFREY AND HELENE MORITA

The trap crop method has long been mentioned in the European literature as one means by which the root-knot nematode may be combated. Experimental work was conducted at the Pineapple Experiment Station, Honolulu, using heavily infested soils in enclosed containers and tomato plants grown in small paper pots of sterile soil as trap crop. In twenty-seven days nematodes which infested the tomato roots at the time they were transplanted or shortly after, had reached maturity and egg masses were evident. At any time prior to the twenty-seventh day plant roots removed from the soil carried with them the nematodes in immature condition. By this means a first planting removed 98 per cent of the nematodes, and second and third plantings reduced the population to practically zero. The roots removed were used to inoculate pots of sterilized (nematode-free) soil. Roots twenty-seven days old carried with them infective material in the form of newly developed eggs. Roots less than twenty-seven days old, many of them showing thousands of galls, carried over only slight infection showing that the vast majority of the nematodes contained within the galls were immature and immobile, and incapable of infesting a subsequent crop. This indicates the possibility of planting a fast-growing nematode susceptible crop and plowing it under at the proper stage with resulting heavy reduction in the nematode population of the soil.

[This paper appears in the Proceedings of the Pineapple Men's Conference, March 23-26, 1927, published by the Association of Hawaiian Pineapple Canners.]

THE PINK DISEASE OF PINEAPPLE FRUITS

By
GWENDOLYN C. WALDRON

A bacterial disease of pineapple fruit, called the Pink Disease because of the bright pink color produced in the flesh of the fruit in advanced stages of infection, is of general occurrance in Hawaii, but has received no extended study. The disease is seasonal, occurring from December to April, mainly in scattered replants, which fruit out of season. No prevention or cure has so far been found.

The pink coloring is generally limited to the base of the ripening fruit, which would indicate that the point of infection is near the base, or that the bacteria develop better there, due to the greater concentration of sugar. When the infection has advanced so far as to give the pink color, the tissue becomes soft, spongy and quite watery. There seems to be no external evidence of infection, the shell remaining firm and normal in appearance.

The organism causing the disease was readily isolated from affected pineapples, on Dextrose beef-agar, glistening cream-white colonies appearing in 24 hours. It is a very small, thin rod, 1.25 microns long by 0.63 microns wide. It readily takes a gram negative stain, and is non-sporulating and only sluggishly motile.

The most annoying feature of the disease is that infected fruits turn brown when cooked. As there is no way of picking out such fruit by appearance or odor before it is processed, except in advanced stages, a study was made to find some substance which would give an instantaneous reaction. After much experimenting, it was found that ammonium phosphate (secondary) brought about the desired result. An indicator paper could be made by treating absorbant paper with a solution of this compound and drying it. A few drops of juice from pineapples infected with this disease will cause the indicator to turn dark brown, when subjected to a jet of steam. This indicator has proved specific for this type of infection, other pineapple discolorations or infections not producing the reaction.

[This paper appears in Proceedings of the Pineapple Men's Conference, March, 1927, published by the Association of Hawaiian Pineapple Canners.]

PINEAPPLE BRAN, A NEW FEED IN HAWAII

By

LOUIS A. HENKE

Pineapple bran is the outer shell of the pineapple, which has been dried and ground to varying degrees of fineness, depending on the class of animals for which it is prepared.

The feed has been made commercially in Hawaii since 1923. Production in 1926 amounted to 6966 tons of the dried material. Much of this is exported to the mainland. Approximately three per cent of the weight of the fresh fruit represents the possible out-put of pineapple bran from any cannery.

This dried feed contains 3.62 per cent protein, 1.01 per cent ether extract, 72.34 per cent carbohydrates, of which 18.23 per cent is fiber and 3.70 per cent ash. It contains five times as much vitamin A as grains, and vitamin B is present in about the same amount as in whole wheat. The calcium content is higher than that of wheat, corn, oats, or barley, but the phosphorus content is lower than in these grains.

Repeated experiments at the University of Hawaii and elsewhere show that, when properly supplemented with protein feeds, it is a good and economical feed for horses, mules, and fattening hogs. The material has also been fed extensively to dairy cows and, when properly supplemented, seems to have given satisfactory results. Pineapple bran, finely ground, has also been fed to poultry, but experimental evidence to date on its value for this purpose is inconclusive.

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, with "the promotion of research and the diffusion of knowledge" as its stated objects.

The activities of the Academy have comprised public addresses, and annual meetings for the presentation of original papers and reports. The Proceedings is the only publication sponsored directly by the Academy, the present issue being the third of this series.

Any resident of the Territory of Hawaii interested in science is eligible for election as a member of the Academy, and non-residents who are interested in scientific problems relating to Hawaii may make application for election as corresponding members. Nomination to membership in either class must be indorsed by three members of the Academy.

Communications to the Academy may be addressed (1928-29) to the President, Nils P. Larsen, Queen's Hospital, Honolulu, or to the Secretary-Treasurer, Paul Kirkpatrick, University of Hawaii, Honolulu.

PROCEEDINGS OF THE THIRD ANNUAL MEETING

WEDNESDAY, MAY 16, 7:30 P.M.

GARTLEY HALL, UNIVERSITY OF HAWAII

Preliminary announcements.
Election of members.
Presentation of papers:
Paul Kirkpatrick and Margaret Dewar: Polarization of reflected X-rays.
Victor Pietschmann: The X-ray in biological work.
George F. Straub: Electrical injuries.
Nils P. Larsen: The poison spider.
E. D. W. Brown: Dietary types, their geographical distribution.
Carey D. Miller, Doris Hair, and Marjorie Abel; Food values of some oriental foods.

THURSDAY, MAY 17, 7:30 P.M.

GARTLEY HALL

Frederick Wood Jones: The morphological approach to physical anthropology.
J. C. Thompson: Primitive mentality.
Andrew W. Lind: A factor in juvenile delinquency.
Romanzo Adams: Factors affecting the rate of intermarriage among people of the racial and cultural groups of Hawaii.
E. H. Bryan, Jr.: Educational recreation in Hawaii.
Peter H. Buck (Te Rangi Hiroa): The significance of Samoan ceremonial.

FRIDAY, MAY 18, 7:30 P.M.

GARTLEY HALL

H. L. Lyon: Palms in tropical forests.
Charles S. Judd: The propagation of indigenous tree seed.
W. P. Alexander: The influence of nitrogen fertilization on the sucrose content of sugar-cane.
A. J. Manglesdorf: Self-sterility in sugar-cane.
F. B. H. Brown: The pre-Linnaen botany of the Polynesians.
J. F. Voorhees: A quantitative study of the rainfall of Oahu.

SATURDAY, MAY 19, 2:00 P.M.

GARTLEY HALL

C. H. Edmondson: The relation of Atya bisulcata to Ortmannia henshawi.

C. Montague Cooke, Jr.: Evolution as a probable index of the relative ages of the Pacific islands.

F. B. H. Brown: Was the Tuamotuan Archipelago ever mountainous??

Kenneth P. Emory: Archaeology of Nihoa and Necker.

H. R. Hopf: Influence of environment upon the office worker.

Iwao Miyake: Acoustic absorption coefficients of a vesicular wall plaster.

SATURDAY, MAY 19, 6:30 P.M.

UNIVERSITY CLUB

The annual dinner was attended by 45 persons. It was followed by the presidential address, the reports of officers and committees, and the election of the following officers for the year 1928-1929:

President, Nils P. Larsen
Vice-President, Harold S. Palmer
Secretary-Treasurer, Paul Kirkpatrick
Councilor, E. H. Bryan, Jr.

ABSTRACTS OF PAPERS

SOME OUTSTANDING DEVELOPMENTS IN AGRICULTURAL SCIENCE DURING 1927

Presidential Address

By

GUY R. STEWART

The divisions of the subject chosen for discussion may appear at first glance to be comparatively unrelated. They have, however, this in common. Each exemplifies some application of the methods of pure science to the problems of agriculture. The theme might possibly be stated as the recent applications of science to agriculture, with exemplifications from four different fields.

There have been several developments in the field of agricultural science during the past year which are of more than passing interest. First among these might be placed the investigations of E. C. Baly and his co-workers at the University of Liverpool upon photosynthesis . The work of Baly and his associates has shown that when carbon dioxide and water were exposed to ultra-violet light by themselves in quartz tubes, only traces of any reaction product were formed. When, however, powders of large surface area were present, such as aluminum powder, barium sulphate, aluminum hydroxide, or the basic carbonates of alumina, zinc, or magnesium, the reaction proceeded to the formation of measurable traces of complex sugars. This not only helps to explain the mechanism of photosynthesis, but it may foreshadow the synthetic production of sugars and starches.

There has been a remarkable development in another closely related field of agricultural science, that of plant nutrition. Early work in plant physiology just as in human physiology indicated that a comparatively small number of elements were absolutely essential for plant growth. Lately a whole series of discoveries has been published which tends to show that minute amounts of manganese, bromine, iodine, zinc, alumina, copper, and flourine are one or all necessary for many of our cultivated plants.

Probably the most definite advance in the broader aspects of soil fertility occurred this past year through the meeting of the International Society of Soil Science in Washington, D. C. A notable group of investigators attended the conference and presented papers dealing with all phases of the study of the soil.

There has been a series of investigations carried out independently in several places which possesses more than passing interest for any student of science. This work has consisted of causing mutations or actual variations in the usual genetic inheritance by exposing plants or insects to X-rays. The experiments in tobacco plants were made by Goodspeed and Olson in California. In Texas, Muller obtained the same increase in the number of mutations by exposing fruit flies to X-rays. This work promises to help explain one possible cause of the mutations which so interest students of heredity.

Agriculture has been only one of the various fields of human activity in which the past year has seen an increasing use of and reliance upon the methods of science. The present discussion has treated largely of the applications of science.

In closing it might be pointed out that even modern industry, under the National Research Council, is contributing to the development of pure science, without direct expectation of benefit, beyond the indirect return which comes to the whole nation as the eventual result of the advancement of human knowledge.

THE X-RAY IN BIOLOGICAL WORK

By
VICTOR PIETSCHMANN
(Abstract by the Secretary)

Lantern slides are projected which illustrate the advantage of radiographs in biological studies, particularly of fishes. It is considered that this valuable aid to such research has been unduly neglected. Such studies leave the organism intact and portray all parts in their correct positions—advantages which dissection can not claim.

Injections of radiographically opaque fluids, such as barium sulphate, reveal all cavities, even the finest capillary vessels, with the utmost clarity; while at the same time, the labor and time involved in such a preparation are negligible as compared with investigations by other methods.

It is considered that the methods herein advanced are capable of profitable application to the fields of paleontology, botany, and entomology.

POLARIZATION OF REFLECTED X-RAYS

By
PAUL KIRKPATRICK AND MARGARET DEWAR

Work is in progress for the purpose of determining (1) the state of polarization of the K characteristic radiation of tungsten, and (2) the magnitude of the polarization imposed upon a beam of X-rays by the process of crystal reflection.

Results to date on (1) are consistent with the supposition that this radiation is unpolarized, as has usually but not always been assumed in the past. The second question is being investigated by scattering at right angles a beam of X-rays which has been reflected by a crystal of rock salt. Investigation of the distribution of scattered intensity permits a deduction of the polarization of the reflected radiation. Primary polarization of the incident radiation is eliminated from these measurements by inclining the X-ray tube at an angle of 45 degrees to the plane of reflection.

Measurements at two angles of reflection have been completed. For $2\theta = 20^\circ\ 10'$ a polarization ratio of .875 is obtained. For $2\theta = 15^\circ\ 08'$ observations yield the value of .932. The values deduced from the classical theory of electromagnetic radiation are respectively .881 and .932. The agreement thus obtained between experiment and theoretical prediction lends support to the view that the process of crystal reflection is a purely classical phenomenon, not requiring the use of the assumptions of the quantum theory.

SELF STERILITY IN SUGAR-CANE

By

A. J. MANGELSDORF

A large number of self-pollinations involving many sugar-cane varieties and seedlings have shown self-sterility to be the rule in Hawaii. Complete self-fertility was found to be rather a rare exception.

This is true even for varieties having normal, viable pollen and ovules, as evidenced by their performance when used in crosses with other canes. Badila, for example, produces an abundance of good pollen which functions normally in crosses. Its ovules also are highly fertile when pollinated with various pollen-producing varieties. When self-pollinated, however, very few seedlings result, in spite of the fact that the stigmas are well covered with their own pollen.

The situation is analagous to that in many other species of self-sterile plants, of which sweet cherries, clover, and rye are familiar examples. The cause in certain species has been found by investigators to be due to the slow growth of the pollen tubes down their own styles as contrasted with their very rapid growth down the styles of unrelated plants.

Even though a variety produces an abundance of pollen it may be safely used as a female parent in crossing if it is self-sterile. The determination of the degree of self-sterility of all cane varieties to be used in the breeding work is therefore desirable, as such information increases the range of crosses which may be undertaken with certainty as to parentage. Final conclusions as to the degree of self-sterility of a given variety can be arrived at only by selfing tassels from a number of sources and over a period of several seasons. [This paper is to be published in full in The Hawaiian Planters' Record.]

ARCHAEOLOGY OF NECKER AND NIHOA ISLANDS

By
KENNETH P. EMORY

An archaeological survey of the uninhabited islands of Necker and Nihoa made by the Bishop Museum in 1923 and 1924 shows that Necker was visited at an early date by people probably from Kauai for the purpose of erecting shrines or performing rites. The culture is southeast Polynesian in ultimate origin, Hawaiian in immediate origin. It is a pure sample of the Hawaiian culture which was almost obliterated about the 13th century by immigrants from the Society Islands, who instituted the historic culture.

Some of the remains on Nihoa Island belong to the same culture as those on Necker, others to the historic Hawaiian culture. The island at one time may have supported a population of more than a hundred, and in later times served as a seasonal visiting ground for fishing and bird collecting expeditions. [This paper has been published in full: Bernice P. Bishop Museum, Bulletin 53, 1928.]

THE COEFFICIENT OF ABSORPTION OF A VESICULAR PLASTER

By
IWAO MIYAKE

The most important difficulty in a room with bad acoustics is that of reverberation, or the persistence of sound long after the source has ceased to emit. To remedy the confusion caused by this persistence of sound, it is only necessary to shorten the time of reverberation by adding sound absorbing materials.

Professor Sabine found that the absorbing power of any material of known area changed with the nature of the material as well as the frequency of the sound source. For a given sound source, therefore, the absorbing power of a material is the product of a constant peculiar to it and the area of the material. The constant is known as the coefficient of absorption of the material.

It is the purpose of this paper to add to the list of available coefficients, the coefficient of a vesicular plaster called "Echo-Less." This plaster is applied to the walls like any other plaster. Its particular feature is that it is very porous. It is made so by the gases released by chemical actions between the ingredients of the plaster. The coffiecient of a plaster of this nature would, therefore, depend somewhat upon the expertness of application.

The coefficient was deduced from the effect the plaster had upon the time of reverberation of the test room. Three frequencies, F 684 dv/sec, G 384dv/sec, and C# 271 dv/sec, were used in the test and their respective coefficients were 0.15, 0.11, 0.10. The coefficient for frequency 512 dv/sec, was found to be 0.125.

FACTORS AFFECTING THE RATE OF INTERMARRIAGE AMONG RACIAL OR CULTURAL GROUPS IN HAWAII

By

ROMANZO ADAMS

Some groups, such as the Hawaiian, Part-Hawaiian, Portuguese, and other Caucasian groups, have a higher rate of out marriage than do the Asiatic groups. The causes may be divided into two classes: 1, Those which arise out of preferential attitudes; 2, those that arise out of mere numerical conditions and location—propinquity.

At the present time, the chief factors are social, not racial in the biological sense. The principal social factors determining preference in out marriage are: 1, traditional marriage customs and standards of the various groups; 2, the absence of a common language, an effective barrier to marriage; 3, economic and social status; 4, home life—food, clothing, furniture, household customs; 5, religion.

If two groups such as the Portuguese and the Spanish show a high preference for each other, it may be on account of racial similarity or on account of cultural similarities—religion, language, social status, and marriage customs; there are no data for a decision. But the existence of a higher preference between the Filipino and Portuguese of similar religion than between the Filipino and Japanese with greater racial similarity shows that the culture factor is stronger than the racial factor. The predominance of the culture factor is likewise shown in a greater preference of Chinese and Japanese for Hawaiians or Americans than for each other. Chinese and Japanese are racially similar. Parental control of marriage is an effective bar to intermarriage.

As all the groups acquire the language and other cultural traits of America, the culture factor as affecting attitudes will be less important and it may be that after two generations the racial factors will be the more important. But by that time the majority of the people will be of mixed race, if present tendencies continue.

EVOLUTION AS A PROBABLE INDEX OF THE RELATIVE AGES OF PACIFIC ISLANDS

By

C. MONTAGUE COOKE, JR.

The islands of the Pacific belong to three distinct types: the low coral island or atoll; the raised limestone island; the high island, which is composed of volcanic or continental rock. The last type has by far the largest number of endemic land shells. On these high islands have been found eight endemic families of pulmonate land shells, representing ancient stocks that are probably older than the rocks of which the islands are composed. Four of the families are limited to the Pacific, four—two of which are represented in the Carboniferous Era—are of world-wide distribution. As most of the land shells that have evolved on the continents since the Cretaceous Period are absent in the Pacific, it is evident that the means of dispersal existing in ancient times do not exist today.

On each group of islands or on single islands the land shells are strikingly different, as: the Hawaiian islands with 2 endemic families and 21 endemic genera; the Society Islands and Samoa with no endemic families or genera; Fiji with, so far as yet known, 5 endemic genera. Such differences in evolution are probably due to several factors. Of these isolation is important, though the part it plays is in keeping stocks more or less pure. The factor of area does not affect the number of genera inhabiting an island if age is also a factor. For example, the larger and apparently younger island of Hawaii has fewer and less varied forms of land shells than Oahu. But if two islands in a group are of about the same age, the larger island will have more species. Thus in Samoa, Upolu has about nine endemic species and Tutuila, which is smaller, only four. The factor of climate seems not to have much effect on the evolution of land shells. On the other hand, the factor of age seems to be of the greatest importance. As the endemic land shells belong to ancient stocks evolution has been slow, and as evolution apparently has advanced at a uniform rate on each island, the comparative age of the islands can be deduced by the number of their endemic genera and species. Thus the Hawaiian islands, having the greatest number of endemic genera, would seem to be the oldest and to be followed in chronological order by Fiji; Rapa, northwestern Society Islands, and Marquesas Islands; southwestern Society Islands and higher Cook Islands; Samoa; Tonga; Austral Islands; and Mangaia.

THE POISON SPIDER, LACTRODECTUS MACTANS

By

NILS P. LARSEN

The spider *Lactrodectus mactans* looks like a black shoe button with a red hour-glass on its abdomen. The largest female seen, measured from toe to toe, 5 cm. It is prevalent in all the southern United States and has been found in the northern ones. Tradition states that the Indians of southern California made emulsions of these spiders to poison their arrow heads. Throughout the United States it is known as the most poisonous of all spiders. Of 150 recorded hospital cases, sent to hospitals because of the severity of the symptoms following a bite, 10 died. So the chance of death from a bite is less than one in fifteen, as only the severest cases are sent to the hospitals.

It has often been stated that poisonous insects brought to Hawaii from the mainland lose their poison. The absence of recorded human cases in the islands, even though the spider is present in fairly large numbers, seemed to lend weight to the "losing poison" theory.

A spider was caught in its natural habitat and after becoming acclimated to the laboratory, several guinea pigs and two rabbits were exposed. The animals were bitten on the nose or ear. Within ten minutes, the first muscular twitchings began to appear, these twtichings continued at rapid intervals, first one part of the body then another being affected. At times the animal would almost jump from the floor. The animals were seen to froth at the mouth and in about half an hour fell over on their sides, semiconscious and apparently expectantly awaiting death. Gradual recovery would take place and in four to six hours the animals would return to a normal health condition. The back legs were sometimes affected and seemed partially paralyzed.

Eggs were then obtained through the courtesy of Mr. Twigg Smith, and from one egg about 250 small spiders were hatched. From this family, there finally survived one adult female and one adult male. The adult male was placed in a jar with the adult female. There was definite evidence of mutual coyness, none of the quick darting attack evidenced when ordinary prey was thrown into the jar. By next morning the adult male had disappeared. This was in July. In January, the female delivered herself of a large white egg. This was removed to a new bottle on February 1, and on February 27, thinking no live spiders were within, the bottle was opened and a dozen small live spiders hurriedly escaped. There were a large number of undeveloped eggs left behind.

The biting apparatus consists of two saw-toothed prongs, one on each side of the mouth. These two prongs are injected into the enemy, making small holes from which minute drops of blood ooze after the animal has been bitten. Notes were also made as to why animals were affected differently.

With man the symptoms are very similar. There is a local pain at the time of the bite, followed in about ten minutes by cramping and aching pains, first in the part near the bite and later spreading over the abdomen, legs, back and chest, increasing in intensity for about one hour. The intense agony may last for hours and even large doses of morphine fail to relieve. Nausea, vomiting, and difficulty in breathing accompanies these symptoms. A little temperature develops, the pulse gets slow and the blood pressure rises. Next day the patient may have pains in the feet and legs and complain of numbness in the soles, which lasts for days. The minute drop injected must be very powerful to produce such symptoms. Emil Bogen, in a very interesting article on arachnidism, has described in detail a number of clinical cases and gives an excellent account of spider poisoning.

Some other interesting observations made were the ability of this spider to overcome enemies. A large centipede thrown into the jar was immediately attacked and within a very short time was wrapped up in a tight web. In the same way a scorpion was snared and bitten.

ELECTRICAL ACCIDENTS AND INJURIES

By
George F. Straub

Electrical injuries are all in a class by themselves, being different from any other trauma. The mechanism of electrical accidents is a complicated one inasmuch as many extrinsic and intrinsic factors determine the course and outcome. Significant in this respect are the questions of contact, ground, shoes, clothing, atmospheric conditions, conductivity of the skin, general state of health, and the personality and preparedness of the individual. Although somewhat different in their effect, high and low voltages and direct and alternating currents are equally dangerous. Currents of even less than 1/10 ampere are liable to be fatal. Fibrillation of the heart never having been proved in the accidents under discussion, the electrical death in many cases is only suspended animation, reversible by immediate artificial respiration properly carried out. There is a decided difference in appearance and clinical course between the electrical current mark and the electrical burn, the mark being characteristic for the current effect at the point of contact, the burn differing in no respect from any other burn. Important are the remote effects of the electrical current on the circulatory and nervous systems which are chiefly determined by the resistance and conductivity of the various tissues, the blood being the best conductor. The explanation of the manifold picture of electrical accidents is furnished in part by the dynamogenic effect, the conduction of the electricity itself, and partly by the psychogenic effect; that is, the conduction of the stimulus caused by the electricity. The modus operandi of the dynamogenic effect is primarily by electronic upheaval in the cell molecules and secondarily by the production of heat, this process being governed by Joule's law. Electrolysis plays a subordinate role. The quality of electrical effect depends entirely upon the effective quantity of the stimulus and the biological response caused thereby and is determind by the biological law of Arndt and Schultz. In parallelism to electrical injuries, death by electricity occurs in four distinct modes: the sudden death, the retarded death, death with a short apparently normal interval, and late death. Immediate artificial respiration will be successful only in a case in which the instantaneous destruction of the current has not affected vital organs. The various phases of the lecture are illustrated by lantern slides.

A FACTOR IN JUVENILE DELINQUENCY

By

ANDREW W. LIND

One of the most important functions of the racial colony in any city is that of providing, during the trying period of readjustment to a new culture and civilization, a haven where the habitual and customary patterns of life are unquestioned and absolute. Within the nondescript and disorganizing slum area of the city, where economic necessity usually compels the immigrant to settle, the racial colony or ghetto serves to conserve and foster the only cultural standards which the immigrant can understand. So, too, for the second generation, caught midway in the assimilative process, the little Tokyo, Chinatown, or little Portugal provide a milieu of stability and accepted values and codes. Unlike the amorphous slum, where all types and varieties of people with as many diverse traditions and moral codes are thrown together in a hopeless welter, the segregated racial colony does preserve one standard of behavior relatively unchallenged. At least the pains of readjustment to the new cultural standards are not nearly so acute as in areas where great diversity of tradition is encountered.

An analysis of the records of the cases appearing before the Juvenile Court of Honolulu in 1927 provides rather striking confirmation of the thesis just stated. For example, it was discovered that in the area of disorganization just back of the city proper, the cases of Japanese delinquency came from neighborhoods where the Japanese were mixed rather indiscriminately with other races, while no cases of Japanese delinquency were reported from an adjoining neighborhood of very high and almost exclusive concentration of Japanese population. For the city as a whole, we find a rough correlation between social disorganization (measured in terms of juvenile delinquency) and the degree of segregation and concentration of the population of the various immigrant colonies. Our data seem to show that "the children of the ghetto," to use Zangwill's phrase, are less likely to run afoul of the American law than their cousins who have escaped from the colony.

VITAMIN CONTENT OF SOME ORIENTAL FOODS

By

Carey D. Miller, Doris B. Hair, and Marjorie G. Abel

The vitamin content of two of the cheapest and most used Oriental vegetables in Honolulu, green gram bean sprouts (*Phaseolus aureus* or *Phaseolus mungo*) and Chinese cabbage (*Brassica chinensis*) have been determined, using Sherman's quantitative method.

The vitamins A, B, and C of raw and cooked bean sprouts were determined by feeding experiments on 65 rats and 20 guinea pigs. The cooked sprouts were steamed for five minutes so that they remained slightly crisp. Compared with some other common vegetables, they have been shown to be a fair source of vitamin A in both the raw and cooked state; a very good source of vitamin B, both raw and cooked; and an excellent source of vitamin C in the raw state and a good source in the cooked.

Preliminary work on the Chinese cabbage showed that the green leafy portion was high in vitamins A and B, whereas the white petiole and rib was extremely poor. In the quantitative experiments the entire cabbage was fed in the raw state, steamed ten minutes and salted in the usual Japanese manner. This cabbage is used much more by the Japanese than by the Chinese. Compared with other vegetables, the Chinese cabbage has been shown to be rather a poor source of vitamin A with considerable loss of the vitamin through cooking and salting; a fair source of vitamin B, with some loss through cooking and more when salted; and an excellent source of vitamin C when raw, a good source when cooked, and a very poor source when salted.

PALMS IN TROPICAL FORESTS

By

Harold S. Lyon

The forestry problem in Hawaii is to cover grass lands with forests, and if we could learn how this is accomplished by nature in other parts of the tropics, we might contrive to start a similar sequence of events here, and then leave it to nature to carry on the work for us.

In north central Trinidad is a grass covered area of considerable extent known as the Aripo Savannah. It lies on a sandy flood plain of compact, barren soil, in which the water table is only a few inches below the surface. This savannah is surrounded by forests. Within the savannah itself are islands or oases of forest. It is evident that the savannah along its margin is being encroached upon by the forest, that forest components are becoming established at points well within the savannah, and from these foci islands are built up. This savannah furnished examples of islands of all sizes, making it possible to trace the sequence of events from the inception of the focus to the completion of an island many acres in extent.

The moriche palm is the originator of many of these islands. Because of its ability to withstand the vicissitudes of soil and climate on the open savannah, it is able to establish itself in competition with the grasses. Growing in the savannah, it creates about itself conditions which make it possible for other trees and shrubs to grow beside it. This society thus started continues to improve conditions in its immediate environment, which makes it possible for additional plant forms to enter the society, and thus the complexity of the organization grows. Eventually conditions are created which make it possible for the more exacting rain forest trees to enter the formation. Once established within the formation, these trees and their associates soon take possession and create conditions under which the palms and other pioneer plants in the forest building are at a disadvantage, and consequently the pioneers are forced into a secondary position, or eliminated altogether.

At another point in Trinidad, we followed the transition from savannah to forest with another species of palm, the Cocorite, acting as the pioneer. This palm invaded the savannah and became the nucleus of a forest oasis.

These observations lead to the belief that certain palms can be used to advantage in starting forest formations on denuded areas in Hawaii.

EDUCATIONAL RECREATION IN HAWAII

By

E. H. BRYAN, JR.

Educational recreation was defined as the constructive, or beneficial, use of leisure time. A brief enumeration was given of the organizations in Honolulu carrying on or encouraging such leisure time activities. Among these were mentioned the Recreation Commission, the Boy Scouts, the Girl Scouts, the Y.M.C.A., the Y.W.C.A., the Y.M.B.A., the Boy's Work Council, the Girl's Work Council, Palama Settlement, the Trail and Mountain Club, the Outrigger Canoe Club and various other swimming and rowing organizations, the Amateur Athletic Union and other athletic associations, the many extension and night classes, the Honolulu Academy of Arts, the public libraries, different racial group organizations, the Aquarium, Bernice P. Bishop Museum, the Pan-Pacific Research Institution, several scientific societies, and civic and religious organizations.

A series of lantern slides, loaned by the American Museum of Natural History, New York, were shown of various educational and recreational activities not as yet carried on in Hawaii. These include circulating natural history collection service for the schools, nature trails, and "visual" education by the touch examination of specimens for the blind.

A QUANTITATIVE STUDY OF THE RAINFALL OF OAHU

By
J. F. Voorhees

An attempt has been made to determine the total quantity of rainfall in Oahu, and to consider briefly what becomes of it. Rainfall data were available for 88 stations well distributed over the island. The records for 12 of these stations were longer than 30 years, 26 were from 21 to 30 years, and 20 from 10 to 20 years in length. The data were platted on a map of the island and isohyetal lines drawn for each 20 inches. The data indicated that elevation might properly be ignored in drawing these lines, a conclusion strengthened by two correlations that were computed. The first, between elevation and rainfall gave $r = .21 \pm .13$ and the second gave $r = .81 \pm .04$, indicating that distance from the crest of the range was a far more important factor than the elevation in determining the amount of rainfall at a station. The elevation of the crest over which the wind blows determines the amount of condensation, and not the elevation of the point at which the rain reaches the earth. The areas between the lines were measured and the number of square miles in each multiplied by the depth in inches giving the number of square mile inches. The total for Oahu was 40889 sq.mi.in. which, divided by the number of square miles gives an average depth of 68.4 inches, which amounts to 713,000 million gallons.

Assuming from certain considerations that 10 to 15 per cent evaporates from vegetation, and that 35 to 40 per cent is lost to the air by transpiration, there is left about 50 per cent of the total rainfall that escapes to the sea by surface runoff or through the artesian basins. The surface runoff has been previously calculated to be about 30 per cent of the total rainfall. The Honolulu Sewer and Water Commission gives 42 million gallons daily as a safe limit for pumping in the Honolulu district. This amount is just about 20 per cent of the rainfall in that area. Because the artesian basins are probably all being pumped to capacity, any addition to the available water supply must be taken from the 30 per cent that now escapes to the sea as surface runoff, or through springs near sea level.

THE PROPAGATION OF INDIGENOUS TREE SEED

By
C. S. Judd

The indigenous Hawaiian trees, with certain exceptions, are not readily or easily handled on a large scale in tree nursery or planting operations in the forest reserves of the Territory of Hawaii.

The koa stands out as an exception. As a seedling its growth is rapid but its seed is almost universally riddled by a moth borer. Also the tree thrives only on well-drained soil. The hau, though satisfactory and readily propagated from slips, has its altitudinal limitations. The *milo, kamani,* coconut, hala, and *kou* germinate well, but are littoral trees and hence are not suitable for forest reserve plantings, though their seeds germinate well. The mountain apple, like the kukui, thrives only in moist bottom land and the *wiliwili,* only in the dry soil of the foothills. The *ohia lehua* is most difficult to raise from seed, is very slow growing and is essentially a wild tree. The *alahee* seed is also almost always infested by a borer.

It would seem that entomologists could be of great assistance in providing more effective natural enemies of these seed infesting insects so that the koa, *alahee,* and other native trees could reproduce themselves more widely by natural seeding.

A more general use of sandalwood is desirable. Before this can be done much more must first be learned about its parasitic habits.

A preliminary study of the germination and growth of six indigenous forest trees and of six introduced trees shows that the native seed has an average germination per cent which is more than twice as high as that of seed of the introduced trees. The native trees, however, require a period almost twice as long for growth to the stage when they are ready for transplanting. [This paper is published in full in The Hawaiian Forester and Agriculturist: vol. 25, no. 4, 1928.]

INFLUENCE OF NITROGEN FERTILIZER ON THE SUCROSE CONTENT OF SUGAR-CANE

By
W. P. Alexander

A study was made at Ewa plantation of 74 nitrogen field experiments to determine under the local environmental conditions the effect of different amounts of nitrogen on sucrose content; the effect of different times of application on sucrose content and whether a better control of nitrogen fertilization could lessen the depression upon sucrose content.

In a paper presented before the Academy two years ago on "The influence of potash fertilizer on sucrose content of the cane" it was shown that, contrary to published data, under certain conditions potash fertilizer has a beneficial effect on the sucrose content of cane. However, with nitrogen applications in general, the reverse is true. More cane per ton of sugar is required when cane is fertilized with nitrogen to offset the depressing effect on sucrose content. This depressing effect varied greatly, averaging about 2 per cent for each additional 50 pounds of nitrogen with a standard deviation of ± 2.3.

The why and wherefore of this lack of regularity in the influence of nitrogen upon the sucrose content was investigated. First there seemed to be some indications that as the nitrogen applications over 150 pounds per acre increased, the loss in sucrose content decreased. The average data may be presented as follows:

When an extra dose of 50 pounds is added

to 250 lbs. P. A. the loss was 1.5 per cent.
to 200 lbs. P. A. the loss was 2.3 per cent.
to 150 lbs. P. A. the loss was 2.9 per cent.

In other words, assuming a quality ratio[1] of 8 with 150 pounds nitrogen

200 lbs. P. A. nitrogen=8.30 Q. R. Difference 0.30 Q. R.
250 lbs. P. A. nitrogen=8.50 Q. R. Difference 0.20 Q. R.
300 lbs. P. A. nitrogen=8.63 Q. R. Difference 0.13 Q. R.

These are very general figures showing as the amount of nitrogen is increased above a certain point, the detrimentel effect is less. There is a great deal of fluctuation between individual tests. An effort was made to correlate the differences in per cent loss in sucrose content due to nitrogen applications with the following factors:

1, soil type; 2, date of harvest; 3, degree of ripeness at harvest; 4, age of cane at harvest; 5, proportion of nitrogen applied between first and second seasons; 6, interval between last fertilization and harvest; 7, fertility of soil as shown by yield—cane per acre per month.

The juice of cane grown on the pali and coral soil types was less influenced by nitrogen applications. When cane was harvested at the time when it ripens normally—that is, in May—the juices were better, irrespective of nitrogen treatment. Conversely, cane harvested in the early season suffered more from added nitrogen.

[1]Theoretical tons cane per ton sugar required

Extra cane yields, usually offset the lower juices when the 150-pound dose was boosted to 200 pounds, often compensated for the poorer quality ratio in the jump from 200 pounds to 250 pounds and seldom counterbalanced the reduction in sucrose content when 300 pounds was applied.

The key to profitable fertilization with heavy doses of nitrogen is application at the proper time. There is a point in the cane's growth when no further nitrogen or only small quantities can be applied with safety. Great care must be exercised not to give the cane overdoses in the second season. [This paper is published in full in the Hawaiian Planters' Record, July, 1928.]

THE RELATION OF ATYA TO ORTMANNIA HENSHAWI

By
CHARLES H. EDMONDSON

Three species of fresh water shrimps of the family Atyidae have been recognized in Hawaii. The species *Caridina brevrostris* is the most primitive.

The species *Ortmannia henshawi* and *Atya bisulcata* differ primarily in the character of their chelipeds. The species *Ortmannia henshawi* possesses a palm, the dactylus being shorter than the propodus, and the wrist, or carpus, of the second cheliped is longer than that of the first. In *Atya bisulcata* the dactylus and propodus are of equal length, thereby eliminating the palm of the hand, while the carpus of the second cheliped is short like that of the first. The tufts of bristles directed forward from the pincers of the chelipeds are longer in *Atya* than in *Ortmannia.*

Of many hundreds of young hatched from eggs of *Atya bisulcata,* all were *Ortmannia henshawi.* Practically all immature and many mature specimens of *Atya bisulcata* were, upon removal and regeneration of the chelipeds, converted into *Ortmannia henshawi.* By the same process, *Ortmannia* may be transformed into *Atya,* the change being made, however, in not more than 10 per cent of the specimens tested, the older animals showing the greater tendency to change.

Investigations in progress aim to determine the character of the young hatched from the eggs of *Ortmannia;* to ascertain the number of chromosomes in the germ cells of *Atya* and *Ortmannia,* and test their interbreeding. Assuming that the young of both forms are at first *Ortmannia* like, an attempt is also being made to learn at what stage and by reason of what stimulus the transformation to *Atya* may take place. [This paper is in preparation for publication by Bernice P. Bishop Museum.]

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PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

FOURTH ANNUAL MEETING

MAY 9-11, 1929

BERNICE P. BISHOP MUSEUM

SPECIAL PUBLICATION 15

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1929

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

During the year 1928-29, three special public meetings of the Academy were held: to hear Dr. Michael Guyer on July 18, 1928, Dr. T. D. A. Cockerell on July 26, 1928, and Dr. Martha Jones on September 27, 1928.

The sessions of the Fourth Annual Meeting were held at the Biology Building, University of Hawaii, and the Honolulu Academy of Arts, May 9 to 11, 1929, ending with a banquet at the University Club.

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PROGRAM OF THE FOURTH ANNUAL MEETING

THURSDAY, MAY 9, 7:30 P. M.

Biology Building, University of Hawaii

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

Mr. D. M. Weller and Dr. N. P. Larsen: The black spore of Hawaii; a report of a two-year pollen survey of the air of Honolulu.

Dr. E. D. W. Brown: Notes on the fern flora of Polynesia.

Mr. Otto Degener: The genus *Bidens (Campylotheca)* in the Hawaiian islands.

Dr. F. B. H. Brown: Notes on plant succession in the Marquesas.

Mr. J. F. G. Stokes: Suggested culture drifts to Hawaii.

FRIDAY, MAY 10, 7:30 P. M.

Honolulu Academy of Arts

Presentation of Papers:

Dr. Martha Jones, Dr. G. P. Pritchard and Dr. N. P. Larsen: Odontoclasia, A form of rampant tooth decay.

Dr. R. W. Leigh: Dental morphology and pathology of prehistoric Guam.

Dr. H. S. Palmer: The geology of Molokini.

Dr. T. A. Jaggar: Graded swelling and shrinking of volcanoes.

SATURDAY, MAY 11, 2:30 P. M.

Biology Building, University of Hawaii

Presentation of Papers:

Mr. O. H. Swezey: Recent immigrant insects in Hawaii that are not pests.

Dr. G. H. Godfrey: Some studies on the location of plant parasitic nematodes in plant tissues.

Mrs. Frances Paxton: Some immunological observations.

Mrs. Lois Godfrey: Methods of determining ultra-violet in sunlight.

Dr. C. H. Edmondson: Effects of ultra-violet rays on regeneration of appendages of *Atya bisulcata.*

SATURDAY, MAY 11, 7:00 P. M.

University Club

Banquet.

Constitutional order of business.

Presidential address.

Installation of new officers.

Adjournment.

ABSTRACTS OF PAPERS

PRESIDENTAL ADDRESS

By

NILS P. LARSEN

An educated man has been defined as "One who knows something about everything and everything about something." It is to try to fulfil this desire that prompts us to get together.

In this day and age of rush, bustle and materialism—in an age of scientific magic and an age in which material worth is frequently measured in millions—in an age in which the word "scientific" is applied and used in connection with every charlatan—in an age in which great cults arise on metaphysical smoke or mental aberrations without even an attempt coldly to gather facts or carefully to consider underlying principles or painstakingly to try to disprove observations, hesitatingly and slowly drawing conclusions—in such an age the Hawaiian Academy of Science was conceived, fathered and born, and we are now gathered at its fourth birthday feast.

We have the pleasure of living, I believe, in an interesting American community. Recently a keen lawyer was visiting here. After he had been here for some weeks he said, "It seems to me this is rather an unusual community; worth—what a man is or is striving to become—seems to be considered as important as what he has or the social position he holds." Perhaps it is true—let us hope it is true! It seems it is this spark, this hope, this ideal that the Academy of Science should subtly stand for. Truth for truth's sake, new facts for the joy of acquisition, experimentation for the pleasure of proving. Does our membership actually believe this? Are we willing joyfully to cooperate to make more work possible? Can we gather more frequently, informally to exchange opinions, to broaden our own interests and make our own conclusions more sound? This, I believe, is also the purpose of the Academy. Teaching is stimulation—do we teach?

It is a pleasure to look over our membership and realize the fascinating fields of research they represent—[Here a short review was given of the work of the Sugar Planters' Experiment Station, the Pineapple Packers' Experiment Station, the Bishop Museum, the University of Hawaii, the Queen's Hospital Research Department, the work of Service men and of independent researchers.]

In casting about for something of interest to you in my own field of endeavor, there occurred to me an argument we had recently. The question was, "Have we any right to experiment upon the human body?" My answer was, "No!" How then is progress possible? A pneumonia experiment was recalled to illustrate the point. The therapeutic agent was first tested on a pure culture of the organisms, then on mice after inoculation, then on monkeys after the introduction of the organism and the disease was well under way. After this chain was successful then the human was tried, but only on each alternate case. This is not experimenting on the human in the true sense, but applying proven animal facts to the human. The alternate case treatment is essential, since without it the proof is not complete, and without complete proof progress is hindered or with false proof many are harmed. The giving of pills or medicines to a patient without careful analysis is much more like experimentation, since that hinges on the fact that probably 80 per cent of all our ailments will run a natural course to recovery. One reason for a research department in a hospital is to try to keep the scientific method in use actively and to prevent the 'post hoc, propter hoc' method of reasoning.

THE BLACK SPORE OF HAWAII

By

D. M. WELLER AND N. P. LARSEN

This paper is the result of two years' study of the pollen, etc., in the air of Honolulu, carried out under the direction of the Research Department of the Queen's Hospital. Microscope slides smeared with albumen and glycerin were exposed daily at six stations in Honolulu—in the downtown section, in Makiki, halfway up Manoa Valley, at the head of Manoa Valley, at Waikiki and at Kaalawai. Microscopic examination of these slides showed the presence of many kinds of pollen grains, fern and fungus spores, and dust particles, varying in number according to the season and the weather. The pollen grains, spores, etc., on a 22 mm. by 22 mm. area of each slide were identified and tabulated. The number varied from one to over a thousand. Thus quantitative data were secured daily on the kind and quantity of pollen, spores, etc., that was in the air throughout a two years' period. From the data thus gathered it was apparent that the pollen flow of certain plants had definite seasonal peaks while others had not. The flow of the latter was graphically represented by low, flat curves, in contrast to the peak of the other type. A significant exception was the consistent high flow throughout the year of a black fungus spore case, as yet unidentified, but previously known and isolated in connection with another problem. The source of this black spore case was located in the bur of the sand-bur grass, *Cenchrus* *hillebrandianus.* Skin reactions had been obtained from pure cultures of these isolations, but not until the present pollen survey had demonstrated its general distribution and extremely high numbers in the air at all seasons was it regarded as a factor in hay fever and asthma, in relation to which afflictions this study has a definite bearing. As is well known, a certain proportion of humans is hypersensitive to pollens as well as to other proteins. This sensitivity expresses itself by symptoms of hay fever and asthma whenever the patient is brought in contact with the specific substance. The value of the pollen survey lies first, in locating the types of pollen which are present in the air in appreciable amounts, and second, in obtaining a sufficient quantity of the important types to test on the skins of sufferers. Such tests have been made with some 25 Hawaiian pollens as well as many Mainland pollens on hundreds of skins.

The black spore, which had never before been mentioned as a symptom producer, was found to be present in larger quantity than any other protein of the air. Good skin reactions have already been obtained in about a dozen cases. This discovery opens the field to the whole range of fungus spores, and these may well be a very important source of sensitivity in a community where they are present in the air in large amounts the year round. [Illustrated by charts.]

THE GENUS BIDENS (CAMPYLOTHECA) IN HAWAII

By

OTTO DEGENER

The common Spanish needle, *Bidens pilosa,* was accidentally introduced into the Hawaiian islands in the early days. There are many relatives of this plant native to the Hawaiian islands, found especially at higher elevations. Hillebrand's "Flora of the Hawaiian Islands" (published in 1888), describes 12 species and 9 varieties, a total of 21 kinds. Since then the number of known species and varieties has been increased to 34 and 16 respectively. Of these 50 kinds, 10 were found by me and my assistants.

The Hawaiian plants seem to represent a synthetic group, exhibiting characteristics that are more or less intermediate between those of the genera *Bidens, Coreopsis* and *Cosmos* of continental regions. The reason for this may be that the ancestor of the Hawaiian forms arrived in these islands in a geologic period when the above three genera had not yet been fully differentiated into distinct, clear-cut groups. Some botanists have in consequence considered Hawaiian plants as belonging to the genus *Bidens,* while others have considered the same plants as representatives of *Coreopsis*. A third group has decided that they form a distinct genus, *Campylotheca*.

The various Hawaiian species and varieties of *Bidens* are for the most part extremely localized in distribution, usually growing on only a single mountain or on but a few ridges. [Illustrated by specimens.]

SUGGESTED CULTURE DRIFTS TO HAWAII

By

JOHN F. G. STOKES

Hawaiian native culture, although basically Polynesian, embraces many features not found among other Polynesians. Some of these might perhaps be attributed to development in isolation, influence of environment, decay of customs, incomplete observation, modern contact or some other influence, much of which however might require involved explanation. It is suggested that some of these cultural features may have been introduced by ocean drift, through the agency of the North Pacific current. It is known that much inanimate drift material from both Asia and North America is stranded on Hawaiian beaches, and it is probable that human drifts arrived in the same way. In fact, several instances are known. Thus from Asia may have come the lua wrestling, the bent massage stick, Hawaiian checkers, the process of pulping fiber for tapa, and forms of wooden bowls, suggesting pottery prototypes. From the American side might be recognized small ivory figures, the sled on runners, and certain forms of food pounders. Most important, however, are gambling and processes of crystallizing salt, present on both continents. In addition there are many indeterminate items, such as the *piikoi,* a missile for entangling, the strangling cord, canoe of rushes, tapa-making implements, ornamental knotting on bags, tanning of fish nets, feather helmet types, basketry types and technic, various dancing appliances, use of wooden spittoons, and a number of stone artifacts. The extensive use of stone is perhaps the most extraordinary. [Illustrated by maps.]

ODONTOCLASIA: A FORM OF RAMPANT TOOTH DECAY

By

MARTHA JONES, G. P. PRITCHARD AND N. P. LARSEN

Detailed dental examinations were made on 2050 children of all races ranging in age from 6 months to 6½ years. A type of dental lesion, called odontoclasia, was observed in a very large percentage of the children. It is related to and may be associated with caries, ordinary decay, but differs in that it occurs in very young babies, even breast-fed infants only three or four months of age; it attacks all teeth, the upper anteriors being most susceptible; it progresses in broad lines through enamel and dentin; it has been experimentally produced in the dog and occurs spontaneously in island-born puppies.

One-third of the babies under one year of age had odontoclasia, and the peak of incidence of this disease was reached in the three-year old children and maintained its high level through the kindergarten age, 76.9 per cent of the kindergarten children, of all races except Caucasian, being affected. Among the city kindergarten children 81.9 per cent of the Orientals showed odontoclasia, while 0.7 per cent were decay-free; the percentages for the Hawaiians were 55.0 and 1.8, and for the Caucasians 8.2 and 46.8. In the country districts the dental condition of the Japanese was far worse, while that of the Polynesians (Hawaiians and Samoans) was distinctly better. The incidence of odontoclasia is high in Hawaiian-born Filipino children. The findings indicate that both Polynesians and Filipinos in Hawaii are undergoing a progressive dental deterioration, which may in time reach the distressing condition now suffered by the Japanese. The evidence at hand indicates that the initial lesion has its beginning in abnormal tooth structure resulting from faulty maternal diet during pregnancy. [Illustrated by lantern slides.]

DENTAL MORPHOLOGY AND PATHOLOGY OF PREHISTORIC GUAM

By

R. W. Leigh

Somatological features of note are: streaming of enamel toward bifurcation, particularly of the inferior second and third molars, terminating in an acute point; corrugation of the enamel on the facial aspect of the superior premolars and molars; marginal ridges on the superior incisors in moderate degree in 20 per cent of skulls; a cusp formula which tends to be $\frac{4\text{-}4\text{-}4}{5\text{-}4\text{-}4}$. The inferior first molar is constant; the inferior second molar is quadricuspid in 80 per cent of the cases; the superior third molar is very variable. Such a cusp formula is not indicative of a primitive race. The superior third molar in many cases is vestigial. Some males have large angular jaws and large teeth with accessory roots.

The palate is short, broad and roundish; 95 per cent are brachyusanic. The average dental index is 42.6, the group tends to be mesodont. The average gnathic index is 98.9, thus the group is mesognathous. In many crania, particularly females, there is a subnasal prognathism; the incisors are somewhat procumbent, with an end-to-end occlusion and fullness of the oral region. There are marked sexual differences, otherwise homogeneity characterises the group, probably resultant from inbreeding. The somatology is unmistakably Mongoloid.

The natives of ancient Guam subsisted exclusively upon the flora and fauna of their insular habitat: fish, fowl, breadfruit, taro, yams, rice, bananas, coconuts. As throughout the tropical Pacific, they are cooked in pits in the earth with heated stones.

Betel nut was the narcotic to which they were strongly addicted; this is a cultural trait of wide Oriental distribution. The nut used is from the betel palm, *Areca catechu*; a part of the nut is wrapped with a few leaves of the betel pepper, *Piper betel,* and the whole sprinkled with a pinch of lime, procured by burning coral. The betel juice produces a soluble red pigment which colors the saliva, lips and mouth a rich red, and gradually but permanently discolors the enamel, particularly on the facial surfaces: the quid is habitually held in the buccal recess. Heavy lime accretions are deposited upon the teeth with resultant pathological processes.

This habit, together with their soft diet requiring but little mastication, were the primary factors in producing a high incidence of chronic degeneration of the investing tissues. All females and 65 per cent of males beyond forty years of age had teeth involved by periodontal disease. Third molars were most frequently affected. No person under thirty years had lost any teeth at decease; periodontoclasia was the major cause of loss in later life.

Dental caries, mostly of the senile type, occurs in 18 per cent of the skulls examined; sixteen per cent evidence periapical lesions, secondary to caries, attrition and fracture. Impacted lower third molars caused extensive disturbance. Serious lesions of the palate and nose of some individuals were evidently resultant from yaws.

Ethnic deformation was practised to a limited extent by filing a lattice design on the facial surfaces of the superior six anterior teeth; and staining the teeth an orange to black color was customary. [Illustrated by specimens.]

THE GEOLOGY OF MOLOKINI

By

HAROLD S. PALMER

Molokini is a small islet lying between Haleakala and Kahoolawe. It has a crescent-shaped outline, as it is in the remnant of a tuff crater rim. It was built by two sets of eruptions, which were separated by a rather long interval of erosion. Drifting of the volcano ejecta by the trade winds caused unequal accumulation with the result that the crater is rather unsymmetrical. The south side has been the most strongly eroded despite the fact that the prevailing winds are from the northeast, for the south side is more exposed to the action of the waves.

[Illustrated by lantern slides.]

GRADED SWELLING AND SHRINKING OF VOLCANOES

By

T. A. JAGGAR

Changes of tilt and of elevation at Kilauea have been noted. The outbreak of lava in Halemaumau February 20, 1929, produced the record on a crater seismograph, including small earthquakes with centrifugal tilt before the outburst; cessation of tilt and continuous tremor during the lava fountaining; reversed or centripetal tilt and excessive tremor as the end of action approached; and cessation of both when the lava stopped flowing.

Tumefaction, due to subterranean vesiculation and rise of temperature, is here in evidence. In 1918 and 1919 this reached proportions such that the entire edge of Halemaumau pit swelled up 15 feet and more, as the bench magma, or semisolid lava paste, rose with the liquid lava to the rim level.

Levelling measurements of Kilauea summit in 1912, 1922 and 1926 showed that the summit away from the active pit rose two feet between 1912 and 1922. This was the rising lava episode. The summit subsided from 2 to 9 feet from 1922 to 1926, the sinking lava episode. With the engulfment and steam-jet eruption of 1924, there went subsidence of nine to thirteen feet of a shore-line fault rift block at the southeast point of Hawaii island. This was succeeded by engulfment into voids in the mountain of 7,000,000,000 cubic feet of old rim rock at the pit. Here was evidence, during a distinct cycle involving both Kilauea and Mauna Loa, of swelling mountain during rising lava, and of shrinking and collapsing mountain during sinking lava.

The bench magma itself swells and shrinks during the minor phases of eruptivity for periods of months. The rim rock swells and shrinks during the crisis of pit filling. The mountain swells and shrinks during the cycle 1913-1924. There appears to have been a major cycle of 134 years from 1790 to 1924 with a maximum of flowing lava in the middle, 1855, when both Kilauea and Mauna Loa reached a grand maximum. There were twelve cycles within the 134 years, making the length of average cycle 11.1 years. This happens to be the sun-spot cycle, and the lava minima of the Kilauea system corresponded somewhat to the sunspot minima, as shown in the following table:

FLOW DURATION DAYS	FLOODING LAVA	LOW LEVEL	SUN-SPOT MINIMA
71	1914-1923	1924	1924
28	1903-1907	1913	1913
37	1892-1899	1902	1901
247	1881-1887	1891	1889
207	1872-1877	1880	1878
307	1859-1868	1869	1867
411	1852-1855	1858	1856
111	1840-1843	1847	1843
21	1832	1836	1833
7	1823	1825	
......	....	1814	
7	1801	1803	
....	1789?	1792	

[Illustrated by charts.]

RECENT IMMIGRANT INSECTS IN HAWAII THAT ARE NOT PESTS

By

O. H. SWEZEY

Contrary to the general belief, immigrant insects, those arriving without intentional intervention of man, are not all pests, although it is certain that many of them, such as the sugar cane leaf-hopper, the cane borer, the Mediterranean fruit-fly, the melon fly, the horn fly, the rose beetle, the *Anomala* beetle, the rice borer and many scale bugs, mealy-bugs and plant lice, are decided pests. Quite a number of immigrant insects are of no economic importance, while some are beneficial and of considerable economic value. Among the beneficial may be mentioned *Cremastus hymeniae,* a parasite on many kinds of leaf-roller caterpillars; *Casinaria infesta,* another leaf-roller parasite; *Hyposoter exiguae,* a parasite on armyworms; *Telenomus nawai,* which parasitizes the nut-grass army worms; *Litomastix floridana,* which attacks the cabbage looper caterpillar. A very recent addition to the immigrant fauna is *Erebus odora,* the "black witch moth." It is a large, attractive species, and while not economically beneficial, it is not rated as a pest anywhere. [Illustrated by slides.]

SOME STUDIES ON THE LOCATION OF PLANT PARASITIC NEMATODES IN PLANT TISSUES

By

G. H. GODFREY

An improved technique of killing and staining plant parasitic nematodes in situ, developed by me, has greatly aided the study of these animals and their effect on their host plants. Sections of root tissue treated by this method show nematodes in all stages from the egg to the adult in their natural position in the tissues. Demonstration material made by the method described would be of great value in teaching certain phases of agriculture, particularly home gardening, as it would clearly show the insidious increase of the parasitic nematodes from small initial infections, and by analogy, the nature of plant diseases in general. [Illustrated by slides.]

SOME IMMUNOLOGICAL OBSERVATIONS FROM QUEEN'S HOSPITAL LABORATORY

By

FRANCES PAXTON

The paper gives a brief review of the development of the blood tests for syphilis and the methods in use in the Queen's Hospital laboratory. Some comparisons are made of the results of the Wassermann and Kahn tests. A survey of the different nationalities shows the relative percentage of positive bloods. [Illustrated by charts.]

METHODS OF DETERMINING ULTRA-VIOLET IN SUNLIGHT

By

LOIS K. GODFREY

Ultra-violet irradiation is a physiological necessity, and although curative in certain pathological conditions, is not a panacea, much present-day advertising to the contrary notwithstanding. The short ultra-violet wave-lengths of the sunlight are absorbed by ordinary window glass, and also to a lesser extent by the special glasses advertised.

Several photochemical methods of measurement have been tried out, and the results of over two years' observations, using the method which seemed best, were presented, showing some of the factors which affect the amount of ultra-violet in the sun's radiation. Heavy clouds over the face of the sun materially lower the amount, but high white clouds, in a position to reflect the sunlight, increase the amount over that observed when the sky is perfectly clear. A hazy atmosphere cuts down the amount of ultra-violet, but other weather conditions, such as humidity, wind velocity, and temperature have little or no effect. Depth of the atmospheric layer to be penetrated by the ray had a great effect, as the short wave-lengths are more strongly refracted than the longer ones. Thus there is less ultra-violet in the sunlight at the beginning and the end of the day. Similarly it operates during the winter months, the effect increasing with distance from the Equator. [Illustrated by diagrams.]

EFFECT OF ULTRA-VIOLET RAYS ON REGENERATION OF APPENDAGES OF ATYA BISULCATA

By

CHARLES H. EDMONDSON

Radiation by ultra-violet rays greatly retards the regeneration of mutilated chelipeds in a common fresh-water prawn, *Atya bisulcata,* especially when the ventral surface of the animal is illuminated.

Exposures of 1 to 5 minutes daily of the dorsal and ventral surfaces of the animals were made at 20, 32, 44 and 52 cm. from the arc. Duration of experiments was usually 8 to 10 days.

With dorsal treatments at 52 cm. from the arc, little or no variation from the normal rate of regeneration was seen. Ventral treatments resulted in marked retardation of regeneration at all distances from the arc and at all lengths of exposure. Single treatments during periods of 8 days showed no effect. Treatments on alternate days showed little or no effect. By altered dosage a differential retardation was noted.

It is suggested that by a ventral illumination the rays fall directly upon the stumps of the mutilated appendages which are regions of high activity as the multiplication of cells occurs here at a rapid rate under normal conditions. The metabolism of surface cells is probably interfered with and their activity retarded or inhibited. With a dorsal exposure and low dosage the rays probably do not penetrate the chitinous exoskeleton and have no appreciable effect on the metabolism of the animal. At close range (32 or 20 cm.) the intensity seems to be sufficient to affect the metabolism of the animal whether the rays fall upon the dorsal or ventral surface. [Illustrated by charts.]

CONSTITUTION

Article I. Name

The name of this society shall be The Hawaiian Academy of Science.

Article II. Objects

The objects of this Academy shall be the promotion of research and the diffusion of knowledge.

Article III. Membership

1. The members of the Academy shall be known as Members and Corresponding Members.

2. Any resident of the Territory of Hawaii, interested in science, shall be eligible for election as a Member.

3. Any person not a resident of the Territory of Hawaii, who is interested in scientific problems relating to Hawaii, shall be eligible for election as a Corresponding Member.

Article IV. Nomination and Election of Members

1. Nomination to membership in either class shall be made in writing to the Council at least two weeks before the Annual Meeting. Each nomination must be signed by three Members of the Academy.

2. The Council shall examine into the fitness of nominees and, at a business session of the Academy, shall recommend for election such nominees as it approves.

3. The Members of the Academy shall vote on the nominees by ballot. Each member shall prepare his own ballot, and the names of all nominees may be written on one slip of paper.

4. At any time prior to two months before the Annual Meeting, the Council shall have the power to enroll as Members applicants about whose eligibility no Councilor has doubt. The names of such persons shall be submitted by the Council at the Annual Meeting for confirmation by the Academy.

5. Election to Membership in either class shall require a favorable vote from three-fourths (¾) of the Members present.

Article V. Officers and Committees.

1. The officers of the Academy shall be a President, who shall not be eligible for re-election until one year from the end of his last incumbency, a Vice-President, and a Secretary-Treasurer. There shall also be a Council.

2. The Council shall be composed of the officers, the retiring President, and two additional Councilors to be elected by the Members of the Academy.

3. The officers shall be elected annually. The additional Councilors shall be elected, one each year, to serve for a period of two years.

4. An Auditing Committee of two shall be appointed annually by the Council. The Auditing Committee shall examine the financial accounts of the Academy and report their condition at the final business meeting of the Academy.

Article VI. Election of Officers

1. At the final session of the Annual Meeting, the Council shall present a list of nominations for officers and councilors of the Academy. Not more than two names shall be listed for any office.

2. Any Member of the Academy may nominate for any office any Member other than those named in the foregoing list, and such a nomination, if seconded, shall be added to the Council's list.

3. When the list of nominations is complete, each Member shall write on a slip of paper, as his ballot, one name for each position to be filled.

4. The person receiving the highest number of votes for a particular office shall be declared elected.

Article VII. Duties of Officers

1. The President shall preside at the meetings of the Academy, perform other duties provided for him in these rules, and carry out such functions as usually pertain to the chief officer of such a society. He shall deliver an address at the Annual Meeting.

2. The Vice-President shall perform the functions of the President in the absence of the latter.

3. The Secretary-Treasurer shall be the custodian of the records and papers of the Academy, shall keep a record of the proceedings of the Academy, and make a written report of the year's activity of the Academy at the Annual Meeting.

The Secretary-Treasurer shall collect the dues of the Members, administer all funds, keep a detailed account of the receipts and expenditures of the Academy, and render a written report at the Annual Meeting.

4. The Council, besides performing the duties assigned in Articles IV, V, VI, VII and IX of this Constitution, shall initiate business for the Annual Meeting, and, in the intervals between the meetings of the Academy, shall strive in every way to promote the interests and efficiency of the Academy as opportunity may be found so to do.

Article VIII. Meetings

1. The Academy shall hold a stated meeting in April or May of each year, to be known as the Annual Meeting. The Annual Meeting shall be announced by a preliminary circular, at least three months before the meet-

ing, calling for papers for the program. Final announcement, giving date and place of meeting, shall be sent out a suitable time prior to each meeting. The program, place and date shall be determined by the Council.

2. All Members desiring to present papers at the Annual Meeting must forward to the Council, at a time which it will set, full titles of all papers which they propose to present, with a statement of the time which each will occupy in delivery. The Council reserves the right to call for an abstract of any paper offered, and to pass upon its fitness for the program.

3. Special meetings of the Academy may be called by the Council. A meeting must be called by the Council upon the written request of ten Members.

4. Stated meetings of the Council shall be held coincidently with stated meetings of the Academy. Special meetings of the Council may be called by the President at such times as he may deem necessary.

5. At stated meetings of the Academy the Members present shall constitute a quorum.

6. Four members of the Council shall constitute a quorum. The Council may appoint a substitute for any of its members absent from the Island of Oahu, for any member resigned, or for any member indefinitely incapacitated.

Article IX. Publications

The Academy shall encourage the publication of papers, presented at its meetings, in appropriate scientific journals. The Council shall give authors such aid as it may in securing publication.

Article X. Dues

1. The dues of Members shall be one dollar ($1.00) per annum, payable within one month following the Annual Meeting. Corresponding Members shall pay no dues.

2. Any Member of the Academy in arrears for eighteen months in the payment of Annual dues shall thereby forfeit his membership in the Academy, provided the Secretary-Treasurer shall have sent the delinquent Member two written notices of the existence of this rule.

Article XI. Order of Business

The order of business at the final session of the Annual Meeting shall be as follows:

a. Call to order by the presiding officer.
b. Reading of minutes of preceding meeting.
c. Announcements.
d. Recommendations from the Council.

e. Report of the Secretary-Treasurer.
f. Appointment of Auditing Committee.
g. Election of Members and Corresponding Members.
h. Reports of Committees.
i. New Business.
j. Election of President, Vice-President, Secretary-Treasurer, and additional Councilor.

Article XII. Amendments

This Constitution may be amended at any Annual Meeting by a three-fourths (¾) vote of the Members present, provided that notice of the proposed amendment has been given to the Members a month previously.

MEMBERS

Abel, F. A. E.
Adams, Romanzo
Agee, H. P.
Aitken, R. T.
Alexander, W. P.
Andrews, Carl B.
Arnold, H. L.
Baker, Ray J.
Barnhart, G. H. W.
Barnum, C. C.
Bean, Ross S.
Bomonti, H. F.
Bond, B. D.
Bond, K. D.
Bowers, F. A.
Brodie, Alex.
Brodie, H. W.
Brown, Elizabeth D. W.
Brown, F. B. H.
Bryan, E. H., Jr.
Bryan, L. W.
Bryan, Royden
Burkland, A. O.
Bush, William
Campbell, E. L.
Carpenter, C. W.
Carson, Max H.
Cartwright, Bruce
Cassidy, Gertrude H.
Cassidy, Morton H.
Castle, Ethelwyn A.
Caum, Edw. L.
Chung, H. L.
Cook, H. A.
Cooke, C. M., Jr.
Cooke, D. A.
Cooke, R. A.
Cooper, Lucy V.
Cooper, W. J.
Cornelison, A. H.
Crawford, D. L.
Davis, A. L.
Davis, L. F.
Dean, Arthur L.
Degener, Otto
Denison, F. C.
Denison, H. L.
Deverill, W. E. H.
Dewar, Margaret M.
Dickey, Lyle A.
Dillingham, F. T.
Donaghho, J. S.
Donahue, Blanche
Doty, Ralph E.
Edmondson, C. H.
Eguchi, G. M.
Ehrhorn, E. M.
Eller, W. H.
Elliott, Raymond
Emory, Kenneth P.
Erwin, Ada B.
Fennel, E. A.
Fisher, G. W.
Ford, Alex. H.
Fronk, C. E.
Fujimoto, Giichi
Gantt, Mrs. P. H.
Giffard, W. M.
Godfrey, G. H.
Godfrey, Lois K.
Gregory, H. E.
Hadden, F. C.
Hance, F. E.
Handy, E. S. C.
Handy, Willowdean C.
Hansson, Frederick
Harl, V. A.
Hartung, W. J.

Henke, L. A.
Holmes, Henry
Horner, J. M.
Illingworth, J. F.
Jaggar, T. A., Jr.
Johnson, Horace
Jones, Martha
Judd, Albert F.
Judd, Charles S.
Kangeter, J. H.
Katsuki, I.
Keller, A. R.
Kerns, Kenneth R.
Kirkpatrick, Paul
Koehler, Lucy J.
Krauss, Beatrice H.
Krauss, F. G.
Kutsunai, Y.
Larrabee, Louise M.
Larrison, G. K.
Larsen, L. D.
Larsen, Nils P.
Leigh, R. W.
Lennox, Colin G.
Livesay, T. M.
Louttit, C. M.
Lyon, Harold L.
Lyon, Maude F.
MacNeil, W. J.
Manglesdorf, A. J.
Martin, J. P.
Masunaga, Eichi
McAllep, W. R.
McCleery, W. L.
McEldowney, G. A.
McGeorge, W. T.
McKay, William
McLennan, R. H.
Miller, Carey D.
Miyake, Iwao
Moe, Kilmer O.
Moir, W. W. G.
Morita, Helene T.
Munro, G. C.
Nacamura, W. T.
Neal, Marie C.
Neilson, N. M.
Northwood, J. d'A.
Odgers, George
Oliveira, Juliette M.
Ostergaard, Jens M.
Palma, Joseph
Palmer, H. S.
Paxton, Frances
Paxton, G. E.
Pemberton, C. E.
Pinkerton, F. J.
Pope, Willis T.
Popert, W. H.
Porteus, S. D.
Pritchard, G. P.
Radir, Paul L.
Renton, G. F.
Ripperton, J. C.
Rosa, Joseph S.
Roberts, E. D.
Russ, Glen W.
Sideris, C. P.
Smith, Madorah E.
Smith, R. N.
Smith, W. Twigg
Spalding, P. E.
Stender, H. K.
Stewart, G. R.
Stokes, J. F. G.
Straub, G. F.
Swezey, O. H.
Taylor, H. J. W.
Thompson, Eleanor
Thompson, H. L.
Thompson, Laura M.
Thurston, L. A.
Topping, D. L.
Van Zwaluwenburg, R. H.

Verret, J. A.
Voorhees, J. F.
Waldron, Gwendolyn C.
Warner, Bernice
Waterman, T. T.
Weeber, Lorle S.
Weinrich, William
Weller, D. M.
Wendt, W. A.
Westervelt, W. D.
Westgate, J. M.
Whitney, L. A.
Wilder, G. P.
Willard, H. F.
Williams, F. X.
Wist, Joseph E.
Withington, Paul
Yang, Y. Chan
Zschokke, T. C.

PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

FIFTH ANNUAL MEETING

MAY 1-3, 1930

BERNICE P. BISHOP MUSEUM

SPECIAL PUBLICATION 16

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1930

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

During the year 1929-30, seven special public meetings of the Academy were held, at which addresses were delivered as follows.

Commander James P. Ault: The work of the non-magnetic yacht "Carnegie." (October 1, 1929.)

Dr. C. M. Yonge: The great barrier reef of Australia. (October 22, 1929.)

Dr. Royal N. Chapman: The trend of animal populations. (November 26, 1929.)

Dr. Frederick Wood Jones: Man's place among the lower animals. (December 17, 1929—a joint meeting with the Anthropological Club of Hawaii.)

Dr. Alexander Goetz: Recent studies in the physical structure of metals. (December 23, 1929.)

Dr. Robert E. Park: The mentality of mixed bloods. (January 15, 1930.)

Professor Douglas W. Johnson: The interpretation of shore-line scenery. (January 28, 1930.)

The sessions of the Fifth Annual Meeting were held at the Biology Building, University of Hawaii, May 1 to 3, 1930, ending with a banquet at the University Club.

OFFICERS

1929-1930

President, Harold S. Palmer
Vice-President, Harold L. Lyon
Secretary-Treasurer, Edward L. Caum
Councilor (2 years), Robert T. Aitken
Councilor (1 year), Edwin H. Bryan, Jr.
Councilor (ex officio), Nils P. Larsen

1930-1931

President, Edward S. C. Handy
Vice-President, Harold L. Lyon
Secretary-Treasurer, Edward L. Caum
Councilor (2 years), Harry L. Arnold
Councilor (1 year), Robert T. Aitken
Councilor (ex officio), Harold S. Palmer

PROGRAM OF THE FIFTH ANNUAL MEETING

THURSDAY, MAY 1, 7:30 P. M.

Preliminary announcements.
Election of members.
Appointment of committees.
Presentation of papers:
Dr. E. D. W. Brown: Polynesian leis.
Dr. Harold L. Lyon: The flora of Moanalua 100,000 years ago.
Mr. J. F. Voorhees: The distribution of rainfall on Hawaii.
Dr. Harold S. Palmer: Rock weathering in Hawaii.
Dr. T. A. Jaggar, Jr.: The Hualalai earthquake crisis of 1929.

FRIDAY, MAY 2, 7:30 P. M.

Presentation of papers:
Dr. Martha R. Jones: The acid-base balance of the blood in relation to dental decay.
Mr. T. M. Livesay: Reaction time experiments with certain racial groups.
Mr. H. A. Wadsworth: Plant and soil-moisture relations in Hawaii.
Dr. C. H. Edmondson: Some new Hawaiian Medusae.
Mr. Ray J. Baker: Biological records by means of the motion picture camera.

SATURDAY, MAY 3, 2:30 P. M.

Presentation of papers:
Dr. Harold St. John: The revegetation of a recent volcano.
Dr. Erling Christophersen: A few remarks on Joinvillea.
Dr. F. B. H. Brown: Notes on Marquesan monocotyledons.
Dr. E. D. W. Brown: Notes on Marquesan pteridophytes.
Dr. C. Montague Cooke, Jr.: Notes on Marquesan landshells.
Dr. G. P. Wilder: Observations on the flora of Rarotonga.

SATURDAY, MAY 3, 6:30 P. M.

University Club banquet.
Constitutional order of business.
Presidential address: The geologic history of Oahu.
Installation of new officers.
Adjournment.

ABSTRACTS OF PAPERS

THE GEOLOGIC HISTORY OF OAHU
(Presidential Address)

By

HAROLD S. PALMER

The only claim to novelty in the present paper is the method of presentation of some long known information. The underlying data are in part from my own observations on Oahu but in large part from the writings of others. The present paper is an attempt to meet the numerous requests that have come to me for an authentic but nontechnical history of the making of the island of Oahu.

About seven years ago, W. M. Davis published some small stereograms showing in a diagrammatic way three of the many stages in the history of Oahu. The corrections necessary to his stereograms result largely from the fact that they telescope into one stage several stages which might well be differentiated.

The island of Oahu is a "volcanic doublet," by which is meant that it has as the essential parts of its structure two volcanic domes. These were built at different times and have had their originally smooth surfaces modified on a large scale by the foundering of great segments and on a smaller scale, but in a more widespread way, by erosion. The erosion has for the most part been by streams which have furrowed the slopes with valleys of various shapes and sizes. In addition waves have cliffed some of the shorelines. Around the margins of the island there has been some addition of a veneer of sedimentary rocks over the lava core. The sedimentary veneer consists in part of calcareous reef rock deposited by corals, Lithothamnium, and associated marine organisms, and in part of stream-carried sediments laid down in quiet lagoon waters behind the reef or in sheltered bays. The geologic history is further complicated by the changes that have occurred in the relative elevations of land and sea.

The following stages are illustrated by the series of stereograms reproduced as lantern slides:

1. The initial stage, when lava flows had built a dome on sea bottom which, though nearly three miles high, was not high enough to reach above the surface of the ocean.

2. The nascent Waianae island stage, when the embryonic Waianae lava dome had first appeared above the surface of the ocean.

3. The adult Waianae island stage, when extrusion of lava had virtually ceased, after having built a rather symmetrical lava dome some 25 miles in diameter at sea level, and reaching 5000 or 6000 feet above sea level.

4. The downfaulted stage of Waianae island, when the southwestern one-third of the island had foundered because of the excessive weight which it applied to sea bottom.

5. The eroded stage of Waianae island, when a number of valleys had been cut into the smooth half-dome. The valleys of the southwestern side were more conspicuous because the steeper gradients there made the streams swifter and therefore better able to entrench themselves.

6. The Olomana and Kaaumakua islands stage, when two or more small islands had appeared above the sea to the northeast of the eroded Waianae island. These were twin embryos of the Koolau Mountains.

7. The adult Oahu stage, when the constructive volcanic processes had built Oahu to its maximum area and volume, by adding to the older Waianae island a dome of pear-shaped ground plan, 30 by 40 miles across at sea level and 5000 or 6000 feet high. The broad end of the pear was at the southeast.

8. The downfaulted Koolau stage, when the northeast part of the broad end of the pear-shaped lava dome had foundered because of its excessive weight.

9. The high level eroded stage, at the end of which Oahu had been cut by streams to much its present condition. An important difference, however, was that sea level (as shown by logs of wells in Honolulu) was a thousand feet or so lower, relative to the island, than it is now. As a consequence the valley forms extend far below the present sea level and far beyond the present shore line, though filled with sediment.

10. The submerged, reef building stage, when sea level was about 40 feet higher on Oahu than it is now. Along the shores at this time were fairly continuous fringing and barrier reefs, on and behind which sediments were laid down by streams. During this time occurred the last series of volcanic eruptions which built such craters as Makakilo and Palailai at the south end of the Waianae Mountains, and the Koko Head group of craters near or in Honolulu, and Ulupau Head and Moku Manu on the windward side.

11. The present stage, in which erosion is the chief geologic agent at work, and in which a recession of sea level has exposed the reefs.

A little west of Waialua one can see from a single viewpoint eight different types of geologic surfaces made by various geologic processes or combinations of processes. They are as follows:

1. Residual fragments of the original smooth constructional slopes of the Waianae dome.

2. Canyons and canyon walls cut in the lava rock by stream erosion.

3. A bold cliff, several hundred feet high, which truncates the seaward edges of the lava flows and of the original slope, and which was cut by the undermining action of waves.

4. Alluvial cones composed of sediments swept out of the canyons and laid down in front of the high sea cliff.

5. Small arroyos cut into the alluvial fan by stream erosion.

6. A second, much lower sea cliff which truncates the seaward edges of the alluvial fans and which was cut by wave erosion.

7. A coastal plain, largely underlain by reef rock and mantled with sediments washed from inland.

8. A bordering sand ridge, in part a dune ridge and in part wave built.

POLYNESIAN LEIS

By

ELIZABETH D. W. BROWN

Polynesian leis were discussed from the standpoint of motive, concept, origin, and age, in relation to each other and to the continental concepts as expressed in literature and art and in present religious practices in India and China.

THE FLORA OF MOANALUA 100,000 YEARS AGO

By

HAROLD L. LYON

A drainage tunnel being driven through one wall of Salt Lake crater at mean sea level reveals the remains of a forest that was buried in ash at the time this crater was formed some 100,000 years ago.

The ground surface on which this ancient forest stood approximated mean sea level of the present day, for the tunnel, which is six feet high, included the old forest floor with its fallen logs, twigs and leaves, which are now clearly imprinted in the tuff resulting through the solidification of the ash.

The rock removed in making this tunnel also included basal portions of the trunks of many trees which were buried in their natural upright positions. Most of the wood in these trunks has disappeared, leaving casts which retain the exact shape of the trees which they represent, there being no evidence of any crushing or distortion. A few specimens of completely silicified twigs and palm-leaf petioles have been found in which the cell structure can be clearly discerned. Perfectly preserved fibrous tissue was also found hermetically sealed in solid rock. From the materials collected, it will be possible to identify with absolute certainty some fifteen or more species of plants closely related to, if not identical with, species of the present day. At this time I shall name only koa, ohia and loulu as known components of this ancient forest. It was such a plant society as now occurs at the very head of the valley, on the backbone ridge of the Koolau Mountains.

Mr. Fred E. Harvey, who is the engineer in charge of the tunnel, recognized the nature of the fossils and called my attention to them in February of the present year. [Illustrated with specimens and charts.]

THE DISTRIBUTION OF RAINFALL ON HAWAII

By

J. F. Voorhees

The subject is considered from two points of view, the variations of rainfall with respect to area and with respect to time, or more briefly, the areal and the annual distribution of rainfall.

The areal distribution is shown by the ordinary isohyetal map of average annual rainfall, while the annual distribution is usually represented by a graph or diagram showing the average rainfall for each month for a given station or district. The map [shown as a lantern slide] presents both features, the isohyetal lines showing the areal distribution for the island of Hawaii and the diagrams showing the annual distribution for several places.

The average rainfall over the ocean in this part of the world is probably less than ten inches per annum. Where more than ten inches per year is recorded at any point on these islands the excess is due to the cooling of the air as it moves up the mountain slopes. Consequently, the heaviest rainfall is found on the windward side of the island. The rather heavy precipitation in the Kona section may seem to be an exception but really follows the rule, for the rain there is due to sea breezes coming from the ocean.

In the diagrams showing the distribution throughout the year great variety is seen. In fact, no two points have exactly the same distribution, although stations in the same locality are usually much alike. The differences are due mainly to differences in topography in relation to the winds. Sometimes the explanation of any given distribution is quite obvious, while in other cases the causes are very obscure. For example, the summer maximum in the Kona district is due to the fact that Kona gets most of its rain from sea breezes which are weak or entirely absent in the cooler half of the year. On the other hand I have no good explanation to offer for the summer maximum in the Kohala mountains.

In making comparisons of this kind it is important to bear in mind the fact that the average distribution for a period of 10 or 20 years may be and usually is very different from the average for 50 years. It should also be remembered that average values of rainfall are always too high, especially so in regions like this which are subject to occasional very heavy downpours. [Illustrated with slides.]

ROCK WEATHERING IN HAWAII

By

HAROLD S. PALMER

In 1912, W. P. Kelley published four pairs of analyses showing the chemical composition of the fresh unweathered cores and of the partly weathered shells of four basalt boulders from the Wahiawa district of Oahu. Examination of these analyses shows that aluminum, rather than titanium, is the most stable ingredient. On the confessedly arbitrary assumption that alumina is perfectly insoluble, it appears that between three-eighths and five-eighths of the titania and sulphur trioxide are removed; between five-eighths and seven-eighths of the phosphorus pentoxide, silica, ferrous oxide and potash are removed; between seven-eighths and fifteen-sixteenths of the manganous oxide and soda are removed, and about ninety-nine percent of the lime and magnesia. There is an actual six-fold gain of water and a seeming gain of ferric oxide of seventy percent, which is really due to the conversion of ferrous oxide to ferric oxide.

An analysis of water from Kalihi stream reports silica, ferric oxide, lime, magnesia, soda and potash in about the relative proportions in which they are seen to be lost on comparing Kelley's analyses. This is a fair check on the validity of the computations given above.

With the methods of computation used by petrographers it is possible to calculate the mineral composition of a rock from an analysis of the rock. Such calculations, when applied to Kelley's analyses, indicate that, of the mineral molecules in the fresh rock, rhodonite, clinoenstatite, wollastonite, iron metasilicate, magnetite, anorthite and noselite are completely destroyed. Albite and orthoclase are largely destroyed. Ilmenite and apatite are about two-thirds destroyed. Quartz suffers little. New minerals that appear are bauxite and limonite, which are abundantly formed, and rutile, mirabilite, gypsum, epsomite, gibbsite and psilomelane, which are formed in small quantities. [Illustrated by graphs and lantern slides.]

THE HUALALAI EARTHQUAKE CRISIS OF 1929

By

T. A. JAGGAR, JR.

Seismograms had been normal in Hawaii until sudden shaking began and continued in North Kona near Hualalai volcano September 19, 1929. The records at Kilauea station indicated average distances of epicenters for four weeks ending October 16 respectively 23, 28, 35 and 44 miles. Big earthquakes of grade IX R. F. occurred at Puuwaawaa September 25 and October 5 after hundreds of smaller shocks. The felt earthquakes had spread from

North Kona to the whole island, and these great ones were felt in Honolulu. From Kona to Kohala there was severe damage to masonry, water tanks, road fills, steep hillsides, chimneys, stone fences, and improperly braced wooden buildings. Airplane inspection revealed no volcanic outbreak. The shaking gradually quieted in November.

The number of shocks recorded at four stations during the period October 1-October 4, 1929, were as follows:

	Oct. 1	Oct. 2	Oct. 3	Oct. 4
Kilauea	19	13	15	18
Hilo	38	26	13	74
Kealakekua	155	110	96	138
Puuwaawaa	241	117	97	114

Hilo has more shocks than Kilauea, yet is farther from Hualalai.

The shock recorder at Puuwaawaa (Scientific American, Nov. 1929) registered shocks as follows:

September	26	599
	27	541
	28	400
	29	334
	30	321
October	1	241

The computed instrumental total for the 26 days (September 21 to October 6) at Puuwaawaa is approximately 6211 shocks, mostly perceptible to a person at rest. This averages 239 per day or 10 per hour.

The cataclysmal earthquakes of September 25 and October 5 showed no preliminary tremor on seismographs at Hilo, at Kealakekua, or at Kilauea. All behaved as though epicentral at distances 40 to 60 miles apart. The ordinary earthquakes showed preliminaries accordant with short distances by the Omori formula. Presumably the big shocks were very deep. [Illustrated with lantern slides.]

THE ACID-BASE BALANCE OF THE BLOOD IN RELATION TO DENTAL DECAY AND ALVEOLAR ATROPHY

By

MARTHA R. JONES

(In collaboration with N. P. Larsen and G. P. Pritchard)

Metabolic, blood, roentgenographic, and histologic studies on dogs showed that alkalosis induced by diets which were potentially alkaline in reaction was invariably associated with resorption of alveolar bone, cementum and dentin. Profound degenerative changes occurred also in the long bones of puppies. In no case was there decay of enamel. On the other hand, rampant disintegration of the crowns of the teeth, called odontoclasia, occurred in 70 per cent of the puppies who were in a highly active state of calcification (recovery from rickets) during the period of eruption of their permanent teeth. The activity of the decay process was usually of short duration (three or four weeks), and appeared to bear a relation to the rate of calcification of the skeleton bones.

Rickets in children in Hawaii is rare. Evidence indicates, however, that bone and tooth development during the first months of life is subnormal in many cases. Later, rapid calcification of the skeletal bones is stimulated by outdoor life and abundance of sunshine. Concomitant with the spurt in bone growth, rampant disintegration of the newly erupted teeth frequently occurs. The decay process, after a period of more or less intense activity, may then be arrested, and crowns of teeth which are mere stumps of dentin remain intact indefinitely.

Evidence indicates that decay of enamel and resorption of alveolar bone and the root of the tooth are the result, primarily, of systemic disorders, and that they do not occur concomitantly. Dental decay and rapid bone growth apparently occur when the imbalance in the tissue lymph and oral secretions is toward the acid side, lactic acid formed on the surface of the tooth by bacteria thus being left free to combine with the calcium in the tooth substance. When basic elements are present in certain amounts or in excess in the body fluids, the lactic acid thus formed in the mouth can be neutralized and dental decay is not only prevented, but partially disintegrated enamel and dentin actually become more dense. Beyond certain limits, bone atrophy begins. Breast milk, cod liver oil and sunshine, which increase the acidity of the intestinal contents of rickety infants and promote bone growth, do not prevent odontoclasia under the conditions mentioned. Diets which yield an alkaline ash (fruits and vegetables in excess) were found to be invariably associated with sound tooth structure or arrested decay.

Experimental and clinical findings agree in great detail. They support Bodecker's theory of the mechanism of dental caries and offer a logical explanation of many phenomena which have long been recognized but not understood. [Illustrated with lantern slides.]

REACTION TIME EXPERIMENTS WITH CERTAIN RACIAL GROUPS

By

T. M. LIVESAY

(In collaboration with C. M. Louttit)

The aim of this project was two-fold: (1) to ascertain the differences in reaction time performances between racial groups; and (2) to determine the relation between reaction time performance and intelligence.

The reaction time measurements were made on a standard "Marietta reaction time set," and in order to insure uniformity of procedure, all measurements were made by the same person. Readings were taken for visual, auditory and visual-choice reaction times.

The measure of intelligence was the Thorndike "Intelligence examination for high school graduates." Scores on this test were available for 253 students who had entered the University of Hawaii one, two and three years previously.

The students who took part in the experiments numbered 286; 59 Caucasian (14 men and 45 women); 71 Chinese (29 men and 42 women); 110 Japanese (69 men and 41 women); and 46 Part-Hawaiian (15 men and 31 women).

The results were as follows: (1) the reaction time differences between the average performances of the several racial groups were consistently low and insignificant; (2) the sex differences in reaction time, while low, were somewhat greater than those for race, and in all comparisons the males excelled the females; (3) the correlation coefficients between the reaction times and intelligence, while positive in all cases, were too low to be of any significance. [Illustrated with charts and apparatus.]

PLANT AND SOIL-MOISTURE RELATIONS IN HAWAII

By

H. A. Wadsworth

Modern investigations of the relations between soils and soil-moisture have modified the conceptions of only a few years ago. The soil mulch is no longer credited with the power of conserving soil-moisture if weeds are removed, and the significance of capillary movement of moisture from relatively wet areas to dry areas has been greatly minimized.

For several years much attention has been directed toward the determination of two of the critical soil-moisture constants for important agricultural soils. These are the maximum water holding capacity and the wilting coefficient, the latter being the minimum percentage of water in a soil which will provide moisture to the roots of growing plants at a rate great enough to maintain normal turgor in these plants. It is interesting to note that the wilting coefficient depends entirely upon the soil and not upon the plant, all plants wilting, or giving some sign of physiological disturbance, at the same moisture content provided the soil used is the same for all.

Hawaiian soils are peculiar in both these critical moisture contents. After irrigation they hold high percentages of water; when wilt occurs they still hold more moisture than most mainland agricultural soils do immediately after a heavy rain. The reason for these peculiarities is not known and deserves study.

Sugar cane and pineapples exhibit wilt, not by apparent loss of turgidity, but by evidence of physiological abnormalities which are probably caused by lack of readily available moisture. In the sugar cane, length growth ceases when soil-moisture is reduced to the wilting coefficient, while in the pineapple, the transpiration rate is abruptly reduced. In each case this disturbance occurs at a soil-moisture content which is significantly close to the wilting coefficient as determined for the soil in question by other plants. [Illustrated with charts.]

NEW HAWAIIAN MEDUSAE

By

CHARLES H. EDMONDSON

Creeping medusae are recorded from the North Pacific Ocean for the first time. The four species of *Eleutheria* found on the reefs of Oahu all seem to be new. Lengerich (1923) recognizes three species of this genus adapted for creeping, two from the coasts of Europe and one ranging through the southern hemisphere from the Antarctic as far north as Port Jackson, Australia. The Hawaiian species differ from these in several critical characters, and are referred to as *Eluetheria oahuensis,* new species; *E. alternata,* new species; *E. acuminata,* new species; and *E. bilateralis,* new species. These four species are all minute, the diameter of the umbrella ranging from 0.5 to 0.8 mm.

A new sessile medusa of the genus *Kishinouyea* is recorded, referred to as *K. hawaiiensis,* new species. This is the first record of this genus from subtropical waters, previously known species having been reported from cold latitudes only. [Illustrated by lantern slides.]

This paper is to be published in full by Bernice P. Bishop Museum.

BIOLOGICAL RECORDS BY MEANS OF THE MOTION PICTURE CAMERA

By

RAY J. BAKER

There is nothing new about the idea of using the motion picture camera for the keeping of biological records. Both American and European workers have made use of this instrument for many years. The increased use of films for educational purposes has, however, given much greater interest to this form of record. A characteristic of living things is that they move, and a record of movement is of the greatest value to the biologist. By means of the interval camera it is possible not only to show movement not usually perceptible to the eye, but also to condense the time so that action requiring hours or even days to complete may be shown on the screen in a few minutes. [To illustrate the use of the motion picture camera, lantern slides of both still and motion picture equipment were shown. The film scenes illustrated cup of gold, hibiscus, spider lily, praying mantis, termites, carpenter bee, mosquito larvae, and surf fish.]

THE REVEGETATION OF A RECENT VOLCANO

By

HAROLD ST. JOHN

Mt. St. Helens is a volcanic peak 9671 feet high, in the southern Cascade Mountains of Washington. At the present time its crater is filled with snow, yet a steam vent indicates warmth not far below.

Violent eruptions were recorded several times between 1830 and 1845. Extensive aa flows on the south side are partially forested. Pahoehoe flows on the north side are practically bare. Tree casts in these basalts indicate a pre-existing large forest, 90 years ago.

All the other slopes and the cone are covered with 40 feet of loose pumice. They show abundant tree casts, one every few feet near Spirit Lake. There, on the surface, another forest has become established. One tree, a Noble Fir, died of old age in 1924. It had 335 annual rings. Hence, the pumice layer is much older than the basalt. Yet the vegetation of this mountain is different from that of surrounding mountains. The Noble Fir is abundant. The dominant tree at and near the tree-line is *Pinus contorta* var. *latifolia,* not found elsewhere above the Canadian Zone.

The rainfall and snowfall are ample, but the pumice layer is so loose and porous that all streams are subterranean, except where they are forced to the surface by a rock ledge.

Adjacent mountains have abundant meadows, non-xerophytic vegetation, and a tree line at 5500 to 7000 feet. Due to perfect subdrainage through the pumice, Mt. St. Helens lacks meadows, has a pronounced xerophytic flora, and the tree-line is at 3500 feet. Revegetation is very slow. [Illustrated by lantern slides.]

A FEW REMARKS ON JOINVILLEA

By

ERLING CHRISTOPHERSEN

Joinvillea elegans and *J. adscendens* (Flagellariaceae) are pictured by Gaudichaud in the botanical atlas of the voyage of the "Bonite," plates 39 and 40, without descriptive text or notation as to locality. *J. elegans,* represented in great detail from a fruiting specimen, has not been collected since in the Hawaiian islands, if it was ever collected here, and *J. adscendens,* represented by a sterile twig with young leaves only, can not be identified with certainty, although it is generally attributed to these islands. Gaudichaud's original specimens have been lost, as were the records of locality. In view of these facts, certain changes in the nomenclature are proposed, to be published at a later date. [Illustrated with lantern slides.]

NOTES ON THE MARQUESAN MONOCOTYLEDONS

By

F. B. H. BROWN

The indigenous monocotyledons of the Marquesas Islands are allied primarily with those of the Society Islands, and secondarily with those of Hawaii.

The degree of endemism indicates that the age of the Marquesas Islands is approximately the same as that of Tahiti, but considerably younger than Hawaii.

It is clearly shown that litoral vegetation is not cosmopolitan in distribution; on the contrary, its percentage of endemism is nearly as high as that of the upland vegetation.

The non-indigenous species and varieties outnumber the indigenous ones; they are composed mostly of species of aboriginal introduction and varieties derived by native cultivation, showing how profoundly the vegetation of these islands has been modified by the early inhabitants.

NOTES ON MARQUESAN PTERIDOPHYTES

By

ELIZABETH D. W. BROWN

In the study of the fern flora of the Marquesas and its affinities with neighboring island groups, the following facts have proven of extreme interest and have an important bearing upon plant distribution in eastern Polynesia:

1. There is a surprisingly high percentage of endemism considering that the spores are seemingly well adapted to wind distribution.

2. The affinities are primarily with the Society Islands and secondarily with Hawaii. The percentages compare so closely with those of the monocotyledons as to suggest that they have followed nearly the same routes of migration as the monocotyledons and may therefore have been carried by the same agencies of dispersal.

The evidence does not favor the conclusion that wind has been a prominent agency in the wide dispersal of pteridophytes in this region.

NOTES ON MARQUESAN LANDSHELLS

By

C. Montague Cooke, Jr.

Little attention has been paid to the landshell fauna of the Marquesas Islands up to the present. Probably much less than half of the species that inhabit these islands have been collected. With the rapid destruction of the native vegetation the land faunas are disappearing and intensive collecting should be begun immediately if anything is to be learned of this interesting fauna.

At present species of 21 genera belonging to 11 families are known: of these genera only 8 are represented by endemic species; 3 have doubtfully endemic species; and the representatives of the 10 remaining genera were undoubtedly accidentally introduced by man, chiefly by early Polynesians. About 75 per cent of these species are endemic and limited in their distribution to the Marquesas Islands, and about 90 per cent of these are known only from single islands.

Seven of the eight genera with endemic species show a fairly high degree of specialization which can only be accounted for by a rather long period of isolation. The more or less even development of specific differentiation in most of these genera seems to indicate that they came to the Marquesas during a single period of time; and since a number of more specialized genera occurring on the nearest groups of islands are absent from here, it is likely that further migrations have not taken place until man came to these islands.

SOME OBSERVATIONS ON THE FLORA OF RAROTONGA

By

GERRIT P. WILDER

Rarotonga, the principal island of the Cook group, lies in the same latitude and longitude south of the Equator that Hawaii lies north of it, and their climatic conditions are practically the same. For these reasons, a comparative study of their floras is interesting.

Rarotonga is of volcanic origin. It is irregularly elliptical in shape, roughly 7 miles long by 5 miles wide, and is surrounded by a coral reef. From the comparatively narrow stretch of flat land encircling the island at sea level, hills begin to rise, gradually becoming more and more precipitous until the peaks of the mountain ranges are reached. The tallest of these, Te Manga, is about 2220 feet high. Deep valleys and steep ravines lead streams to the sea, and an annual rainfall of about 90 inches keeps the valleys and hillsides green and heavily wooded. Thus Rarotonga, in its physical aspects, resembles Hawaii, and its zones and elevations yield much the same species of plants as are found in Hawaii.

During my three visits to Rarotonga, I have selected from among the wealth of rare plants growing there certain ones which will be valuable additions to the flora of the Hawaiian islands. These have been successfully introduced into the Territory, and are now thriving. Among them may be mentioned: *Angiopteris evecta,* a tree fern with fronds 15 to 25 feet in length, the fragrant young leaflets of which are often woven into garlands and wreaths for personal adornment; *Alphitonia ziziyphoides,* a stately forest tree with a straight trunk and spreading branches, dark colored and very hard wood, formerly used for spears and agricultural tools—a tree that bears quantities of seed and should be a useful tree in Hawaiian forests; *Elaeocarpus rarotongensis,* another hardwood forest tree, the bright blue fruits of which, each containing a single seed, hang in great bunches from the terminal branches; *Fitchia speciosa,* a symmetrical medium-sized tree with glossy leaves, and with large yellow flowers that contain an abundance of nectar; and *Inga preussii,* a large tree bearing a bean one to two feet in length, the seeds of which, an inch in diameter, are surrounded by an edible pulp. [Illustrated by lantern slides.]

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PROCEEDINGS
HAWAIIAN ACADEMY OF SCIENCE

SIXTH ANNUAL MEETING

APRIL 30—MAY 2, 1931

BERNICE P. BISHOP MUSEUM

SPECIAL PUBLICATION 19

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1931

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

During the year 1930-1931, three special public meetings of the Academy were held, at which addresses were delivered as follows:

Dr. Charles A. Kofoid: Easter Island. (September 16, 1930.)

Dr. Peter H. Buck: Practical uses of anthropology. (January 15, 1931.) A joint meeting with the Anthropological Club of Hawaii.

Dr. Julius L. Collins: Effect of radium on living, growing cells. (April 20, 1931.) A lecture in connection with a showing of the famous Canti film, obtained through the cooperation of the University of Hawaii Extension Division.

The sessions of the Sixth Annual Meeting were held at the Biology Building, University of Hawaii, April 30 to May 2, 1931, ending with a banquet at the Pacific Club.

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PROGRAM OF THE SIXTH ANNUAL MEETING

THURSDAY, APRIL 30, 7:30 P. M.

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

Mr. J. F. Voorhees: Is the average rainfall the most probable rainfall? and The average rainfall in the Honolulu district.

Dr. Madorah E. Smith: Is the oriental or English direction of reading the more natural?

Dr. John Wesley Coulter: The distribution of population and land utilization in the Hawaiian islands in 1853.

Dr. Tokue Takahashi: About the discharge of mercury arc lamps.

Dr. T. A. Jaggar, Jr.: Niuafoou volcano in Tonga; its eruptions and its people.

FRIDAY, MAY 1, 7:30 P. M.

Presentation of papers:

Dr. C. H. Edmondson: Asexual reproduction in sponges.

Miss B. H. Krauss and Dr. C. P. Sideris: The physiological role of titanium in the development of chlorophyll.

Dr. C. P. Sideris and Miss B. H. Krauss: The effect of different iron concentrations on the growth and metabolism of plants.

Dr. Christopher J. Hamre: The influence of iodine upon the development of the thyroid of trout (*Salmo fario*).

Mr. E. H. Bryan, Jr.: Kahoolawe, the island of dust.

Mr. Ray J. Baker: Biological records by means of the motion picture camera.

SATURDAY, MAY 2, 2:30 P. M.

Presentation of papers:

Mr. D. M. Weller: The sugar cane plant: root pressure and root pressure liquids.

Dr. C. Montague Cooke, Jr.: Evidences of climatic changes in the Hawaiian islands. (Read by title.)

Dr. E. D. W. Brown: Pteridophyta of southeastern Polynesia.

Dr. Oscar W. Allen: Characteristic properties of the virus of fowl-pox.

Mr. Charles S. Judd: Botanical bonanzas.

SATURDAY, MAY 2, 6:45 P. M.

Pacific Club banquet.

Constitutional order of business.

Presidential address: Revolution in Hawaiian culture.

Installation of new officers.

Adjournment.

ABSTRACTS OF PAPERS

REVOLUTION IN HAWAIIAN CULTURE
(Presidential Address)

By

EDWARD S. C. HANDY

The Kapu

The *kapu* was the principle of integration of the old Hawaiian culture. *Kapu* is defined as "regulation of living according to psychic law," or "discipline by imminent supernormal agency."

Social classes

The ancient society was a caste system, with *kapu* regulating the relationship and respective functioning of the three castes: *alii* (sacred chiefs), *makaainana* (commoners), and *kauwa* (outcasts).

The Family

The ancient Hawaiian family was motivated and regulated in accordance with the prevailing Polynesian principle of the sanctity (*kapu*) of the male and the commonness (*noa*) of the female. This principle of sex classifications rather than incest prohibitions like those common to most peoples, regulated personal and marital relationships. Terms of relationship reflect the sex classification. Economic and domestic functions were based on it: males segregated themselves for cooking, eating, working. Females had their separate places for eating, natural functions connected with reproduction, and industries. The father was priest for the family gods. Women had their separate patron spirits.

The Nation

The *Mo-i* (Supreme) or Sacred King, was the pivot of the government and of the social order. His succession to the title and his authority and religious and social functions arose out of his purity of blood and direct descent from the gods. He regarded himself as an incarnate god (*akua*), and priests and people revered him as such. All land belonged to the *Mo-i*, and every new *Mo-i* upon accession reallotted districts and estates to relatives and loyal supporters, who in turn allotted holdings and rights to farmers and fishermen. Administration was under the *Kalaimoku* (Island-cutter), a man of either noble or common birth, loyal, experienced and sagacious; he was termed the "Back-bone" (*Kua-mo'o*) of the King. Civil administration, diplomacy and war were under the *Kalaimoku*. The *Konohikis*, or land supervisors and tax assessors, were under him. The priests of the temples of Ku, the war lord, and Lono, the god of peace and agriculture, represented a second "party" in government that influenced and abetted or restrained the *Mo-i*. The *Mo-i* was the ultimate court of appeal in matters of justice.

In peace time, and during the great agricultural harvest festival, the Sacred King was the symbol and embodiment of Lono, god of rain and patron of agriculture. In the drama of the annual harvest festival (*Makahiki*), the *Mo-i* played the chief role, assisted by priests of Lono. The sacred *Hula* was a form of magic to induce fertility in *Mo-i* and in the land, to cause rain and plenty. The harvest offerings were not mere taxes, but part of an elaborated magical cult to increase bounty: the farmer and fisher expected Earth and Sky to return with interest what was demanded of him as tribute during the festival. When he had made his harvest offering, there followed a long period of festivity, no work, feasting, dancing, sports, and the pageantry of the sacred drama of Lono. "The *Mo-i* was the life of the land," says an old chant. The *Mo-i* was the rallying point for the people, the *Makahiki* was the rallying time.

Again, in war time, the *Mo-i* was pivotal. In the elaborate ceremonial of dedicating a new effigy to the war lord and consecrating his temple (*Luakini*), the *Mo-i* played the central role, assisted by priests of Ku. The campaign was planned by the *Mo-i* with the assistance of his *Kalaimoku*. Every man raised to be a *Mo-i* was trained from infancy in the art of war and offence and defence, both personal and military. The *Mo-i* was, therefore, actually inspirer and leader, in preparations and on the field of battle, where he fought in the midst of his men arrayed in brilliant feather helmet and cape, surrounded by his family similarly arrayed, and by the feather symbols of his gods, borne by attendants and priests. The *Mo-i* was, then, in peace and war, the pivot of the social order, whose prestige rested upon *kapu*. In him the folk concentrated their intense devotion, upon his leadership and inspiration they were utterly dependent.

Industry

In industry, *kapu* was the regulating principle. Labor was consecrational; materials, workers, places, tools, the object being made were *kapu* during construction; fishing was consecrational, and planting likewise. In house building, in canoe building, in fishing, in planting, the common man was dependent upon the leadership of experts whose technical knowledge and ceremonial functioning represented a body of tradition passed on through systematic apprenticeship. This was true also of medical practice, witchcraft, and so on. The *kahuna*, then, or expert professional, was pivotal in the industrial life.

Abolition of the Kapu

Kamehameha united the islands under one rule, thus preparing the way for the abolition of the *kapu,* which could certainly never have been achieved by edict under the ancient system of divided rule under many *Mo-i.*

Kamehameha died in 1819, and chiefly through the instrumentality of the chiefess Kaahumanu, his dissipated son Liholiho abolished the *kapu* almost immediately after his accession to the *Mo-i* title. As Alexander puts it, "The effect of it was like that of displacing the keystone of an arch. The whole structure both of idol-worship and the tabus fell at once into ruins. The high-priest (Hewahewa) himself set the example of setting fire to the idols and their sanctuaries, and messengers were sent even as far as Kauai to proclaim the abolition of the tabus, which was termed *ai-noa* or free eating, in opposition to the *ai kapu.*"

In a word, the *Mo-i* and chief *kahuna* at a stroke swept away the principle upon which they stood. In principle, they abolished their respective roles, and at the same time the principle of discipline and integration of the native social order, and the social and industrial pivots upon which the commoner was, to a degree difficult for us to imagine, dependent.

What did this do to the individual Hawaiian? After 1820 it was at least a generation before the better influences of Euro-American civilization even began to take root in the life of the masses.

A picture is drawn of the condition of cultural deprivation and demoralization that must have prevailed as a result of the revolution or abolition of the *kapu,* in the two decades following 1820: the effect on family life, relations between the sexes, the withdrawal of leadership of *Mo-i* and *kahuna* in relation to planting, war, fishing, boat and house building; the effect on children born at that time; the psychological condition; confusion, troubled mentality, slackness, uncertainty; so that the mind of the individual and the whole social body must have suffered. At the same time, while divested of every stabilizing influence of his own cultural heritage, the native was subjected to the worst possible influences brought by seafaring men and adventurers from America and Europe.

While the Hawaiian cultural revolution was more dramatic than that elsewhere, it was by no means exceptional. The same revolution has taken place, in some cases with even more devastating results, practically throughout Polynesia. The more radical youthful leaders in China, India and elsewhere are in many cases bent upon bringing about such a cultural revolution and abandoning their own heritage in favor of western ways.

The question is posed: does the history of the Hawaiian people and of the Polynesians indicate that revolution, or abandonment of cultural heritage, is wise? Or is evolution, meaning transformation to meet new conditions, preferable?

IS THE AVERAGE RAINFALL THE MOST PROBABLE RAINFALL?

By

J. F. VOORHEES

Everyone understands that in any agricultural project the water supply is one of the essential factors. This is true whether we depend on the rain falling where it is needed, or at some point from which it may be brought.

Modern times and conditions have added a new problem. In these days when everyone is trying to attain godliness by the water route it takes more water to meet the necessities of one person than it formerly took to meet the needs of a large family. The result is that our great and growing cities are reaching out for greater and greater supplies of water. In almost every case this water supply must come from a limited area and as a result the study of the most probable rainfall is becoming more and more important, as the demand approaches the supply.

Any study of a long rainfall record reveals the fact that there are more years when the rainfall is below the average than there are when it is above the average. As an example, take the record for the month of February at the Weather Bureau in Honolulu. The average rainfall for 53 years is 3.63 inches. February was below that amount 38 times in the 53 years and above it only 15 times. One February had 24.93 inches or slightly more than the combined total of the 26 driest Februaries which amounted to 24.78 inches.

It is suggested that the median or middle value for any month for which we have a long record would more nearly represent the probable rainfall than does the average. [Illustrated with charts, including a map showing the rainfall distribution for the Honolulu district.]

READING DIRECTION AND THE EFFECT OF FOREIGN LANGUAGE SCHOOL ATTENDANCE ON LEARNING TO READ

By

MADORAH E. SMITH

This study endeavored to discover which direction of reading (Chinese or English) is the more natural to the young child and what effect the study at the same time of another language written in a different direction is upon learning to read English.

A picture-naming test was devised for this purpose that was applicable to young children and which has a high correlation with the older individual's preferred reading direction. The youngest children begin at the lower right-hand corner of the page most frequently. Children of four and five show a marked tendency to follow the edge of the page filling up the center last. Those who can read follow the order most similar to the language they read most. The return movement of the eye to the line below or column next rather than reversing the direction on the next line or column is a more frequent procedure with readers than with non-readers. Children who could read scored higher on the test than those just beginning to learn to read.

Children attending foreign language schools, when paired on intelligence tests with other Orientals not attending foreign language schools, showed greater variability on the reading direction test, fewer English direction patterns being used and fewer perfect scores being made. They scored lower on every one of the five reading tests used. An analysis of the errors made by them showed a markedly higher number of errors in the recognition of letters and words that differ in orientation indicating a greater confusion of orientation in reading than among children attending but one school.

The study suggests that children may not be so disturbed by the different reading directions if they would not enter both schools at the same time and that it would be well for teachers to pay specific attention to teaching the approved reading direction and to words and letters easily confused in orientation. [Illustrated with charts.]

THE DISTRIBUTION OF POPULATION AND LAND UTILIZATION IN THE HAWAIIAN ISLANDS IN 1853

By

JOHN W. COULTER

Among considerations which make 1853 a good year in which to determine accurately the distribution of population in the Hawaiian islands are: 1, that was the first year for which a census report of the islands by districts is available; 2, at that time the people were settled permanently on the lands to which they had received title after the great *mahele*. The total population was 73,138 of which 2,119 were foreigners. Among the sources of information for land utilization in the islands in that year are: 1, official lists of exports from the islands; 2, accounts of travellers; 3, research publications; 4, "kamaainas" in the territory. There was a close relationship between the distribution of people on each inhabited island and the location of food crops and the supply of fish in offshore waters. Nearly all the people lived on or near the coast. Agriculture was an adjustment to a climate which, at sea level, is characterized by a low annual, monthly, and daily temperature range, absence of frost, and a moderate to heavy rainfall with striking contrasts in the amount of precipitation for areas at different altitudes and with different exposures to the prevailing trade winds; and to a relief which restricted most of the arable land to coastal plains and river deltas. Some of the more important uses to which the land was put were the raising of wet land taro, dry land taro, yams, sweet potatoes, bananas, and breadfruit. Sugar cane, coffee, corn, wheat, and Irish potatoes were also raised. Pastoral activities were carried on mainly on higher lands. Honolulu and Lahaina, ports of call for whaling vessels, were the larger urban centers in the islands. [Illustrated with maps and slides.]

This paper is to be published in full by Bernice P. Bishop Museum.

OBSERVATIONS ON THE DISCHARGE OF MERCURY ARC LAMPS

By

TOKUE TAKAHASHI

To overcome certain variations in the spectrum of the light emitted by quartz mercury lamps, a lamp provided with a plane quartz window was made. With this lamp the difference of intensities of radiations, both in the periphery and in the center of the discharge, was demonstrated by a pinhole photograph.

Spectroscopic examinations showed there were variations of spectra obtained from the different positions of the discharge. A band spectrum was described and shown, which begins with a sharp edge near 2537 and ends diffusedly in the region of visible rays. It was found that the band spectrum was shown most strongly by the light from the periphery of the discharge. It is possibly the same spectrum which was claimed to have been observed first by Lord Rayleigh, though he obtained it in a different way.

The ordinary spectrum of mercury lamps appears to consist of a line spectrum, superimposed on which is a band spectrum characteristic of the light from the periphery of the discharge. [Illustrated with slides.]

NIUAFOOU VOLCANO IN TONGA: ITS ERUPTIONS AND ITS PEOPLE

By

T. A. JAGGAR, JR.

Niuafoou, an active volcanic island belonging to Tonga, stands on the northeastern corner of the submerged portion of the Australian continent between Samoa and Fiji. It lies 15.5 degrees south of the Equator. It is almost a perfect ring five miles across, with a lake of brackish water three miles in diameter surrounded by a ridge 600 feet high. This is much like Crater Lake in Oregon. The whole island is covered with coconut palms and other verdure and most of the people live in nine villages on an outer lava platform surrounding the ring ridge.

The people are Polynesians with a civilization much like that of Samoa, and they are strictly governed by a high chief, a magistrate, and a police service representing the Queen of Tonga. There are usually seven or eight white people at Angaha, the principal port, where a rough landing may be made with boats. The people are completely Christianized, members of three denominations, and are constant church attendants and lovers of religious music. The population is about 1,100, there are several motor cars, the trails are broad, and lovely avenues encircle the island amid coconuts, ironwoods, mangoes, pandanus, and plantations of yam, taro, papaias, sweet potatoes, bananas, and manioc.

There have been numerous lava eruptions in the 19th and 20th centuries at average intervals of 16 years. There were explosive eruptions through the central lake region in 1814 and 1886. A lava outbreak producing feldspar basalt took place July 25, 1929, along a concentric rift along the outer lava platform on the west side of the island. Numerous flows poured into the sea in the course of a few hours, coconut groves were invaded and thousands of tree molds were formed, cones were built up along the rift, and the village of Futu was destroyed. No lives were lost. This eruption was typical of what has occurred repeatedly on the west side of the island. The explosive eruption of 1886 produced no loss of life, but sent up cauliflower clouds, dropped about 2.5 feet of ash on the settlements, and piled up new cinder hills at one side of the lake, shutting off lateral lagoons. Earthquakes occur at times of eruption in Niuafoou, but tests with a shock-recorder in 1930, a year after the 1929 eruption, revealed seismic quiet.

The writer was privileged to make his map and exploration as a member of the Eclipse Expedition of the United States Naval Observatory under Commander C. H. J. Keppler. His volcanologic report will be published by the United States Geological Survey. [Illustrated with lantern slides.]

ASEXUAL REPRODUCTION IN SPONGES

By

Charles H. Edmondson

It is assumed that most species of marine sponges normally reproduce by the sexual process, but, like other animals of simple organization, asexual methods of reproduction may be employed when necessary. Among marine sponges there are occasionally seen phenomena which seem to parallel the gemmule formation of many fresh-water species.

An undetermined but familiar sponge in the shallow waters of Hawaii is a small hemispherical colony about one inch in diameter, white with a yellowish tint. On subjection to abnormal conditions in the laboratory, remarkable morphological changes occur. Processes of several kinds are protruded from the body. Some of these are long and filamentous, in length two to three times the diameter of the colony, others are short and club-shaped, and still others assume stellate forms with long, slender rays. All processes consist of an axial core of spicules surrounded by cells of a uniform type, amoeboid and highly granular.

The stellate bodies detach themselves from the parent sponge and, when confined in a stender dish, coalesce, finally producing a contracted spherical mass which develops into a new sponge. I have not observed the filamentous or club-shaped masses detaching themselves, but if severed from the colony each contracts into a spheroidal mass becoming potentially an embryonic sponge. Experimental work by other investigators indicates that similar bodies may be produced from sponge colonies as a result of foul water, low temperatures, overfeeding, or a lack of calcium.

It is known that in some low organisms somatic cells, violently disassociated from the body, will reassemble in clumps or aggregations, each mass becoming a regenerative body capable of developing into a new organism. Many Hawaiian sponges will thus form aggregations. Among the disassociated cells two general forms are recognizable: large, granular, amoeboid cells and small vibratile ones bearing collars and flagellae. Various investigators agree that the amoeboid cells absorb the flagellate cells as aggregations are formed and then pass into a generalized state comparable to a mass of blastomeres, in which growth and differentiation later occur. These aggregations are apparently comparable, physiologically, to the stellate masses formed from the body of the sponge under abnormal conditions. [Illustrated with slides.]

THE PHYSIOLOGICAL ROLE OF TITANIUM IN THE DEVELOPMENT OF CHLOROPHYLL

By

B. H. Krauss and C. P. Sideris

(Presented by Miss Beatrice H. Krauss)

The authors found that titanium could stimulate the development of chlorophyll in pineapple plants. Pineapple seedlings grown in nutrient solutions complete except for iron became chlorotic in two months. Titanium then added at the rate of 5 p.p.m. to the nutrient solution caused the plants to green up and grow as well as plants to which iron had been added in the same way. This stimulus over chlorotic check plants continued for eight months, when they again became chlorotic. Upon the addition, however, of 1 p.p.m. of iron the plants again became green and grew well. Check plants receiving 1 p.p.m. of iron alone remained chlorotic and did not grow.

The experiment repeated with the faster growing plants of corn gave some stimulus but not as marked as in the case of the slower growing pineapple plants.

The explanation offered for the physiological role of titanium in the development of chlorophyll is that the titanium reduces the oxidized iron (which becomes oxidized during the photosynthetic process and is thus made unavailable) in the ferric form to the available ferrous form. When iron occurs in very low concentrations, titanium makes it available over and over again through repeated reduction of its oxidized forms. This titanium stimulus becomes very pronounced with slow growing plants where the photosynthetic process is slower and less iron is necessary. In faster growing plants where more iron is needed the role of titanium is necessarily reduced.

THE EFFECT OF DIFFERENT IRON CONCENTRATIONS ON THE GROWTH AND METABOLISM OF PLANTS

By

C. P. Sideris and B. H. Krauss

(Presented by Dr. C. P. Sideris)

Iron through its direct influence on the development of chlorophyll may favor or inhibit plant growth.

We have found through a series of experiments that different concentrations of iron cause profound physiological changes in plants. They may influence (1) the amount of chlorophyll produced per unit area of leaf tissues; (2) the amount of sugars produced by such tissues; (3) the assimilation of nitrates and (4) the absorption of such elements as potassium, calcium, etc.

Plant growth and the concentration of chlorophyll and sugars increases with increments of iron. The maximum for growth and chlorophyll production is between 14 and 28 p.p.m. of iron but that of sugars was found to increase even beyond 28 p.p.m. of iron.

The form in which the nitrogen is furnished to plants influences tremendously the iron requirements of plants. It has been found that plants receiving ammonium sulphate as their source of nitrogen are able to grow well in as low as 1 p.p.m. concentrations of iron, whereas similar plants receiving their nitrogen in the form of potassium nitrate require at least 15 times as much iron to grow equally well.

The concentration of the water soluble iron of all our culture solutions has never been found higher than 3 p.p.m. Hence, the increased rate of growth was due to that portion of the insoluble iron which had been extracted by the roots of our plants.

Plants grown in low iron concentrations contain more nitrates because they are unable to assimilate them on account of the low chlorophyll content of the leaves. The quantities of such elements as potassium and calcium are greater in the low iron concentrations on account of the low growth rate of the plants.

These results indicate that absorption of inorganic salts by plants is primarily a function of time modified doubtless by environmental conditions and the size of the root system. [Illustrated with charts.]

THE INFLUENCE OF IODINE ON THE DEVELOPMENT OF THE THYROID GLAND OF TROUT

By

CHRISTOPHER J. HAMRE

The studies reported in this paper have confirmed the results obtained by Marine and Lenhart and by Gaylord and Marsh in that iodine added to the water has been found to prevent thyroid hypertrophy in trout. Thirty and a hundred parts of sodium iodide added per billion parts of water effectively inhibit hypertrophy. Though iodine effectively inhibited physiological thyroid hypertrophy it did not completely inhibit the process of enlargement of the thyroid concerned in its embryonic differentiation. Also it was found that iodine must be administered continuously or intermittently at close intervals to maintain a normal histological condition of the thyroid, for evidences of hypertrophy were found at 30 days after discontinuation of iodine administration, distinct hypertrophy after 82 days and complete disappearance of the normal histological condition by 130 days after treatment.

Iodine was also found to influence growth, thirty parts of sodium iodide per billion parts of water distinctly stimulating growth. In contrast one hundred parts of sodium iodide inhibited growth as long as it was administered, increased rate of growth being found to follow discontinuation of iodine administration, indicating one hundred parts of sodium iodide to be of excessive dosage.

Extreme individual variation in degree of hypertrophy of the thyroids of untreated fish suggest that different individuals may possess thyroids differing in degree of ability to utilize available iodine. [Illustrated with charts and slides.]

KAHOOLAWE, THE ISLAND OF DUST

By

E. H. BRYAN, JR.

Kahoolawe, with an area of 28,000 acres, lies between Maui, Lanai and Hawaii. It is wedge-shaped, 11 miles long and 3½ to 6½ miles wide. It rises to a height of 1,477 feet near the east end. The island is of volcanic origin, and there are six distinct cones, three of which have pronounced craters. On the east and south the land rises abruptly from the sea in cliffs. On the north and west the slope is more gentle, with small bays, having sandy and rocky beaches, and numerous gulches. Much of the central portion is a flat, windswept plain of red hardpan, nearly bare of vegetation, the soil which once covered it having been literally blown away. The rainfall is very scanty and usually comes in a few heavy storms.

The island was used as a place of banishment in the early 19th century. On January 1, 1863, a 50-year lease was given to Elisha H. Allen, which was assigned in turn to five other lessors, ending with Eben P. Low. On August 25, 1910, the island was proclaimed a forest reserve, in order that the great numbers of sheep and goats might be removed or destroyed, and reclamation commenced. But funds for this work were not available, and after several unsuccessful attempts to rid the island of destructive animals, it was withdrawn from the Forest Reserve, April 20, 1918. Reverting to the public lands, it was leased to Angus McPhee and Harry A. Baldwin, of Maui, by whom it is at present being used as a cattle ranch.

What the vegetation might once have been is hard to determine. There are statements that the island was once forested. At present the only native plants are a few wiliwili trees, pili grass, and scattered remnants of four species of shrubs and herbs. The rest consists of introduced algaroba trees, and immigrant shrubs and weeds, a total of about thirty species. About sixty species of insects have been collected on the island, and eight species of birds noted, none native. There are numerous rats and mice, a few sheep and goats remain; a hundred or more head of cattle and horses are pastured; turkeys, dogs and cats are kept by the population of five adults and four children. Water is stored in tanks and cisterns, there being neither wells nor streams. Special scientific interest lies in the problem of reforestation, and in the interrelationship of the insects, plants, introduced animals, and their environment. [Illustrated with maps and projected photographs.]

BIOLOGICAL RECORDS BY MEANS OF THE MOTION PICTURE CAMERA

By

RAY J. BAKER

The showing consisted of several reels of film, taken with the interval camera, showing the life of a number of flowers, such as *Hibiscus, Sonchus, Crinum* and *Cereus,* as well as the germination of the seeds of the Mung bean. In addition to these, there were several micro subjects, the highly magnified photographs showing the dehiscence of the anthers of *Hibiscus,* the streaming of the protoplasm in the leaves of *Elodea,* and the swimming movements of *Paramoecium* and several other protozoa, together with action studies of a rotifer and the arthropod *Daphnia.*

THE SUGAR CANE PLANT: ROOT PRESSURE AND ROOT PRESSURE LIQUIDS

By

D. M. WELLER

When stalks of the sugar cane plant were cut off just above the surface of the soil and the ends of the stumps connected by means of rubber tubing to flasks, liquids pumped up by root pressure were collected under toluene for chemical analyses. In 12 hours after attachments were made, as much as 500 ml. to 1000 ml. of liquid were pumped up by the roots of single stools of cane. A greater amount of liquid was pumped up at night than during the day from the same stool. A definite technique of making these attachments was developed. The general purpose of this work was:

1. To compare the amounts and forms of plant nutrients in these root pressure liquids with those in different nutrient solutions in which such plants were grown.

2. To determine whether or not such comparisons would prove useful in determining nutritional requirements of the cane plant and the possible deficiencies of plant nutrients for cane grown under field conditions.

Mercury columns (manometers) were attached to stools of the following varieties of cane: H-109, Lahaina, Yellow Caledonia, D-1135, Uba, and P.O.J. 36. The height of these mercury columns was read every three hours throughout the day and night for a period of twenty-one days. In some instances columns of mercury 140 cm. high resulted. This height of mercury corresponds to that of water columns of more than 60 feet. These data when presented in graphic form showed a rising curve for the night readings and a descending curve for the day readings. These day and night pressure differences correlated with the different amounts of liquid obtained during the night as compared with the amounts obtained during the day.

After irrigations the direction of these curves was upward and, if irrigations were excessive, the direction of the curves was temporarily upward followed by a downward trend. If irrigations were withheld long enough these curves descended to and crossed the zero point and registered as much as 50 cm. of negative pressure. A correlation existed between the pressure curves of certain varieties and their relative drought resistances.

When a tube was attached to the stump of but a single cut stalk of a stool and all of the other stalks of the stool left growing, the stalks of the stool left uncut drew into the plant by "leaf pull" various concentrations of salts added to the tube. The idea of using this technique as a means of studying the effects of various forms and amounts of liquids and gases, salts, disinfectants, stimulants, etc., when thus introduced "hypodermically" into stools of growing cane was suggested. [Illustrated with charts and demonstration material.]

PTERIDOPHYTA OF SOUTHEAST POLYNESIA

By

E. D. W. and F. B. H. Brown

In a survey of the Pteridophyta of southeast Polynesia, including the Marquesas, the Tuamotus, Mangareva, Pitcairn, Henderson, Oeno, Rapa, and Austral Islands, the following interesting data were obtained: of the

122 species and varieties described and the majority figured, 59 (48 per cent) are new species (25) or varieties (34); 64 are endemic to this region and 58 non-endemic. Like the spermatophytes, the pteridophytes may be grouped into floral regions characterized as follows:

I. Marquesas.—High endemism (49%); a primary affinity with the Society Islands and a secondary one with Hawaii. In this latter connection, the first record of *Diellia* occurring outside of Hawaii is found in the Marquesas, while *Selaginella arbuscula*, heretofore considered by some authors to be endemic to Hawaii, is one of the most striking elements of the Marquesan flora.

II. Society Islands.—The relation of its fern flora to that of the Marquesas is such as to suggest a derivation in large part from a common center of origin.

III. Tuamotus.—Low islands without marked endemism. This archipelago forms a center about which the others are grouped. The affinities suggest that this region is the geographical as well as the genetic center of the Pteridophyta of southeast Polynesia.

IV. Austral.—Relatively slight endemism (19%) and scarcely distinct from the Society Islands.

V. Rapa.—Ranks next to the Marquesas and comparable with Pitcairn in high endemism (31%). The primary affinities are with the Society Islands, while the secondary affinities are with the Austral Islands, Marquesas, and Hawaii.

VI. Mangareva, Henderson, and Oeno, marked by low endemism, Pitcairn by relatively high endemism. The chief affinities are with the Society Islands and the Marquesas.

CHARACTERISTIC PROPERTIES OF THE VIRUS OF FOWL-POX (EPITHELIOMA CONTAGIOSUM)

By

O. N. Allen

Epithelioma contagiosum is recognized as a specific infectious disease of fowls. The disease is easily diagnosed by a cutaneous eruption commonly found on the unfeathered parts of the body. These eruptions later increase in size, change in color from whitish yellow-gray to a brown-black, frequently become hemorrhagic and in course of time dry and assume a scabby appearance. Owing to these clinical features of the disease it is commonly spoken of as "fowl-pox."

The disease is caused by a living filterable virus which can be easily demonstrated in any stage of the lesions subsequent to the pus or cutaneous eruptive stage. Virus isolated from spontaneous cases of fowl-pox showed the following characteristics: 1, the virus is demonstrable in infected tissue and not in normal tissue; 2, the virus is filterable through the pores of a Berkefeld filter; 3, the virus occasionally occurs in the circulating blood stream, but has its strongest affinity for the cytoplasm of cells of the squamous epithelial layer and outer mucous membranes; 4, the virus is infectious in very small amounts; 5, the virus is moderately resistant to drying, high and low temperatures; 6, fowls are immune following recovery from the disease or after a "take" injection of the attenuated virus; 7, there are indications that the virus is host specific; 8, attempts to cultivate the virus have been unsuccessful.

The present investigations have been made possible by the coöperation of Mr. C. M. Bice of the Poultry Division of the University of Hawaii, who is conducting an extensive vaccination program against the disease.

BOTANICAL BONANZAS

By

C. S. Judd

The rich endemicity of its flora is one of the remarkable botanical features of Hawaii. This is due to isolation and antiquity. Affinities of Hawaiian flora are found not only in Malaya and Australasia, South and Central America, but also in Brazil on the Atlantic side. This flora is considered as a gold mine by visiting botanists. Many of the mines are worked out and certain endemic trees such as the *hau kuahiwi, Cyanea comata,* have been lost to the world. Others such as the *ohai, nanu,* and *kou* are in great danger of becoming extinct.

On the other hand, trees thought to have been rare are being found in large numbers by exploration and there are certain areas where there is a rich assemblage of native trees. These have been advertised by Rock and consist of Kipuka Puaulu, Kapua, and Puuwaawaa on Hawaii, and Auahi on Maui.

An interesting mine of 42 different species of Hawaiian trees was discovered recently in a small gulch in Makua Valley on Oahu. The most notable trees are five *mehamehame,* which was thought to exist only in Kapua. The largest at Makua is 11.3 feet in diameter. Here also is a *kalamona* 38 feet high which Hillebrand described as a shrub 3 to 4 feet high. [Illustrated with slides].

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PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

SEVENTH ANNUAL MEETING

MAY 4-7, 1932

BERNICE P. BISHOP MUSEUM

SPECIAL PUBLICATION 20

HONOLULU, HAWAII
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1932

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

During the year 1931-32, one special public lecture was held, in cooperation with the Extension Division of the University of Hawaii, when Dr. Richard Woltereck of the University of Leipzig spoke on "The differentiation of species and of races in islands and lakes." (January 26, 1932.)

The sessons of the Seventh Annual Meeting were held in Dean Hall, University of Hawaii, May 4 to 7, 1932, ending with a banquet at the Pacific Club.

OFFICERS

1931-1932

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PROGRAM OF THE SEVENTH ANNUAL MEETING

WEDNESDAY, MAY 4, 7:30 P. M.

Preliminary announcements.
Election of members.
Appointment of committees.
Presentation of papers:
Mr. C. S. Judd: The parasitic habit of the sandalwood tree.
Mr. G. W. Duss: Notes on the distribution of Neowawraea.
Dr. Harold St. John and Mr. E. Y. Hosaka: Noxious weeds of the Hawaiian pineapple fields. (Presented by Dr. St. John.)
Mr. W. C. Davis and Dr. O. N. Allen: Observations on the Myxomycete flora of the island of Oahu. (Presented by Mr. Davis.)
Dr. J. L. Collins: Polyploidy in pineapples.
Dr. C. P. Sideris and Miss B. H. Krauss: Physiological studies on pineapples.
Mr. Otto Degener: A new illustrated flora of the Hawaiian Islands.

THURSDAY, MAY 5, 7:30 P. M.

Presentation of papers:
Dr. H. S. Palmer: An odd detail of weathering of pahoehoe lava.
Mr. C. B. Andrews: The mechanics of soils.
Mr. H. A. Wadsworth: Some factors affecting the moisture equivalents of soils.
Dr. C. H. Edmondson: Quantitative studies of the copepod fauna on local shores.
Dr. F. X. Williams: Water-loving insects of Hawaii.
Dr. R. N. Chapman: An experimental study of insect populations.
Mr. K. P. Emory: A comparison of the maraes of Tahiti and Necker Island.

FRIDAY, MAY 6, 7:30 P. M.

Presentation of papers:
Dr. E. D. W. Brown: Is there an Indo-Malayan element in the pteridophyte flora of southeastern Polynesia?
Dr. F. B. H. Brown: Notes on the dicotyledons of southeastern Polynesia.
Dr. J. W. Coulter: Land utilization in the Hawaiian islands in 1930.
Mrs. M. G. Abel and Miss C. D. Miller: The vitamin content of Chinese cabbage (*Brassica chinensis*). (Presented by Mrs. Abel.)
Miss C. D. Miller: Studies of the nutritive value of the opihi (*Helcioniscus exaratus* and *H. argentatus*).

Miss M. D. Vernon: Scenes from the life of Edison.

Mr. R. J. Baker: Biological Records by means of motion pictures.

SATURDAY, MAY 7, 2:30 P. M.

Mr. G. C. Munro: The rotation and distribution of plants. (Read by the Secretary.)

Mr. d'A. A. Welch: The locomotion of gastropod molluscs.

Dr. Madorah E. Smith: The influence of age, sex, and situation on the frequency, form, and function of questions asked by pre-school children.

Dr. Romanzo Adams: Racial "passing over" in Hawaii.

Dr. A. W. Lind: A measure of issues in Hawaiian elections.

Dr. Harald Wülffing: Der Wohnungsmangel und seine Bekämpfung. (Read by title.)

SATURDAY, MAY 7, 6:45 P. M.

Pacific Club banquet.

Constitutional order of business.

Installation of new officers.

Presidential address: Some personal correspondence.

Adjournment.

ABSTRACTS OF PAPERS

SOME PERSONAL CORRESPONDENCE
(Presidential Address)

By

HAROLD L. LYON

The Presidential Address, unfortunately, does not lend itself to successful abstraction, and it is not feasible to present it in its entirety. It consisted of the reading of some correspondence between Dr. Lyon and a missionary in India, arising from a discussion between them on shipboard enroute from Penang to Calcutta. This discussion of the relationship between dogmatic religion and modern science led to a very clearly defined and carefully worded statement of his personal scientific philosophy, which Dr. Lyon had prepared for the enlightenment of the ecclesiastic, and which made up the body of the address.

THE PARASITIC HABIT OF THE SANDALWOOD TREE

By

CHARLES S. JUDD

The *laau ala* or fragrant heartwood of the sandalwood tree enabled the first king of Hawaii to start a profitable trade with China with such success that in one generation he succeeded in leading his people from barbarism to civilization.

The sandalwood trade was at its height from 1810 to 1825 and ceased in 1840. It led to extravagant spending on the part of the king, and to oppression of the common people and to the decimation of all the large trees in the islands, and finally ended in Boki's disastrous expedition to Eromanga from which only 20 people returned out of the 500 who originally set out.

Contrary to general belief, the sandalwoods in Hawaii were not exterminated but are still found on all the larger islands. Though in India there is only one species, which produces probably the most valuable wood in the world, botanists recognize in Hawaii 8 distinct species and 3 varieties.

The commonest species (*Santalum freycinetianum*) is rather small and insignificant with curling leaves and brittle, drooping branchlets, and grows very slowly in well drained soil in the drier regions. The only fragrant part of the tree is the oily heartwood.

Very little is known about the parasitic habit of the Hawaiian sandalwoods but studies made in India throw considerable light on the subject. The actual transference of sap is made by means of a sucking organ, the haustorium, which attaches itself to the root of the host and by breaking down the cortical cells makes direct connection with the fibro-vascular cylinder and transfers the stream of salts and water through vascular strands to the sandalwood. Studies now being conducted in Hawaii aim to determine whether the Hawaiian species are true parasites and how they may be propagated successfully and in quantity. (Illustrated with slides and growing specimens.)

NOTES ON THE DISTRIBUTION OF NEOWAWRAEA

By

GLEN W. RUSS

In 1912 J. F. Rock discovered on the island of Hawaii three trees which he considered representatives of a new genus, and which he described as *Neowawraea phyllanthoides.* These trees have been rediscovered with others in the same locality, and more have been found on Oahu and Molokai. The species should occur on Maui and Kauai as well. It is the most impressive tree in the Hawaiian forests, the largest one known on Oahu having a trunk circumference of 37 feet. The wood is impregnated with oil, hard, durable and straight grained. The sapwood is white and the heartwood rich brown. As now known the tree is restricted to the upper forests of the Waianae Mountains of Oahu, except for the five or six trees on Hawaii and one on Molokai. In all about 25 living trees are known, most of them overmature. Large numbers of logs lie strewn over the ground in the Waianae Mountains, showing that not over 200 years ago the species was an important member of the Waianae forests.

The species is of a very elemental type and became decadent probably through changing climatic conditions to which, like many relic species, it was unable to adapt itself. The introduction of new animals and weeds into the forests has broken up the balance which the species had maintained, and started the submergence of the less vigorous.

Rock classed *Neowawraea* as being closely allied to *Phyllanthus* or *Bischofia,* but more recent studies of its characters, with fuller material, show it to be congeneric with *Drypetes,* a genus of probable African origin which is distributed throughout South Africa, Malaysia, the Philippines, the West Indies and tropical America.

The ancestors of the Hawaiian plants must have arrived here in very remote times, as the climatic conditions of the shores today could not sustain them. But that conditions suitable for their reception existed here ages ago is shown by the presence of fossilized wet forest plants intermingled with shore rushes, in situations very little above sea level. This time was possibly during some of the early periods of glaciation.

Unless aided by human agencies the species will soon become extinct. Such aid is now being given and healthy young trees are already growing in the Territorial Nursery. (Illustrated with slides and growing plants.)

NOXIOUS WEEDS OF THE HAWAIIAN PINEAPPLE FIELDS

By

HAROLD ST. JOHN and EDWARD Y. HOSAKA

The study of weeds is not new; it is as old as agriculture. A weed is a plant out of place—that is, from man's point of view. The grower of pineapples has to fight these invaders in his cultivated field and he tries to prevent the weeds from taking possession of the field. He needs to know the duration of the particular weed, whether short-lived or long-lived; its propagation, whether by seed, by runners, or by underground root-stocks; its nature of growth; and the frequency of new generations.

Several important agents serve to spread the weeds in the fields. Wind blows the seeds of many, as the Horseweed (*Erigeron canadensis*) and the Red Pualele (*Emilia sonchifolia*). Man, while walking in the fields, carries the burs of weeds, such as the Sand-bur (*Cenchrus echinatus*) and the Bristly Foxtail (*Setaria verticillata*), later brushing them off. Horses spread the same burs or bristly fruits, like the Spanish Needle (*Bidens pilosa*). Birds eat the berries and scatter the seeds of plants like the Popolo (*Solanum nodiflorum*) and the Lantana (*Lantana camara*). The planting materials, the pineapple crown, slip or shoot carry weed seeds with them to new fields. The pineapple boxes in their journeys from the field to the cannery and back, often to another field, serve as efficient carriers and disseminators of weed seeds.

The study revealed 83 noxious weeds. Of this total only 5 are indigenous to Hawaii and of these only 1 a probable endemic. The others are all adventives: 15 from the Pacific islands and southern Asia, 11 from Eurasia and Africa, 29 from tropical America, and 23 widely distributed throughout the tropics. Thus the noxious weeds of the Hawaiian pineapple fields are nearly all foreign invaders. (Illustrated with lantern slides.)

OBSERVATIONS ON THE MYXOMYCETE FLORA OF OAHU

By

W. C. DAVIS and O. N. ALLEN

The Myxomycetes, commonly called Slime Molds, constitute a group of minute, non-chlorophyllaceous organisms reproducing by either exogenous or endogenous spores. These spores upon germination produce either ciliated or non-ciliated zoospores which in turn develop into swarm-spores. The coalescence of these swarm-spores gives rise to the plasmodial stage. The Myxomycetes are generally considered as a borderline group between the plant and animal kingdoms. The forms are widely distributed throughout the world, and decaying plant material under moist conditions provides a very suitable sub-stratum for their growth.

Only five species representing four genera have been previously described for the Territory of Hawaii. To date the authors have identified thirty-four species representing twelve genera from collections made in various localities of the Waianae and Koolau mountain ranges of Oahu. Dr. C. L. Shear has recently contributed to this study a collection of unidentified Hawaiian Myxomycetes which were collected on Oahu several years ago. These forms have previously been included in the herbarium of the United States Department of Agriculture.

Each species is being studied from the standpoint of habitat, relative abundance, and type of original sub-stratum as well as from taxonomic characters. Attempts are being made to trace the entire life cycle of some of the species by means of growth on artificial culture media and permanent histological slides of the developing stages. (Illustrated with lantern slides and specimens.)

POLYPLOIDY IN PINEAPPLES

By

J. L. COLLINS

The normal somatic chromosome number in *Ananas sativus* Lindl. and in *Ananas microstachys* Lindm. is 50, and the gamete number is consequently 25. Triploid pineapples containing 75 chromosomes in the somatic nuclei have been found in hybrid populations. Most of them were in the F_1 hybrid produced by crossing the two species mentioned above. It has also been shown that the Cabezona, a variety grown commercially in the West Indies, is a triploid with 75 chromosomes.

The triploids are larger and more robust than the comparable diploid forms. This increased size is especially noticeable in leaf length, leaf width, fruit weight and pollen grain size and in the slower rate of maturity.

The pineapple triploids originated from the union of diploid egg gametes with normal haploid pollen gametes. Diploid egg gametes might arise either from non-reduction of the egg mother-cell or a doubling of the chromosome number in the nucleus following the heterotypic division. The former method was operative in the cases described here. The conclusion is based upon both genetic and morphological evidence. Cayenne, the female parent, is heterozygous for the dominant character smooth leaves, while the male parent, *A. microstachys,* is homozygous for the recessive allelomorph spiny leaves. In the population of diploid hybrids resulting from this cross half have spiny leaves and half have smooth leaves. If the diploid egg gametes had formed by a doubling of the chromosomes following the heterotypic division the same ratio of smooth to spiny leaved triploid plants should have been produced; however, all the triploids have smooth leaves, which indicates that they originated from non-reduction and that the 50 diploid Cayenne and 25 Wild Brazil chromosomes are present in these triploids.

Gametogenesis in the triploids is a very irregular process. During diakinesis varying numbers of trivalent, bivalent and univalent chromosomes are found in different pollen mother-cells of the same plant. The chromosomes at the metaphase are scattered irregularly along the spindle. During the anaphase many lagging chromosomes are observed but they eventually reach the poles and are included in the new nuclei formed at the end of the telophase. No micronuclei or microcytes have been found. The two meiotic divisions are completed with the formation of tetrads which appear to be normal. Development of the pollen grain subsequently, however, is quite abnormal; many of the microspores become evacuolated, shrink in size, and finally collapse into flat empty exine membranes showing no visible protoplasmic contents. The microspores which escape this fate produce pollen grains varying greatly in size. A small percentage of this pollen is functional when used on the Cayenne parent. When the triploid was used as a female parent no viable seeds resulted.

The discovery of triploid pineapple plants is a highly significant event with implications of greatest importance for pineapple breeding. (Illustrated with slides and charts.)

A NEW ILLUSTRATED FLORA OF THE HAWAIIAN ISLANDS

By

OTTO DEGENER

As real need exists for an up-to-date comprehensive flora of Hawaii, the writer decided to produce a "Flora Hawaiiensis." This is to contain all pertinent previous knowledge concerning local ferns and flowering plants as well as put into convenient form the final results of present and future investigations. This will be issued in fascicles consisting of approximately 100 plant descriptions and 100 full-page plates. These fascicles, by means of an ingenious yet simple method, will permit the binding of new pages of descriptions in taxonomic sequence rather than in chronologic order of publication. Thus this flora, which is intended to displace all other taxonomic works used by the general botanist and layman, will always remain the "New Illustrated Flora of the Hawaiian Islands."

With this purpose of producing a "Flora Hawaiiensis," the writer began collecting and critically studying Hawaiian plants in 1922. Though modestly disclaiming all responsibility, this work was stimulated in an unusual way on recommendation of the Director of Bishop Museum. During the last decade the writer spent a year studying Hawaiian collections at the New York Botanical Garden and botanized extensively in Hawaii, devoting in the aggregate over two years in the field. He has employed at least one native collector since 1926 to help gather material and from one to as many as four illustrators to draw the rare plants discovered. As a result he now possesses the largest private herbarium of Hawaiian plants in existence and over 500 carefully executed drawings.

The first fascicle of the "Flora," privately printed, is now in press. Succeeding fascicles will quickly follow as the writer is taking his entire herbarium to American and European botanical centers for study and comparison with historical Hawaiian collections, an opportunity not so readily available elsewhere. (Illustrated with specimen plates.)

AN ODD DETAIL OF WEATHERING OF PAHOEHOE LAVA

By

HAROLD S. PALMER

During a recent study of the shores of the island of Hawaii, with Dr. Howard A. Powers of the Hawaiian Volcano Observatory, we repeatedly noticed blocks of pahoehoe lava on the surface of which were roughly circular pits 1 to 2 inches across and 1 to 2 inches deep. The pits lie at intervals of a couple of inches along arcuate, subparallel lines. A first guess as to their origin ascribed them to the work of sea urchins, which are well known to bore pits into rocks. However, sea urchins make larger holes and space them more irregularly, so this hypothesis was abandoned. Then it occurred to Mrs. Palmer, who also saw them, that they might be some sort of primitive playing board such as the *papamu,* but this hypothesis had also to be abandoned but for opposite reasons—the pits are not regular enough in any one slab and no one slab is like any other slab.

The key, in the form of a genetic series, was stumbled onto on a young pahoehoe flat a little north of Hookena, where the lava has been scaled away to varying degrees. The origin seems to be as follows: When pahoehoe lava is in slow motion the drag of the still liquid interior wrinkles the crust into the subparallel, arcuate folds that characterize the so-called "ropy" lava. Each wrinkle is 1 to 4 inches high and 2 to 10 inches wide in general. The gas rising through the lava cannot escape through the solidified crust of the wrinkles and is trapped beneath a long arch. Various small bubbles combine to form large bubbles. The crust above the bubbles is rather glassy and, on exposure, wears away more rapidly than does the stonier lower lava. Thus the pits represent the lower parts of the large bubbles. The arcuate arrangement of pits reflects the arcuate course of the wrinkles. The uniformity in size and spacing is due to the uniformity of the physical properties of the lava. At the key locality half a dozen stages were found that range from complete pahoehoe wrinkles through partly exposed bubbles to typical pitted surfaces. (Illustrated with slides and specimens.)

THE MECHANICS OF SOILS

By

CARL B. ANDREWS

The classical earth pressure theories of Coulomb and Rankine have given results so much at variance with results obtained in practice, that further investigations of phenomena of soil movement have been undertaken on the basis of the laws of physics.

The engineering problems in soils are: 1, the bearing value of soils; 2, the pressures against retaining walls; and 3, the stability of earth slopes with respect to sliding. While the classical earth pressure theories, for the sake of simplicity, were based on the assumption that the soil under consideration was a loose granular mass, possessing friction but devoid of cohesion, the newer theories have taken into account the cohesion which is present in all soils except those made up of granules of somewhat large size, such as sands and gravels. The presence or absence of water in the pores of the soils makes a great difference in the soil behavior. The more fine-grained soils, such as clays and muds, shrink when dried and expand when wet to a marked degree, and it has been found that pressures on walls, when back-filled with materials of these sorts, is likely to be due to expansion because of the presence of water, rather than to the weight of the retained material. In slides of earth, it has been shown that whereas cohesionless soils will stand at the "angle of repose" to any desired height, soils which depend on cohesion rather than on friction for their stability require a flatter slope for a high embankment than for a low one, for the same factor of safety against sliding.

The fine-grained soils of Hawaii differ from corresponding soils of temperate regions in having a greater void volume, and both Hawaiian laterites and mainland clays show properties resembling the elastic properties of solid bodies.

SOME FACTORS AFFECTING THE MOISTURE EQUIVALENTS OF SOILS

By

HAROLD A. WADSWORTH

That the moisture equivalents of soils are closely correlated to the percentages of colloidal materials in them has long been recognized, but minor departures from direct proportionality have so far been disregarded. Recent chemical analyses of specimens of extracted colloid from widely separated soils permit a closer study of this relation.

Although many materials may be present in a soil colloid, the larger part is composed of SiO_2, Al_2O_3, Fe_2O_3 and organic matter. If the molar ratios of these mineral materials reported in a recent government paper be compared with the moisture equivalents which are given, one may secure a correlation coefficient of $+0.732$ for the $\frac{SiO_2}{Al_2O_3}$ ratio and $+0.751$ for the $\frac{SiO_2}{Al_2O_3 + Fe_2O_3}$ ratio. This procedure, however, is faulty on two scores: first, the organic matter is ignored, and second, it is tacitly assumed that Al_2O_3 and Fe_2O_3 have the same inherent water-holding capacity.

More refined interpretation by the method of least squares permits the evaluation of the potential water-holding capacity of each of these materials. When this is done a correlation coefficient of $+0.850$ is secured between the computed moisture equivalent and the observed moisture equivalent.

The assumption that SiO_2 and Al_2O_3 act as entities in the colloidal material needs justification. Arbitrary groupings of these two materials into alumino-silicates ranging from $4\ SiO_2 \cdot Al_2O_3$ to $SiO_2 \cdot 4\ Al_2O_3$ fails to change the correlation coefficient.

The conclusions from the work to date would indicate that the water-holding capacity of a colloid depended upon its percentage composition of SiO_2, organic matter, Fe_2O_3, and Al_2O_3, the decreasing significance of these materials in affecting the moisture equivalents being in the order given. (Illustrated with charts.)

QUANTITATIVE STUDIES OF THE COPEPOD FAUNA ON LOCAL SHORES

By

CHARLES H. EDMONDSON

An attempt is being made to correlate the abundance or paucity of copepods with the growth of organisms which depend more or less directly upon these minute crustaceans for food.

Stations have been established on both the windward and leeward sides of Oahu. The base station A is on Waikiki reef, near the Marine Biological Laboratory. Station B and six substations are also on Waikiki reef. Pier 2 at the entrance of Honolulu Harbor is another station and collections are frequently taken at the navy pier in the middle loch of Pearl Harbor. Kaneohe Bay has been the center of investigations on the windward side of the island.

Collections were more frequent at Station A, because of its convenient locality, averaging three or four daily. Occasionally collections were made hourly for 24 consecutive hours. Results for a period of 8 months, September to April, inclusive, may be summarized as follows:

A remarkable paucity of copepods is observed in the shoal waters of Waikiki reef, the maximum count being 90 per 11 liters of water, the unit of measurement. Here two peaks are usually noted daily, an early forenoon peak (6 to 8 o'clock) and an early evening peak (6 to 8 o'clock). In the early afternoon, especially on clear, warm days, the number falls to a minimum. Few copepods are in circulation in the shoal water during high tide. During this period the number of copepods reached a minimum at Station A in January, the maximum count for this month being 11 per unit. Substations farther out on Waikiki reef show a slightly higher count than at Station A, but in no case did they exceed its peak of 90 per unit.

At the Pearl Harbor station the number of copepods per unit of surface water is seldom less than 1000, and frequently ranges between 3000 and 4000. On a clear, hot afternoon the number at the bottom may be twice as great as at the surface.

At Pier 2 the count is usually under 100 per unit of surface water. During the afternoon 10 times as many copepods may be found at the bottom as at the surface.

Copepods seem to be more abundant in the waters of Kaneohe Bay than at other localities about Oahu, the maximum count for surface water being 8083 per unit. A larger number is found over the deep channels than over the shoal sand-covered areas, especially at low tide, due probably to the intensity of reflected light.

Six or eight species seem to make up the copepod fauna of the shoal waters about Oahu, but determinations have not yet been made. The responses of the different forms of copepods to various ecological factors under laboratory conditions are being studied. (Illustrated with charts.)

WATER-LOVING INSECTS OF HAWAII

By

FRANCIS X. WILLIAMS

Here are included insects that spend at least a part of their existence in the water or on its surface. The Hawaiian fauna of this type is rather poor except in damsel flies (*Agrionidae, Odonata*).

Such adult insects here that float on the surface film of water use chiefly the middle pair of legs for support and propulsion; those adult insects that swim in the water depend more or entirely on the last pair of legs for propulsion.

Dytiscid beetles swim with simultaneous strokes of the hind legs, hydrophilid beetles with alternate strokes; the dytiscid (*Rhantus*) larva devours its prey submerged, the hydrophilid (*Hydrobius*) holds its prey more or less out of the water; the hydrophilid larva is a poor swimmer and swallows air to insure buoyancy.

Hydrophorus praecox, an immigrant lowland surface-skating dolichopodid fly, is carnivorous as larva and adult, devouring blood-worms, etc. The larva pupates in a cocoon. *Brachydeutera hebes,* apparently endemic, is a very adaptable ephydrid fly that laps its food from the surface of the water; its larva swims, and is phytophagous and a scavenger. A somewhat canoe-shaped puparium is formed. A large psychodid fly, *Telmatoscopus albipunctatus,* seems a recent arrival here, and breeds in mud and water pockets in trees. The larva does not swim. The mosquito-like midge, *Chironomus hawaiiensis,* is harmless. The eggs are laid in gelatinous masses in the water, and the larvae are called blood-worms.

Anax strenuus is a very large native dragonfly, living chiefly in the mountains. *Pantala flavescens,* the common brown dragonfly of the lowlands, is not native. Some damsel flies (*Agrion*) breed at the leaf bases of Astelia and Freycinetia.

A corixid bug inhabits quite salty water; a back-swimmer bug (*Buenoa*) lives in fresh water and feeds on mosquito larvae, etc. We have two very small fresh-water-strider bugs. The marine water-strider bug (*Halobates sericeus*) is wingless and very fast. It is sometimes beached in great numbers during Kona storms. (Illustrated with slides.)

AN EXPERIMENTAL STUDY OF INSECT POPULATIONS

By

ROYAL N. CHAPMAN

The problem of animal populations in general has been of interest to mathematicians and biologists. Some have viewed the problem essentially as the Platonic school of Greek philosophers looked at natural laws in general, as purely mathematical phenomena. These students have considered their hypotheses as of more value than data on populations because the data may be incomplete, while their hypotheses are based on natural laws. The more typical biologists consider the factors influencing the population to be too involved to be susceptible to careful analysis. They are content to deal with broad generalizations.

A study of the confused flour beetle, *Tribolium confusum*, has demonstrated that it is possible to maintain these beetles under natural conditions and to measure experimentally the effects of physical and biotic factors of the environment on the population. This method has shown that physical factors may have a very definite influence on the rate at which the population curve attains its asymptotic value; and that such biotic factors as parasites may thereafter cause fluctuations of regular sequence and amplitude. Both the experimental conditions and the method of measuring the population can be reduced to great precision. (Illustrated with charts and a demonstration.)

A COMPARISON OF THE MARAES OF TAHITI AND NECKER ISLAND

By

KENNETH P. EMORY

The stone shrines or maraes of Necker Island form the most convincing evidence so far uncovered of an ancient cultural contact between Hawaii and the Society Islands.

This type of marae, although it has disappeared elsewhere in Hawaii, reappears in the extreme eastern part of the Tuamotu Archipelago. In the western part of the Tuamotus and in the adjacent Society Islands there exists a very similar marae, apparently derived from it, which has undergone considerable elaboration in the Society Islands during the last twenty-five generations.

The only important difference between the early Society Islands marae and the Necker marae is in the number and arrangement of the stone uprights along the back and against the front of the platform. In Tahiti, the rear uprights consist of a central upright and, in some, one upright at each end also. On Necker there are a number of uprights on one side of the central one and an equal number on the other. In Tahiti the upright in front of the rear central platform was placed against the front of the platform instead of on it, and this upright had an upright on each side of it. This trinity of uprights is carried as far east in the Tuamotus as Fakahina. Further east the feature begins to disappear, multiple rear platform uprights appear, and the marae takes on a remarkable resemblance to the Necker marae. (Illustrated with slides.)

IS THERE AN INDO-MALAYAN ELEMENT IN THE PTERIDOPHYTE FLORA OF SOUTHEASTERN POLYNESIA?

By

ELIZABETH D. W. BROWN

The 122 species of pteridophytes covered by the survey may be grouped according to distribution into (1) endemics or strictly Polynesian species, and (2) non-endemics having a range extending beyond Polynesia.

The endemics comprise not less than 66 per cent of the total number, a surprisingly large proportion considering the seeming adaptibility of fern spores for wind distribution. The probable center of origin of these species seems to be, in large part, the Tuamotuan region, whose flora in turn seems to have been derived, in large part, from the American continent.

The non-endemics comprise the remaining 34 per cent of the total number of species. Their origin may be considered from three lines of evidence as follows:

The closest affinities of each species shows that an overwhelmingly large proportion (80%) of the non-endemics find their closest relatives in the Indo-Malayan region, 6 per cent have their closest relatives in America, 8 per cent in Australia, and 6 per cent in Antarctica. Substantially the same percentages have been obtained for this region by other authors, some of whom have inferred that the flora of this region is largely Indo-Malayan.

It seems clear that although such statistics may point to a line of migration they do not indicate in which direction migration has taken place. It may have been eastward or westward.

A safer method of indicating the direction of migration of this group is to determine the probable center of origin of each species as indicated by the grouping of all of its relatives. By this method it is shown that an overwhelmingly large proportion (82%) of these non-endemics are probably of American origin, only 13 per cent are probably of Indo-Malayan or Asiatic origin, 2 per cent are probably of Australian origin, and 2 per cent probably of Antarctic origin.

Morphological characters of the spore and scale together with similar constant characters indicate that many species are older in the Marquesas and other parts of southeastern Polynesia than in Fiji or westward which strengthens the conclusions that migration has been from east to west rather than from west to east.

NOTES ON THE DICOTYLEDONS OF SOUTHEASTERN POLYNESIA

By

F. B. H. Brown

In part 3 of the manuscript of "The flora of southeastern Polynesia," now in the final stages of preparation, the dicotyledons to date described number 440 species and varieties as compared to 328 monocotyledons and 122 pteridophytes recently published in parts 1 and 2 respectively.

Time will not permit a full discussion of even a part of the 83 families represented in this part of the flora. Therefore some of the Campanulaceae have been selected because they are typical of a large part of the flora of this region in contributing evidence suggesting the former existence of high islands in the Tuamotuan region which seemingly served as a genetic center from which many Polynesian species have been derived.

To the genus *Sclerotheca* De Candolle of this family have been added two new species, one from Rapa and the other from the Marquesas. This necessitated the revision of the genus to include these new species with those from the Society Islands. As the genus is now revised, part or all of the anthers may be bearded at the tip, and the simple style may terminate in a slightly 2-lobed stigma or the style may terminate in two long stigmatic branches. However, the essential capsule characters remain fairly constant in all species. As De Candolle has stated: "The genus is well characterized by the sclerous capsule which is dehiscent by two pore-like openings at the apex." This character holds good for all of the species in southeastern Polynesia of which there are not less than five centering around the Tuamotuan region, two in the Society Islands, one in Rarotonga, one in Rapa, and one in the Marquesas, suggesting a Tuamotuan origin for the genus.

Another member of this family, a primitive lobelioid of interest, has been preserved in the Marquesas. To definitely place this, it has been necessary to erect a new genus *Cyrtandroidea*. This new genus closely connects the Lobelioideae with the Gesneriaceae through the Polynesian genus *Cyrtandra*.

LAND UTILIZATION IN THE HAWAIIAN ISLANDS IN 1930

By

JOHN WESLEY COULTER

Current literature draws attention to agricultural crises in various countries in the world. The question of the most profitable use of the land is uppermost. In Great Britain, South Africa, and Russia much attention is being given to this problem. Agricultural economists and economic geographers in the United States have attacked it. Last year Secretary of Agriculture Hyde called a conference on land utilization, the announced purpose of which was "to consider essential steps towards a nationalization policy of land utilization." In Hawaii, officers of the government, members of various departments in the University, and others are occupied with the problem.

The use of the land in the Hawaiian islands may be thought of in a general way in zones from sea level to about 7,000 feet. Taro and rice, sugar cane, pineapples, coffee, beef cattle, and forests are the products, respectively, from sea level upwards. Scattered areas at various elevations are used for dairy farming, diversified agriculture, and truck farming. By far the larger portion of the arable land is used for the production of sugar cane and pineapples. The cultivation of rice, formerly an important economic activity, has nearly ceased. Marginal pineapple land is being abandoned. A considerable amount of agricultural produce is being imported into Hawaii from the mainland of the United States each year. Preliminary surveys indicate that some of the imported commodities could successfully be produced in the Territory. The fact that much of the remaining arable land is in small, scattered holdings involves a problem in its cultivation, as large scale machinery cannot be used successfully. (Illustrated with maps.)

THE VITAMIN CONTENT OF CHINESE CABBAGE

By

MARJORIE G. ABEL and CAREY D. MILLER

Chinese cabbage (*Brassica chinensis*) is one of the most commonly used leafy vegetables grown in Hawaii. An investigation of its vitamin content, undertaken in the Nutrition Laboratory of the University of Hawaii, included determinations of the vitamin A, B, G and C potency of raw Chinese cabbage, and of the effect of salting and of pickling in salt-rice bran paste on that vitamin content. A short study of the vitamin B and G potency of rice bran was also made. The following conclusions may be drawn: 1, raw Chinese cabbage is an excellent source of vitamin A, in tests on white rats, 0.0416 gram daily inducing an average weekly gain of 6.4 grams per rat; 2, approximately half the vitamin A in the raw cabbage is destroyed in pickling in salt-rice bran paste; 3, raw cabbage is a fair source of vitamin B, 4.5 grams daily inducing an average weekly gain of 3.5 grams per rat; 4, rice bran compares very favorably with yeast as a source of vitamin B, 0.1 gram daily inducing a gain of 5.4 grams per week; 5, salting destroys a large part of the vitamin B, the feeding of a weight of salted cabbage equivalent to 4.5 grams of the raw food did not prevent a loss of 0.5 grams weekly; 6, cabbage pickled in salt-rice bran paste is an excellent source of vitamin B, 1 gram daily inducing an average weekly gain of 7.9 grams. Subsequent experiments by Miss Miller indicate that pickled cabbage has a vitamin B potency 8 to 10 times that of salted cabbage. This additional vitamin B was probably adsorbed from the rice bran. The mean pH value of the fresh leaf extract was 6.38, which changed during the pickling process to 4.74. This value is well within the range reported by other investigators as being most favorable to the adsorption of vitamin B on most adsorbing agents; 7, raw cabbage is a fair source of vitamin G, 5 grams daily inducing an average weekly gain of 7.06 grams, although all pellagra-like symptoms were not cured; 8, about a third of the vitamin G is destroyed in the pickling process; 9, rice bran is much lower in vitamin G potency than in vitamin B; 10, raw cabbage is a fair source of vitamin C, 3.0 grams daily preventing scurvy and inducing a fair growth in guinea-pigs; 11, pickling in salt-rice bran paste destroys approximately 85% of the vitamin C potency; 12, salting destroys more than 80% of the original vitamin C potency. (Illustrated with slides and charts.)

THE NUTRITIVE VALUE OF THE OPIHI

By

CAREY D. MILLER

The nutritive value of some of the principle vegetable foods of the ancient Hawaiians has been previously studied, and the work is now being extended to include the animal foods, the first being *opihi* (*Helcioniscus exaratus* and *H. argentatus*). *Opihi* were one of the most widely distributed and favorite shellfish of the ancient Hawaiians. They can usually be bought on the Honolulu markets today but are something of a luxury, as they sell for 25 to 30 cents a pound including shells. As only about 35 per cent is edible, the cost of this edible portion is approximately 80 cents a pound.

The only studies on the vitamin content of mollusks previously reported were made by Jones and Nelson of the Bureau of Chemistry in Washington on oysters and clams. No studies have been made on the gastropods. Vitamin studies thus far completed indicate that whole *opihi* are devoid of vitamin C, that they have low vitamin B value and a fairly good content of vitamin G.

In view of the relatively low fat content (1.43%) of the *opihi*, it was not expected that they would show a high vitamin A and D content, but experiments have proven that they are a remarkable source of vitamin A and a good source of vitamin D.

Whole *opihi* contain an average of 77 per cent moisture, which means that 1 gram of fresh *opihi* is equivalent to 0.23 grams of dried material; 0.5 gram of fresh *opihi* per week gave, in rats, almost as good results as 0.1 gram of codliver oil, indicating that whole *opihi* are nearly as good a source of vitamin A as is a well-known brand of standardized codliver oil. This vitamin is concentrated partially, but not wholly in the organs of the shellfish. With a feeding of 0.05 gram weekly of fresh organs consisting of the hepato-pancreas and intestinal contents, the rats are protected from xerophthalmia and make good growth.

The eggs and sperm have been tested separately. The sperm are a better source of vitamin A than the eggs, even though the eggs contain more fat (8.71% as against 2.16%). Neither are such a good source of A as the organs, but are better than the whole *opihi*.

Four grams of *opihi* fed daily for 8 days to standard rats made rachitic by feeding the Steenbock diet for 21 days, gave full protection against rickets as judged by the line test. Two grams daily gave only fair protection. One gram of organs fed daily gave almost complete protection as did the eggs. In all cases tested, one gram of sperm daily gave complete protection. In contrast to these results, oysters and clams are reported as failing to give any healing when fed in 5 gram daily doses to rachitic rats for five days, and only slight healing in ten days.

Hawaiians state that the soft parts of the *opihi*, consisting of organs and gonads, were mixed with a little poi and fed to babies before they had teeth to chew the whole *opihi*. It would thus appear that the Hawaiians had in the *opihi* an excellent source of vitamins A and D that was consumed at all ages. (Illustrated with slides and charts.)

SCENES FROM THE LIFE OF EDISON

By

MABEL D. VERNON

Thomas Alva Edison can be called the benefactor of all humanity. His lifelong search for truth made him the greatest inventor of the age and gives him the highest rank for scientific creative instinct and insight. He gave the world some 3,000 inventions which have revolutionized our everyday life. Whatever we do or wherever we turn we see the genius of Edison; his electric light, the telegraph system which he perfected, the telephone transmitter, the phonograph, the radio microphone, the motion-picture machine and the storage battery, all "miracles" of this great man's inspirations.

Edison's first experiment, at the age of twelve, was to test the theory that gases might enable a person to fly. He induced a boy employed in his father's family to swallow a large amount of Seidlitz powders. However, although the boy developed pains, he did not fly. His first patented invention was a vote recorder which, in spite of its value, was not popular with the legislatures, as it did not permit the members of these august bodies to change their votes after being recorded. His next venture was with stock tickers, and these proved popular and profitable.

Edison perfected the transmitter which made the Bell telephone a commercial success. After finishing with this he invented a machine that talked. This machine when perfected had required 65 patents and cost Edison over two million dollars. At the Paris Exposition in 1889 over 40,000 people flocked to hear the phonograph. The Eiffel Tower did not so completely astonish them.

Edison was not the first to search for an electric light, but he began where the others left off. Scientists challenged him to subdivide the electric current, as they declared it to be impossible. Edison left nothing untouched in his search for filament material, carbonizing everything he could lay his hands on. For some years a Japanese bamboo supplied the filament until superseded by the thread filament and then by tungsten.

Simultaneously with the achievement of the electric light, Edison made radical improvements in the construction of dynamos, making them suitable generators for systems of distribution of current for light, heat and power.

The two fundamental principles of modern radio belong to Edison, the microphone which he patented in 1887 and the "Edison Effect," on which every radio tube is based, invented in 1883. He filed his first patents on "wireless telegraphy" in 1885. A flood of inventors claiming the credit for wireless began to develop in the next decade, but Edison's position was assured. Attempts were made to secure his patents, but he took a firm stand in favor of Marconi, whom he considered the founder of radio.

Mention must be made of Edison's work with the storage battery. If this had been his only contribution to the world he would still be a great man. He made over 50,000 series of experiments, with 10,000 in each series. According to his own statement the storage battery called forth more original thought, work, perseverence and monumental patience than any other of his inventions. (Illustrated with slides.)

BIOLOGICAL RECORDS BY MEANS OF THE MOTION PICTURE CAMERA

By

RAY J. BAKER

The motion pictures shown related especially to life in the sea. The reels opened with shore scenes, to show the habitat, and then followed views of some of the familiar species of Hawaiian fish and a close-up view of an octopus, probably *Polypus marmoratus*. Several scenes were shown of the mottled periwinkle (*Littorina scabra*) in action. Of special interest was the detail picture of a holothurian (*Ophedesonia spectabilis*) which kept its shield-shaped tentacles in almost constant motion, and when irritated made use of the longitudinal muscles for contracting the body. A laboratory specimen of the mushroom coral (*Fungia scutaria*) was fed with crab meat. Small particles of the food were placed on the dorsal surface of the coral, and the process of gradually moving the particles of meat to the mouth and their engulfment was plainly shown. Special scientific interest lies in the fact that the film may be projected repeatedly, and the actions of the organisms studied until thoroughly analyzed. A micropicture was included which showed Brownian movement in minute particles of gamboge gum in water, and another showing the streaming of protoplasm in the leaves of Elodea. There were also views, taken with the interval camera, showing the sprouting of soy beans (*Glycine hispida*).

THE ROTATION AND DISTRIBUTION OF PLANTS

By

GEORGE C. MUNRO

A theory has been advanced that the indigenous plants of Hawaii have about run their course on the older islands. Flourishing in basalt in its early stages of decay, they deteriorate on the older soils.

The native plant life of Lanai bears out this theory in a marked degree. No native tree attains a large size there. Ohia and koa are small trees, and *mamani* is little more than a shrub. Some endemic species are almost extinct. Two plants which have evidently evolved to specific rank on Lanai are represented by only one known tree of each. On the other hand, exotic plants attain a maximum growth on the island. A Norfolk Island pine has reached a height of more than 100 feet and a diameter of 3 feet in fifty years. According to Wentworth, Lanai has had about 200,000 years of existence.

Mountain top bog plants transplanted from Puu Kukui on western Maui are growing in the Lanai forest. Given conditions as near as possible to their native habitat, under a rainfall of about 250 inches less a year and at an elevation lower by 2,000 feet, a violet and a plantain have flowered, seeded, and given rise to young plants. The silver-sword and other plants are also growing well. This goes to show that competition has driven them to the open bog and higher elevation.

Perkins has drawn attention to the possibility that the lobelia family once predominated in the plant covering of these islands. The large number of endemic species and the evident modification of the beaks and tongues of some of the endemic honey-eating birds to enable them to secure the honey from the deep tubular flowers indicates the dominance of that class of flowers for a long time. Many of the endemic species of this family are suffering from competition with later arrivals.

THE LOCOMOTION OF GASTROPOD MOLLUSCS

By

D'ALTE A. WELCH

Most Gastropods move by either rhythmic or arhythmic locomotion. In rhythmic locomotion the animal is moved by rhythmic activity of the ventral surface of the body (the so-called foot), which appears in the form of dark color bands or waves. These bands are best seen through a plate of glass when the animal's foot is observed from below during progression. Animals showing arhythmic locomotion show no waves or bands on the sole of the foot. This form may be termed a refuge for our ignorance, for when we cannot explain how a certain species moves, we place it in the arhythmic group. It is probable that in time a great many snails said to have arhythmic locomotion will be found to have a definite type of rhythmic locomotion.

Gastropods having rhythmic locomotion fall into two groups, direct, where the waves move forward from the tail toward the head, and retrograde, where the waves move from the head toward the tail. In both these groups there are two types of waves, the monotaxic, where the foot is coursed by a single system of waves, and the ditaxic, where the foot is divided by a median line or furrow, the waves moving independently on each half. Where the waves start simultaneously on both halves of the foot and proceed with parallel motion we have opposite ditaxic locomotion. Where the waves move alternately on the two sides we have the alternate ditaxic type.

Besides these locomotor forms, there are still other methods. Thus the Cypraeidae progress by lateral waves, the Strombidae by a leaping movement, and the Truncatella by a curious stepping movement.

Each locomotor type has been found to be constant for all species of a given genus or family. If we look at any classification of the families of the molluscs, we find a hodgepodge of locomotor types grouped under the same suborder or section. Such a classification does not seem to give a true picture of the evolutionary development of the Gastropods. If, after more data have been accumulated, the molluscs are grouped according to their method of progression, we may not only formulate a far better arrangement of the Gastropod families, but we may obtain a clearer picture of the evolution of marine shells into land species. There is a chance that we may find intermediate forms enabling us to link up the entire evolutionary chain. (Illustrated with charts and motion pictures.)

THE INFLUENCE OF AGE, SEX, AND SITUATION ON THE FREQUENCY, FORM AND FUNCTION OF QUESTIONS ASKED BY PRESCHOOL CHILDREN

By

MADORAH E. SMITH

The material analyzed consists of verbatim records of the conversation of 153 girls and 152 boys ranging in age from 18 to 72 months, with the average at 43.6 months. Two situations were studied: A, when the child was alone with adults (198 records); and C, when he was engaged in free play with other children of preschool age (107 records). Of the 22,944 sentences recorded, 13 per cent were questions.

The most striking differences due to age were: 1, the increase in the proportion of questions to total number of sentences with each half-year up to five and one-half years, when both numbers and percentage fell, and the increase from 49 per cent of question-asking children at 2 years to 95 per cent at 5 years; 2, the same increase in proportion of questions to total number of sentences for mental ages from 2 to 5 years, with a drop at 6 years and a rise at 7 years; 3, "what" and "where" were the interrogative words most frequently used by the youngest children. "How," "when" and "why" were not used at all at two years, but after that increased in frequency at each age level, while the "what" and "where" questions correspondingly decreased in relative frequency; 4, almost half of the questions asked by two-year-olds were introduced by an interrogative word, about a quarter of them at 4 years and a third at 5 years; 5, questions of greatest frequency at two years, and which decreased in relative frequency with age, were those inquiring as to the whereabouts of persons or objects, and those asking for the names of persons or things; 6, questions increasing significantly with age were those of fact, time, invention, concerning number and calculation, concerning human intentions or actions, and those of cause.

The most striking differences due to sex were: 1, girls asked more questions at two years; 2, boys asked more causal questions and used "how" and "why" more frequently; 3, girls asked more questions concerning social rules, names of things and questions of place.

The most striking differences due to situation were: 1, many more questions proportionately were asked in A than in C, and there was a tendency, especially among the younger children in situation C, to direct many questions to adults; 2, questions concerning human actions or intentions and questions of fact, time, invention, cause, calculation and corroboration, barring mere requests for a repetition of the question and variations of the imperative, were more frequent in situation A; 3, questions of place, name, classification, and variations of the imperative were more frequent in situation C.

Those differences favoring boys and situation A are for the most part in the same direction as those noted in the older children. (Illustrated with charts.)

RACIAL "PASSING-OVER" IN HAWAII

By

ROMANZO ADAMS

A comparison of the census population of Hawaiians and part Hawaiians for 1930 with estimates based on the figures for 1920 and births, deaths, and removals for the intervening years indicates a passing over of six or seven hundred part Hawaiians into the Hawaiian group.

If one takes the reported births of Hawaiians and part Hawaiians for any recent year and deducts for each group the deaths reported up to 1930, the remainders—the numbers of those surviving—do not correspond to the census count in that the census has about twenty per cent more Hawaiians than expected and correspondingly fewer part Hawaiians. This suggests that when some part Hawaiians marry Hawaiians they consider the small amount of non-Hawaiian blood as too little to be worth reporting to the enumerator.

This theory is confirmed by some dark part Hawaiians who say that while they know that they possess a little non-Hawaiian blood, they do not think it enough to be worth reporting. They claim full Hawaiian ancestry.

This passing over of part Hawaiians does not appear to be induced by any hoped-for advantage. It seems to be just when the non-Hawaiian blood is not sufficient to be evident in their color or features or to affect their social status. Probably this passing-over has been going on for more than a hundred years and there is some ground for the conjecture that there was a higher proportion of such passing in the period 1830-1870 than in the more recent years.

Probably two-thirds of the present Hawaiians as enumerated for census purposes have at least a little of the blood of immigrants and transients who came to Hawaii after 1778.

A MEASURE OF ISSUES IN HAWAIIAN ELECTIONS

By

Andrew W. Lind

The attempt to completely reduce politics to mathematical formulae is doomed to failure, but certain preliminary measures of election issues have been devised for Honolulu. The high ratios of participation in elections on the part of most of the racial groups bespeaks an informed and interested electorate.

The method utilized in the present study was the correlation of the vote received by various candidates in the elections of 1928 and 1930 in 46 precincts of Honolulu with certain other measurable factors, such as the ratios of the several racial groups, the percentages of the dominant economic group, and the proportion of party strength in the voting population of the same areas.

The disposition of all groups to vote for candidates of their own racial stocks appears prominently only with respect to candidates who are relatively unknown, or who represent no important civic issues. When a candidate becomes popularly identified with a given point of view or a vital public issue, he draws support from a variety of cultural and social levels, while at the same time he alienates a part of his own racial community. In the more hotly contested elections, the tendency for candidates to cut across racial lines is accentuated. Correlations between the votes received by various candidates of the same political party confirm local opinion that party affiliations exercise the greatest influence upon the vote, transcending all other bonds, such as race, religion, or economic class. The deviation of the vote polled by a given candidate from the pattern of his party suggests the best index of the effectiveness of "personal" factors in political campaigns. (Illustrated with charts.)

THE HOUSING PROBLEM AND ITS SOLUTION

By

Harald Wülfing

(Translation by Dr. Robert E. Park)

In construction with public rather than with private funds there is the danger that the law of supply and demand will be left out of consideration, assuming that a building program of this sort is to be carried out and the resources are to be divided accordingly under conditions prevailing in the present uneconomic procedure characteristic of large city development. With means provided by their taxpayers, large cities are able to build immense suburban cities. In doing this the officials assume that everyone who seeks a dwelling within the city is economically justified in settling there without taking into account the probable future demands of the community for labor. They accordingly undertake to assist, at public expense, in the erection of the necessary buildings without considering the possibility of the decentralization of industry and of the possible return of urban laborers to the rural type of living. The consequence is that a type of housing which has its origin in an economic situation that is uncontrolled is supposedly solved by the arbitrary intervention of governmental financing and in accordance with the uneconomic procedure imposed by the centralization of industries in great cities where the rent-barracks have been erected on the grandest scale.

The question of economic management, having in view the necessity of rebuilding, is solved by industry and commerce and by rationalization; in actual city building by decentralization of the industrially employed masses. Under these circumstances the question of high or low buildings, assuming the permanence of existing land values, will inevitably solve itself in favor of the low horizontal type, by a movement into the region of low-priced land.

New building, intended to meet the demand for housing, because of the high rate of interest and the lack of capital, must rely upon public rather than private funds, since public funds can be obtained at a lower rate of interest. The amount of the unsocial house-rent tax, funded for purely political purposes, is bound to be limited with the new building activity and, with the far-reaching intervention of private capital, in view of the greatest possible building activity, designed to diminish the numbers of the unemployed. However, this involves a complete and rapid abandonment of the public housing and of the official financial assistance for new building. The final consequence of all this will be the revival of reliance upon private credit and the return to a housing program which gives the widest scope to every sort of private initiative and permits the full and free functioning of the law of supply and demand.

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HAWAIIAN ACADEMY
OF SCIENCE

EIGHTH ANNUAL MEETING

MAY 3-6, 1933

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Eighth Annual Meeting were held in Dean Hall, University of Hawaii, May 3 to 5, 1933, ending with a banquet at the Pacific Club, May 6.

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1932-1933

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PROGRAM OF THE EIGHTH ANNUAL MEETING

WEDNESDAY, MAY 3, 7:30 P. M.

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

Mr. J. F. Voorhees: Some factors controlling rainfall and rainfall distribution in the Hawaiian islands.

Mr. E. G. Burrows: Climate and health in Hawaii.

Dr. Romanzo Adams: The population of Hawaii in 1779.

Dr. J. W. Coulter and Miss Bernice B. H. Kim: The Koreans in Hawaii. (Presented by Miss Kim.)

Mr. L. A. Henke: Cane molasses as a feed for livestock.

Miss Carey D. Miller: Studies of the nutritive value of opihi (*Helcioniscus exaratus* and *H. argentatus*). II—Hemoglobin regeneration in anemic rats fed on opihi.

Dr. C. J. Hamre: Histology of the spleens of anemic rats fed on opihi.

Dr. H. L. Lyon: Measuring sunlight.

THURSDAY, MAY 4, 7:30 P. M.

Presentation of papers:

Dr. J. L. Collins: The genotype of the Cayenne pineapple.

Mr. K. R. Kerns: Histological studies on gametogenesis and fertilization in the pineapple.

Dr. M. B. Linford: Correlation studies on pineapple fruits and crowns.

Dr. O. C. Magistad: Nitrogen fertilization of pineapples.

Dr. Constance E. Hartt: The rôle of potassium in the nutrition of plants, with special reference to sugar cane.

Dr. F. B. H. Brown and Dr. Elizabeth D. W. Brown: A discussion of representative Pacific genera with evidence bearing on their origin and migration. (Presented by Mrs. Brown.)

Dr. T. G. Yuncker: A revision of the Hawaiian species of Peperomia.

Mr. T. C. Zschokke: Poisonous plants now in Hawaii.

FRIDAY, MAY 5, 7:30 P. M.

Presentation of papers:

Dr. F. X. Williams: Architecture among wasps.

Mr. D. T. Fullaway: A new Thripoctenus parasite from the Philippines.

Dr. E. M. Bilger, Mr. W. H. Hammond, and Mr. R. M. Loveland: The iodine content of Hawaiian food products. (Presented by Dr. Bilger and Mr. Loveland.

Dr. Leonora N. Bilger, Mr. W. Y. Young, and Mr. Mark Westgate: Some chemical investigations of the avocado. (Presented by Mr. Westgate, introduced by Dr. Bilger.)

Dr. Leonora N. Bilger and Mr. H. Y. Young: A study of the chemical reactions occurring at the various stages in poi fermentation. (Presented by Mr. Young, introduced by Dr. Bilger.)

Dr. C. P. Sideris and Miss Beatrice H. Krauss: Physicochemical variations in pineapple fruits and their importance in the quality of the fresh and canned product. (Presented by Miss Krauss.)

Mr. R. S. Bean: Protease activity of the vegetative tissues of the pineapple plant.

Mr. G. C. Munro: Preserving the rare plants of Hawaii. (Read by the Secretary.)

Mr. R. J. Baker: Biological records by means of motion pictures.

SATURDAY, MAY 6, 6:45 P. M.

Pacific Club banquet.
Constitutional order of business.
Installation of new officers.
Presidential address: Water.
Adjournment.

ABSTRACTS OF PAPERS

WATER
(Presidential Address)

By

CHARLES S. JUDD

"The cry of the wounded on the battlefield, of the traveler lost on the desert, and of shipwrecked mariners adrift in a boat; that which is usually taken for granted and is never missed until the well goes dry; the greatest solvent known; a good servant but a most powerful and destructive master; the lack of which is the most effective agency in limiting human settlements; a powerful factor in changing the configuration of the earth's surface; and what for centuries was considered and still is spoken of as an element, and what, when pure, is colorless, tasteless and odorless."

Water exists in the greatest quantity of any single substance and is absolutely essential for existence. Covering as it does five-sevenths of the earth's surface it would, were this surface smooth, without mountains or valleys, cover it uniformly to a depth of about two miles. The amount of water used by some plants is shown by calculation that an acre of normal beech forest will transpire in a year the equivalent of about 10.6 inches of rainfall. Man's absolute dependence on water is indicated by the fact that this substance makes up about two-thirds the composition of the human body.

The problem of how the topmost cells of trees obtain the water in which they are continually bathed is still unsolved, but experimentation has indicated that water in thin columns has tensile strength and power of coherence sufficiently strong to withstand the pull from above.

The terrific power and force of water in motion is exemplified by the work of the waves of the sea, and by laboratory tests where the hardest steel alloys have been cut through by tiny jets of water. To water in motion in the form of ocean currents we are indebted not only for marked influences on the climate of many lands, but also for the wide dissemination of plants over the face of the globe. To the oceans and inland waters we are indebted also for a large share of our food supplies, and for easy and comparatively cheap methods of transportation. To water in motion, in the form of floods and freshets, we owe the almost inconceivable damage caused by the erosion of agricultural lands, although it must be admitted that this damage is initiated in great part by man's misuse of lands.

The practical problem of controlling and preventing this excessive erosion lies almost wholly in retaining and passing into the soil the maximum amount of precipitation, instead of allowing it to run off the surface. Soil conservation, chiefly the building or retaining of a vegetative cover, is almost synonymous with moisture conservation, and vegetation is our most dependable ally in the control of precipitation waters.

In opposition to the view that a forest cover is essential for water conservation, two prominent mainland engineers, Hoyt and Troxell, have argued against the protective value of the forest, basing their opposition on water measurements from certain watersheds which are extreme in character of soil and climate. In their arguments they omitted many facts that are vital to any logical and sane discussion of the subject of forests and stream flow, of watershed protection, and of the general utilitarian value of forested versus denuded lands. Despite the fact that their revolutionary ideas, if brought to their logical conclusion that to obtain a higher yield of water it is necessary simply to remove all the vegetation from the watersheds, would mean the eventual removal of all the soil as well, some misguided local individuals have been sufficiently influenced by these assertions to disparage the work of forest protection carried on in this Territory.

The value of the forest cover for water conservation has been recognized in Hawaii for many years, and during the last quarter of a century great progress has been made in preserving the unspoiled native forest areas and in reclaiming other areas on which the native forest has been destroyed. About 25 per cent of the total land area of the Territory has been set aside as forest reserves, and open areas in this important estate are now being replanted at the rate of about 30,000 trees per month. Despite the progress being made, we are still behind on our program of properly protecting our soil and water resources through forest extension.

Water supply, floods, erosion and worn-out soils are problems of the entire nation, and once the few fundamental facts about erosion are understood, the remedies become apparent. The situation is simply that there is only one fundamental way to control navigability and regularity of streams and to maintain normal climatic conditions and abundant crops, and that is by retaining in the ground itself as much as possible of the precipitation falling on the ground, and by retarding as much as possible its run-off from the surface of the soil.

SOME FACTORS CONTROLLING RAINFALL AND RAINFALL DISTRIBUTION IN HAWAII

By

JOHN F. VOORHEES

Nearly all rainfall is produced by mechanical cooling of the atmosphere. This cooling is due to the expansion of rising bodies of air. Air rises as a result of two forces, convection and the upward deflection of winds by mountains.

Convectional rains are comparatively few in the Hawaiian islands, but are more or less general in character and produce about one-fourth of the annual precipitation. The infrequency of convectional rains is probably due to the presence of an inversion in the vicinity of the 10,000-foot level when trade winds are blowing.

Distribution of the orographic rain is controlled by the direction and force of the wind, by the slope, height, dissection, and trend of mountains, and by their location with respect to other mountains.

A study of absolute humidity indicates that sea-level air ascending a mountain will nearly always reach its saturation point before attaining an altitude of 2300 feet. We would therefore expect to find rainfall increasing from sea level to 2300 feet and decreasing above that altitude. This is approximately true on the broad comparatively smooth windward slopes of Mauna Kea, Mauna Loa, and Haleakala. On Oahu the steep windward slopes of the Koolau mountains seem to drive the air upward so rapidly that the rain is carried over the top of the range, which is 2500 to 3000 feet high, and the maximum rainfall is found a short distance to the leeward.

On western Maui and Kauai are mountains 5000 to 6000 feet high with deep V-shaped valleys facing the trade winds and acting like funnels through which the rain is carried to the crest of the mountain and dropped there. These two crests are the wettest points in the Territory.

The mountains on Molokai seem to produce less rain than the Koolau mountains of Oahu although they are considerably the higher. The reason appears to be that the Molokai range is almost parallel to the trade winds, instead of at nearly right angles to them.

The Waianae Mountains on Oahu are higher than the Koolau Range and parallel to it, but receive less rain because they are to the leeward and the air has lost the major portion of its moisture in passing over the windward range. (Illustrated with maps.)

CLIMATE AND HEALTH IN HAWAII

By

EDWIN G. BURROWS

This study was made under the direction of Prof. Ellsworth Huntington, of Yale University, as a test case of the proposition that white men do not thrive in tropical climates. The study has two objectives; to gain a general idea of the healthfulness of Hawaii's climate, and to analyze in detail the effect on health of various climatic factors in Hawaii.

Army statistics of admissions to hospitals are a more accurate index to health than any civilian figures. Admissions at United States army posts show that Hawaii is distinctly more healthful than the other tropical stations, the Panama Canal Zone and the Philippines, and for the last few years has been more healthful than any mainland corps area. This shows that Hawaii is decidedly healthful for a residence of two or three years.

To study effects of residence lasting through several generations, the status of members of the Hawaii Mission Children's Society was compared with that of other Caucasians in Hawaii. The descendants of missionaries hold an average of one and one-half directorates per man in corporations listed on the Honolulu Stock Exchange, as compared with one directorate to forty men among other Caucasian residents. The percentage of descendants listed in "Who's Who in America" is 0.09 as against 0.03 for other Caucasian residents. Although irrelevant factors affect these comparisons, they show that a superior group of Caucasians can maintain its superiority in Hawaii through at least three generations.

Detailed analysis of climatic factors brought out the following conclusions: 1, the warmer months in Hawaii are the more healthful; 2, a clear optimum of effective temperature was not found, Hawaii's climate staying either within the "summer comfort zone" or slightly below it; 3, sunlight appears to have no marked effect on health under ordinary living conditions; 4, Kona weather is as healthful as trade-wind weather, if the samples studied are adequate.

The healthfulness of Hawaii shows that the proposition "White men do not thrive in tropical climates" is not entirely true. A comparative study of effective temperatures and admissions to hospitals at a large number of army stations, in and out of the Tropics, promises progress toward a more accurate statement of what truth may be in the proposition. This might be expected to take the form of an optimum range of effective temperatures. (Illustrated with charts.)

THE POPULATION OF HAWAII IN 1779

By

ROMANZO ADAMS

It is now possible to compare the estimate of the population of Hawaii made by Captain King with the estimate made by Mr.—later Admiral—Bligh, who was master on Captain Cook's ship. So far as the islands of Kauai and Niihau are concerned, the estimates of King and Bligh may be compared with that of Captain Cook. The data for such a comparison are found in the following table.

	Capt. Cook 1778	Capt. King 1779	Mr. Bligh as of 1779
Hawaii	....	150,000	100,000
Maui	....	65,400	40,000
Molokai	....	36,000	20,000
Lanai	....	20,400	1,000
Oahu	....	60,200	40,000
Kauai	30,000	54,000	40,000
Niihau	500	10,000	1,000
Lehua	....	4,000	200
Total		400,000	242,200

The main purpose of this paper is to point out the desirability of some competent re-estimate not only of the population at this time, but of other early doubtful statistical data. It is suggested that the Hawaiian Academy of Science appoint a committee to assemble the relevant factual information, to deliberate thereon and report findings at some future meeting. (Illustrated with charts.)

THE KOREANS IN HAWAII

By

John Wesley Coulter and Bernice B. H. Kim

The Koreans in Hawaii, although small numerically, 6,461 in 1930, only 1.8 per cent of the total population of the islands, are a people about whom one hears peculiar reports concerning their political and national movements and the relatively high proportion of youthful and adult delinquents. Their economic and cultural status in the islands is largely the result of their natural environment and social background. Korean civilization approximates that of the Chinese, yet the two peoples are as different as the French and the English. The four main aspects of the cultural background of the Koreans are: a great respect for learning; filial piety and ancestor worship; the *yangban* (gentleman class) philosophy; the subservient position of women and their seclusion. Between 1903 and 1905 more than 7000 Korean immigrants, mainly common laborers and ex-soldiers from port cities, came to Hawaii to work on sugar cane plantations. Over 6000 were young bachelors between the ages of 20 and 30, the remainder being married people, some with families. The general reaction to plantation work and life was one of disappointment, and resulted in the return of about 2000 to Korea and the moving on of 1000 more to the mainland United States. With the loss of Korea's independence in 1910, the remaining Koreans divided into two factions, and the cleavage has remained. Two factors caused the Koreans to migrate from the country to the city: the bringing in of picture brides from 1910 to 1923 and subsequent settling about Honolulu, and the Japanese strike on Oahu in 1919, during which a large number came as strike-breakers from the other islands. Many settled in the Liliha district of Honolulu because of its proximity to the pineapple cannery and the water front, where they found employment. Within a generation the change from Korean to American ideas and practices has taken place, a change too rapid and unselective, resulting in an appreciable personal and social disintegration. In educational advancement the Korean students in Hawaii compare favorably with the two older and more numerous Oriental groups, both in achievement and in proportional representation. A special problem that will arise in the near future for the Korean community will be the guidance of the children of the picture brides, who compose the large majority of the young Koreans.

CANE MOLASSES AS A FEED FOR LIVE STOCK

By

LOUIS A. HENKE

Hawaii with its million tons of sugar produces about 225,000 tons of cane molasses annually, some of which is exported and some used locally as a fertilizer or feed.

Cane molasses is a feed low in protein but rich in carbohydrates, largely in the form of easily digestible sugars. The potash content is high. In general it is appetizing to most animals and it has long been fed to plantation horses and mules in Hawaii and elsewhere with satisfactory results. The investigations with this feed, recently carried on at the Hawaii Experiment Station and reported here, have to do largely with the value of cane molasses for fattening swine and for dairy cows.

As a result of five experiments, ranging in length from 70 to 126 days and involving a total of 63 pigs, it seems well established that cane molasses in amounts up to 20 per cent of the concentrate mixture fed is worth approximately as much or more, pound for pound, as barley as a feed for fattening swine.

Dairy cows were fed a ration containing 25 per cent cane molasses in the concentrate mixture. In two, short-time, fifteen-week, double-reversal feeding experiments, one with 8 and the other with 10 cows, the production of milk and fat was practically the same on the molasses and non-molasses rations. The cost of milk production was lower on the molasses ration.

In a long-time test designed to show the accumulative effects, if any, of heavy molasses feeding to dairy cows, a 25 per cent cane molasses ration was fed for seven years, including with the necessary controls, a total of 232 cow years to date. Production on the molasses ration has been quite satisfactory, but a lowered reproduction efficiency has necessitated continuing this work for further data. (Illustrated with charts.)

STUDIES OF THE NUTRITIVE VALUE OF OPIHI (HELCIONISCUS EXARATUS AND H. ARGENTATUS)
II.—HEMOGLOBIN REGENERATION IN ANEMIC RATS FED OPIHI

By

CAREY D. MILLER

Young albino rats raised in the laboratory were used as subjects. From birth until the supplementary feeding began they had milk as their only food. At weekly intervals blood samples were taken and the hemoglobin determined. When the rats showed a very severe anemia, 3.0 to 5.0 gms. of hemoglobin per 100 cc. of blood, the supplementary feeding was begun.

The first set of experiments, in which 4 to 8 gms. of *opihi* were fed daily as a supplement to the milk diet of 16 anemic rats, showed that the *opihi* had a low hemoglobin regenerating value. Four control rats fed daily 4 gms. of calves' liver showed a rapid rise in the hemoglobin. Three rats fed a supplement of 0.5 gm. iron per day were expected to serve as positive controls. After 4 weeks they still showed little hemoglobin regeneration and were in poor condition, but when 0.01 mg. copper was added daily, the rats began to look better in 2 days, and in 3 or 4 weeks the hemoglobin was almost normal.

After the first set of anemia experiments was complete, Miss Ruth Robbins made additional analyses of the *opihi,* including calcium, phosphorus, copper, and iron. These analyses showed the *opihi* to be very high in iron, 0.0134 per cent of fresh material, but very low in copper, 0.00023 per cent of fresh material.

A second set of experiments was then carried out in which 15 anemic rats were fed daily 2 to 4 grams of *opihi* as the only supplement to the milk diet, and 12 anemic rats were fed *opihi* plus 0.01 mg. of copper as the daily supplement. In several cases the subjects of these contrasting diets were carefully matched litter mates. The results showed that the hemoglobin content of the blood will rise more rapidly and to a higher figure when copper and *opihi* are fed as supplements than when *opihi* alone is fed. Our results confirm the contention that copper is necessary for hemoglobin building and that the hemoglobin regenerating value of foods, at least for the anemic rat, depends largely on their iron and copper content.

In the course of these experiments it was noted that severely anemic rats usually showed enlarged hearts, a fact that has previously been reported.

We have also noted a condition which seems not to have been previously reported, namely enlarged spleens. The control animals on milk that succumb rather quickly to severe anemia, have spleens of normal size, but animals fed supplements such as *opihi,* that permit a moderate recovery of hemoglobin may show much enlarged spleens.

A word of caution about applying the results of these experiments to human nutrition. Enlarged spleens do not necessarily follow the eating of *opihi.* The changes taking place in the spleens occur only in rather severely anemic animals and can be produced at will by feeding other foods as supplements to the milk diet. The *opihi* is undoubtedly a valuable food, being a concentrated source of vitamin A and an excellent source of calcium, phosphorus, and iron. The need of the human body for iron is very much greater than is the need for copper, and we are more likely to get enough copper than enough iron. (Illustrated with slides and charts.)

GROSS AND HISTOLOGICAL CHANGES OF THE SPLEEN OF ANEMIC RATS FED SUPPLEMENTARY DIETS

By

CHRISTOPHER J. HAMRE

Gross and histological studies were made of the spleens of anemic rats and of rats in various stages of recovery induced by various supplementary diets. Strictly anemic rats possessed spleens of about normal size, that is, of a normal proportion to their total body weight. The supplementary diets were found to induce enlargement of the spleen in an inverse proportion to their capacity to induce recovery from anemia, those producing the lowest grade of recovery producing the greatest enlargement of the spleen. The supplemented diets found to produce the greatest enlargement of the spleen and the lowest grade of recovery from anemia were milk and flour, and milk and *opihi.* Milk, *opihi,* and copper produced complete recovery and normal-sized spleens, as did also milk, iron and copper. Milk and iron produced a very low grade of recovery from anemia and was without effect on the size of the spleen.

Histologically the spleens of strictly anemic animals were found to be characterized by the loss or reduction of the periarterial white pulp and the malpighian corpuscles and a relatively proportionate increase of the red pulp. Iron added to the anemia diet induced no histological changes in the spleen while other supplementary foods induced regenerative changes. These changes were characterized by the early appearance of groups of basophilic cells and lymphocytes in the red pulp area and their later disappearance as the periarterial white pulp and malpighian corpuscles were regenerated.

No explanation of the enlargement of the spleen was offered other than that it might have been associated with the general resumption of growth which the supplementary foods induced. The possible connection of the groups of basophilic cells to lymphocyte production was also suggested. (Illustrated with slides and charts.)

MEASURING SUNLIGHT

By

HAROLD L. LYON

The speaker exhibited and described an instrument in which a Franklin pulse glass was supported at its center across the upper end of a rotating axis, said axis being inclined to the vertical. An adjustable stop inserted at the highest point in the circle in which the pulse glass might swing permitted the pulse glass to swing back and forth or teeter on the axis through an angle of from 150° to 175°. The instrument was enclosed in a housing which was so designed that when a bulb of the pulse glass was at the lowest point of its possible swing it would be exposed to sunlight, while the other bulb, which would at the same time be at the highest possible point in its swing, would be shaded. Heat from sunlight would drive the liquid out of the exposed bulb into the shaded bulb until this bulb became heavier than the exposed bulb, when the pulse glass would swing on its axis and the heavier bulb would pass to the lowest point in its swing, where it would in turn be exposed to the sunlight. The liquid would then be driven out of this second bulb back into the first bulb until it caused rotation in the other direction. A wing was so arranged on the axis that at each swing of the pulse glass it would simultaneously contact two points and, in so doing, close an electric circuit which operated a recording device yielding a printed record. Records made by one of these instruments were exhibited, which clearly showed not only the length of time that the sun was obscured by clouds, but also the relative density of those clouds. (Illustrated with charts and instruments.)

THE GENOTYPE OF THE CAYENNE PINEAPPLE

By

J. L. COLLINS

Vegetative reproduction such as we have in the pineapple offers almost no opportunity for heterozygous recessive genes which are present in the genotype to become apparent in development, and they may be carried along hidden and unsuspected for many generations.

We learn about the kind of genes present in the genotype of an individual or variety by examination of the progeny from sexual reproduction and from the rare mutations occurring in asexually produced populations. These two methods have shown that the genotype of the Cayenne pineapple contains many hidden recessive genes.

From a study of the progeny produced when Cayenne is selfed it is evident that the variety has many more heterozygous recessive genes than the 16 that have been rather critically studied, and concerning which something is known. The question naturally arises as to why this variety is so extremely heterozygous. Two explanations can be offered for this fact: 1, we believe the Cayenne originated as a seedling, a hybrid between two other types, and part of its heterozygosity dates from the hybrid origin; 2, some of the recessive genes now present in the genotype were not there originally, but have appeared since the variety was a clon.

Vegetative reproduction is a method which permits the accumulation of recessive mutations, while sexual reproduction, and in particular self-fertilization, prevents the accumulation of recessive genes in the genotype.

The phenomenon of mutation is not new, but the knowledge of the rôle it plays in increasing the heterozygosity of clons is relatively new. Müller made use of this principle in an ingenious manner in studying the rate of mutation in the fruit fly *Drosophila melanogaster,* a sexually reproduced organism, and Banta and Wood found that long continued parthenogenesis in *Cladocera* resulted in the accumulation of recessive genes, which became evident in the subsequent sexually produced progeny.

It is, therefore, my opinion that the genotype of the Cayenne pineapple today contains many more recessive genes than it had when the variety was new, and, furthermore, that this heterozygosity will continue to increase. As a result we may reasonably expect an increasing number of mutant characters to appear in Cayenne populations with the passage of time. (Illustrated with slides and charts.)

HISTOLOGICAL STUDIES ON GAMETOGENESIS AND FERTILIZATION IN THE PINEAPPLE

By

KENNETH R. KERNS

The archesporial cell arises under two layers of nucellus. It is recognized by its larger size and different staining capacity. As the archesporial cell enlarges, the ovule bends, becoming the anatropous type. When the ovule becomes bent about 90 degrees the inner integuments first appear. The archesporial cell continues to elongate and enlarge, and the outer integuments are differentiated. The inner and outer integuments continue to encircle the ovule, forming the micropyle where they meet. This is the small opening through which the pollen tube will enter at the time of fertilization.

When the inner integument has nearly encircled the ovule the archesporial cell first divides reductionally. Each of the two resulting nuclei divide again equationally to form four nuclei. Apparently walls are formed between these nuclei. The basal of the four nuclei separates from the other three and is destined to form the entire embryo sac. The degeneration of the three nuclei at the micropylar end is apparently a general rule, although at least one instance was observed when those at the chalazal end degenerated, leaving the one at the micropylar end.

The remaining nucleus divides three times equationally to form eight free-swimming nuclei. These move into place, two forming the synergids and one the egg nucleus at the micropylar end of the ovule. Three form the antipodals, which lie at the chalazal end of the ovule and quickly degenerate. The other two form the endosperm nuclei, each of which keeps its own identity, lying together in the mid portion of the embryo sac.

The fertilization is very regular, the pollen tube entering the micropyle and the double fertilization taking place. The two male nuclei are about the size of the egg nucleus and smaller than the endosperm nuclei.

The styles of Cayenne flowers have a distinct tendency to arrest the development of Cayenne pollen tubes. (Illustrated with slides and charts.)

CORRELATION STUDIES ON PINEAPPLE FRUITS AND CROWNS

By

MAURICE B. LINFORD

This discussion deals with some relationships of pineapple fruit development and quality.

Quality has been judged visually on a numerical basis by comparison with 5 standard photographs defining 5 quality classes. Class 1 includes very poor fruit with wholly opaque flesh, while Class 5 includes superior, translucent-fleshed fruits. Classes 2, 3, and 4 are intermediate.

About three-quarters of the period from planting to harvest is given to growth of stem, leaves, and roots. Then, during a brief transition, the number of florets to compose the aggregate fruit is fixed by floral differentiation. Unlike most horticultural fruit plants, which blossom profusely and then absciss excess blossoms or immature fruits, the pineapple must carry to maturity the full number of florets or eyes differentiated.

Number of florets differentiated was found correlated with stem diameter, less closely with stem weight, but not at all with stem length in two sample lots. Number of eyes differentiated is not directly proportional to plant size and probably is not proportional to ability of the plant to mature fruit of good quality.

Eye weight is a measure of degree of development. Eye number, for calculation of eye weight, has been estimated by counting eyes in one spiral and multiplying by 8 the number of similar spirals.

Specimen data presented showed no correlation of translucence (quality) with eye number, some correlation with fruit weight, and better correlation with eye weight.

Data from one fertilizer test showed increasing rates of application to be followed by better quality, heavier fruit, more eyes, heavier eyes, and relatively shorter crowns. Advance of the season here resulted in reverse changes.

Adverse factors during fruit growth and ripening may limit quality, but it is suggested that sometimes quality is limited by the differentiation of more fruitlets than the plant is prepared to mature. (Illustrated with slides and charts.)

NITROGEN FERTILIZATION OF PINEAPPLES

By

O. C. Magistad

The results of 28 field experiments with pineapples, in each of which the amount of nitrogen added was varied, was shown in the form of graphs. With but a few exceptions on virgin soils, addition of nitrogen caused an increase in average fruit weight and tonnage per acre. It was shown that yields were greater on virgin soils at the same level of added nitrogen than on non-virgin soils.

On the basis of a composite yield curve derived as a mean of the result of field experiments, the most economical rate of nitrogen fertilization at varying prices of fertilizer and fruit was graphed. (Illustrated with charts.)

THE RÔLE OF POTASSIUM IN THE NUTRITION OF PLANTS WITH SPECIAL REFERENCE TO SUGAR CANE

By

Constance E. Hartt

Data are presented indicating that in sugar cane potassium deficiency causes derangement in synthesis and translocation of proteins and carbohydrates.

Sugar cane plants, variety H-109, grown in quartz sand and supplied with 1, 87.9 p.p.m. K; 2, 39.0 p.p.m. K; 3, 3.9 p.p.m. K; 4, no K, but Na; 5, no K, no Na, were harvested in November, 1931, and April, 1932, when they were 9 weeks and 7½ months old, respectively.

Determinations were made of the percentages of amino, protein and total nitrogen, and sucrose, reducing and total sugars found in the blades and stems of plants 1 to 3 of the November harvest and of all the plants in the April harvest.

Because in November the blades of plants 3 contained 0.231% amino and 1.461% protein nitrogen, whereas the blades of plants 1 contained 0.07% amino and 1.585% protein nitrogen, it is suggested that the synthesis of proteins from amino acids was curtailed in the potassium-deficient plants. Stems at that age showed similar but smaller variations. When 7½ months old, the blades of all the potassium-deficient plants contained larger percentages of amino, protein, and total nitrogen, while stems showed the reverse condition. It is, therefore, suggested that by the time of the second harvest, translocation of nitrogenous compounds from blades to stems was decreased. Microscopic observation showed a necrosis of the phloem, which might decrease translocation.

Sugar analyses showed that in general the blades and stems of the controls contained more sucrose and less hexose and a more active invertase than the potassium-deficient plants. This indicates that the synthesis of sucrose from hexoses is curtailed by potassium deficiency due to the weak activity of invertase. The stems of plants 4 and 5, harvested in April, were low in hexoses, and since the blades of those plants were high in hexoses it is suggested that their translocation from blades to stems was affected by severe starvation. (Illustrated with charts.)

A DISCUSSION OF REPRESENTATIVE PACIFIC GENERA WITH EVIDENCE BEARING ON THEIR ORIGIN AND MIGRATION

By

FOREST B. H. BROWN AND ELIZABETH D. W. BROWN

In the paper as presented the data dealing with the Pteridophytes were contributed by Dr. E. D. W. Brown, those with the Spermatophytes by Dr. F. B. H. Brown.

Investigations now in progress show with fair conclusiveness that more than 80 per cent of the flora of southeastern Polynesia is of American origin. Many close affinities are Malaysian, but here the ultimate affinities, significant as to origin, are largely American. Neither Asia nor Malaysia seem to have contributed more than a very minor proportion of the antecedents of the flora of southeastern Polynesia.

It is not improbable that the antecedents were carried by ocean currents in two main waves of dispersal from isthmian America, one in Cretaceous time or earlier, and the other in the Lower Eocene, as suggested in previous publications dealing with the Hawaiian flora. That whole islands of living vegetation may have been transported at this time is suggested by the presence of peculiar fauna associated with nearly every species. *Ficus prolixa,* for example, and the closely related *Ficus marquesensis,* are both present in the Marquesas, together with the peculiar wasps necessary for the fertilization of the fruits.

Plant evidences strongly indicate that the Tuamotus were at one time emerged, with high altitudes above the timber line, and supported a rich independent flora, largely of American origin. This flora, which possibly existed in Cretaceous time, is here designated as the Pre-Tuamotuan flora in distinction from the meager flora of the present Tuamotus. Affinities suggest that before and during submergence the Tuamotuan flora was dispersed to the Marquesas, Society Islands, Austral Islands, Rapa, and even westward to Malaysia. Some emigrants seem to have reached Hawaii.

Close affinities between Hawaii and islands centering around the Tuamotuan region suggest that the long ridge upon which Palmyra and other atolls now rest was probably emerged with high protuberances during Cretaceous time, affording a path of intermigration between the Hawaiian and the Pre-Tuamotuan floras. Very likely it also supported a Pre-Palmyra flora of American origin, from which some elements were dispersed to Hawaii and others to the Pre-Tuamotuan flora, from which, in turn, radiations reached the Marquesas, Society Islands, Rapa, Austral Islands, and other parts of Polynesia or westward to Malaysia. The distribution of *Campylotheca,* for example, suggests a Pre-Palmyra origin for this genus. (Illustrated with maps.)

A REVISION OF THE HAWAIIAN SPECIES OF PEPEROMIA

By

TRUMAN G. YUNCKER
(DePauw University, Greencastle, Indiana)

The Piperaceae are represented in Hawaii naturally by the genus *Peperomia* and by two introduced species of *Piper.* In 1913 Casimir deCandolle presented a treatment of the Hawaiian Peperomias recognizing 73 species, of which 47 were described as new. Many species of *Peperomia* exhibit considerable variation and it is often difficult if not impossible to identify specimens with the use of existing keys. As a result of a study made during the past nine months of a large amount of herbarium material including most of the types and, more especially, of the plants in the field, a revision of the genus is presented which includes 38 species, 8 of which are described as new to science. All but 4 species are believed to be endemic. It has been impossible to verify or accept some of the features which previous authors have used for specific distinction, which accounts for this great reduction in the number of species. *Peperomia reflexa,* a widely distributed species, is our only member of the subgenus Micropiper. Several species which develop fruit with an oblique apex and a subterminal stigma belong in the typically American subgenus Sphaerocarpidium. There are present in Hawaii, in addition, a number of species with fruit having rounded or pointed apexes and more or less apically placed, divided, and penicillate stigmas. These do not agree with any of the subgeneric divisions which have been previously established, and a new subgenus is described to include them. All members of this new subgenus, for which the name Hawaiiana is proposed, are believed to be endemic. The fruit of *Peperomia* is very viscid and it appears most logical to assume that distribution has been by birds. From available evidence it appears that the Polynesian species of *Peperomia,* including those in Hawaii, are more closely related to American than to Malaysian species.

POISONOUS PLANTS NOW IN HAWAII

By

THEO. C. ZSCHOKKE

The list of plants presented, comprising upwards of 80 species, was compiled with the assistance of botanists, foresters, physicians, and veterinarians, and is as complete as available information can make it. These species are roughly classified as poisonous if swallowed, poisonous if introduced into the blood stream through wounds or otherwise, possessing juice which is extremely painful although not fatal if taken into the mouth, possessing juice which causes temporary blindness or blisters on the skin, possessing stinging hairs or similar irritants other than sap, unsafe to use if not properly prepared, poisonous to live stock, fish poisons, and plants reputed to be unsafe, but concerning which no definite information is at hand.

Little was found in the literature concerning the poisonous properties of many of these plants, at least in a form that is intelligible to a layman, and much of this little seems to be contradictory or indefinite. Considerable research is necessary to determine at what stage in the growth of the plant the deleterious properties are most effective, or whether the reputedly poisonous effects assigned to certain plants have a basis in fact. In many species, likewise, it is not definitely known in just what part or parts of the plant the poisonous properties reside. As a corollary to this, the symptoms of the various types of poisoning should be classified and information concerning the antidotes made known to the public at large.

The list of poisonous plants, to which reference is made here, has been issued by the Agricultural Extension Service of the University of Hawaii as No. 49, dated May 3, 1933, and copies are available to persons interested.

ARCHITECTURE AMONG WASPS

By

Francis X. Williams

The architecture in the nests of wasps varies from mere holes in the ground through the mud-cell type to a culmination in the elaborate paperlike nests of the social species.

In the genus *Larra* are wasps that build no nests. Their prey consists of mole crickets, which the wasps drive to the surface of the soil, temporarily more or less immobilize by several stings and, before the crickets recover, glue an egg upon them. The crickets soon go underground, to be finally killed by the wasp grub. The large Philippine *Ammobia* wasp digs a burrow, stores it with Orthoptera and plugs up the entrance with soil. The tropical American *Podium* wasps go one step further, for they plug up with mud their short burrows, stored with cockroaches, or else make entire clay cells, as do the *Sceliphron* spider wasps. There is considerable architecture in some of the nests of the slender *Trypoxylon* wasps, and in the Psammocharidae of the group *Pseudagenia* and its relatives; here the cells are of mud, sometimes a number of cells together; one wasp uses a spider's retreat for her cells, another waterproofs them, while others use dried leaf-bits for building materials. The East Indian *Zethus cyanopterus* makes an elegant roofed-over nest of green leaf-bits and feeds her larvae daily with disabled caterpillars. *Stenogaster* wasps construct very elegant nests of old wood pulp and the like, and also feed their young daily. In the completely social wasps, such as *Polistes,* the cells are of papery materials and in many genera are protected by a cover. One species, *Leipomeles lamellaria,* builds under a leaf, the petiole of which is covered with gummy material as a protection against ants, etc. *Parachartergus apicalis,* also tropical American, makes a large, rather finely ribbed paper nest. (Illustrated with slides.)

A NEW THRIPOCTENUS PARASITE FROM THE PHILIPPINES

By

David T. Fullaway

The account here given is based entirely on a report made by Dr. I. D. Dobroscky.

The genus *Thripoctenus* is fairly new, it having been erected by Crawford in 1911 to provide for a Tetrastichus-like chalcid fly which had been reared from the bean thrips in California. Other species were found later in various parts of the world, the one here noted being the eighth. All are larval parasites of thrips, with similar habits.

This species, *Thripoctenus vinctus,* was found by Dr. Dobroscky at Los Banos, P. I., while searching for natural enemies of *Thrips tabaci,* which had been proved by Linford to be the vector of pineapple yellow spot virus. *Thrips tabaci* not being available in the Philippines, other possible hosts of *Thripoctenus* were investigated. *Taeniothrips longistylus* was found to be very common in the flowers of the lima bean and the cowpea, and when these were brought into the laboratory invariably a few *Thripoctenus* were brought with them. It was not known whether this species would parasitize *T. tabaci,* but as it was late in the season when the parasite was obtained, on the off-chance that it would be able to accommodate itself to other hosts, efforts were made to secure the parasite in sufficient numbers to test its adaptability in Japan, where *T. tabaci* is abundant on onion plants. In securing the parasites we learned much about their life history and habits. The adult was found to be positively phototropic, which made its collection easy at window lights. Females, which reproduced parthenogenetically, were generally collected. They chose to oviposit mostly in young thrips larvae not past the third instar. The time elapsing between oviposition and the first outward sign of parasitism in the prepupa was 7 to 9 days. When the prepupal skin of the thrips is shed, the pupa of the parasite is exposed. This transition occupied 1 to 2 days. The pupal period was 10 to 12 days. Adults lived about 4 days. Propagation in test tubes was secured by placing one female *Thripoctenus* with 50 larval *Thrips,* the highest degree of parasitism obtained by this method being about 40 per cent. Increase was very uncertain, however, since both parasite and host proved to be very delicate. Adults were more often reared from larvae collected in the field. The percentage of parasitism in field-collected material, however, was very low at times, probably due to fluctuations in the host populations. Transportation from the Philippines to Japan was effected while the parasite was in the pupal stage. Many lots were successfully transported, but the species failed to maintain itself on *Thrips tabaci* larvae, giving additional evidence of the correctness of the assumption that there is a high degree of specificity in *Thripoctenus*. The work here reported was done under the auspices of the Experiment Station, Association of Hawaiian Pineapple Canners, and the Territorial Board of Agriculture and Forestry. (Illustrated with specimens.)

THE IODINE CONTENT OF HAWAIIAN FOOD PRODUCTS

By

EARL M. BILGER, WESLEY HAMMOND, AND ROBERT LOVELAND

Iodine is an essential constituent of the diet, and small quantities are necessary for the elaboration by the thyroid gland of thyroxine, a regulatory substance or hormone important, among other things, in determining the rate of metabolism. In this investigation, which included the determination of the iodine content of air and water, two different colorimetric methods were employed. Turner's method, used by Mr. Hammond, depends upon ashing the dried sample, liberating iodine by means of bromine water, and estimating the amount through its blue color with starch in a Klett colorimeter. In the McClendon method, used by Mr. Loveland, the usual silica tube was replaced by a muffle furnace, where large samples (300 to 1000 grams) were necessary. This furnished a satisfactory method of ashing for most vegetables, but was unsuitable for cereal grains, nuts, or oily materials. In the latter cases an especially constructed oxygen burner was used. The iodine salts obtained by either process were treated with phosphoric and sulphurous acids and the resulting iodides converted to free iodine by means of sodium nitrite. The iodine, dissolved in carbon tetrachloride, was determined with a Klett colorimeter. Results of the analyses are expressed in parts per billion (p.p.b.) of air or water, or of the food material dried to constant weight at 100° C. Air contained 2.1×10^{-8} p.p.b. Ten samples of Honolulu tap water averaged 1.7 p.p.b., and ten samples of Aiea well water averaged 1.6 p.p.b. Places in the United States where water contains more than 2 p.p.b. are few. Water from typical goitrous regions contains less than 0.5 p.p.b. Other water analyses gave for Hahaione trench water 15 p.p.b.; Kaelepulu fishpond, 4.0; Manoa brook water, 3.5; ocean water, 25.7. Twenty-four food products were analyzed, the p.p.b. of the dried weight being: avocado oil, 8092; burdock, 156; beets, 167; string beans, 1427; mustard cabbage, 726; head cabbage, 192; cucumbers, 335; carrots, 548; celery, 635; daikon, 7706; fish powder, 936,198; ginger, 326; lotus, 1719; lettuce, 600; opihi, 4480; bell peppers, 330; Chinese peas, 436; pineapple, 1070; poi, 316; Irish potatoes, 164; sweet potatoes, 75; spinach, 2023; squash, 610; tomatoes, 200; yams, 175. A comparison between these figures and figures obtained by other investigators in the determination of iodine in vegetables grown in various sections of the United States shows that the iodine content of Hawaiian foods is sufficient to meet the needs of normal animal metabolism and that the foods compare favorably in this respect with the food products of certain mainland localities. The results are consistent with the absence of simple goiter in the islands. (Illustrated with charts and demonstration.)

SOME CHEMICAL INVESTIGATIONS OF THE AVOCADO

By

LEONORA N. BILGER, W. Y. YOUNG, AND MARK WESTGATE

This investigation of the sterol content and vitamin value of avocado oil was undertaken as part of a series of chemical studies on avocado pears. Some time ago W. Y. Young made an investigation of the tannin content. For commercial as well as scientific purposes it was of interest to establish certain facts concerning the nutritive value of avocados. Attention was directed to the oil, since Santos, Weatherby, and others worked with dried oil-free pulp, avocado mash, or whole fruit.

Vitamin research has revealed the fact that ergosterol when irradiated becomes Vitamin D. With a view to establishing a connection between the sterols of avocado oil and the nutritive value of the pears, the sterols of avocado oil were isolated by the following process: the whole oil was saponified with potassium hydroxide, the diluted soap extracted with ether, the ether solution of sterols evaporated, and the residue recrystallized from absolute alcohol. A yield of 0.2 per cent of sterols, glistening white flakes melting at 143-144° C., was obtained. A combustion analysis and molecular weight determination showed the molecular formula to be $C_{26}H_{44}O$.

A series of experiments on white rats was carried on, using irradiated and unirradiated whole avocado oil, sterol-free oil, and pure sterols. Avocado oil was shown to be a poor source of Vitamin D, and no Vitamin A was present. In a comparative study of avocado oil with Wesson's cooking oil, the former was shown to have no unusually high nutritive value.

AN INVESTIGATION OF THE CHEMICAL CHANGES OCCURRING IN THE VARIOUS STAGES OF POI FERMENTATION

By

LEONORA NEUFFER BILGER AND H. Y. YOUNG

A bacterial study of poi at various stages of its fermentation, made by Dr. O. N. Allen and Mrs. Ethel Allen, resulted in the establishment of the presence of lactobacilli, streptococci, yeasts, and mycoderms.

The purpose of this chemical study was to determine the products of the fermentations induced by the above organisms.

Three preliminary investigations were made. Poi was subjected to a complete quantitative analysis, in which water, starch, pentosans, reducing sugars, sucrose, proteins, fat, crude fiber, ash, phosphorus, and calcium were determined. The changes in starch and reducing sugar content during fermentation were determined. A decrease in reducing sugars at the beginning of the fermentation and a decrease in starch in the later stages were shown. The volatile and non-volatile acids were estimated at various stages of fermentation. More non-volatile acids were shown to be present at early stages and equal quantities of volatile and non-volatile acids at the later periods.

In the chemical study of fermentation products, the tests were made at the same stages as those used by Dr. and Mrs. Allen in their bacteriological investigation. These ranged from two hours to ten days. Lactic acid was found to be present at all stages although smaller amounts in zero-hour poi and in early stages than in later. In the presence of calcium carbonate, butyric acid was formed in later stages. The butyric ferment was present in poi, but is active only when the fermenting medium is neutral or slightly acid. Acetic acid was found to be present from two hours to ten days in gradually increasing quantities. Its formation results from the action of mycoderms on alcohol. Positive tests for small amounts of formic acid were given at all periods from two hours to ten days. *Lactobacillus pastorianus,* found in poi, is known to produce formic acid through its action on sugars and dextrin. Alcohol was absent at the beginning of the fermentation, but small amounts were detected from two hours to ten days. Carbon dioxide was found throughout the fermentation.

The products of fermentation, lactic, acetic and formic acids, alcohol and carbon dioxide, proven to be present at various stages, were consistent with the bacteria found at corresponding periods.

PHYSICOCHEMICAL VARIATIONS IN PINEAPPLE FRUITS AND THEIR IMPORTANCE IN THE QUALITY OF FRESH AND CANNED PRODUCT

By

C. P. Sideris and Beatrice H. Krauss

The tissues of ripe pineapple fruits may be opaque, semi-opaque, semi-translucent, or translucent. This condition is due to the presence of air in the intercellular spaces of the tissues, an opaque fruit containing great amounts, whereas a translucent fruit may have very little or none.

Tissues are white or opaque because of the great light-reflecting power of the air bubbles, which are here analogous to foam. In the translucent tissues the yellow pigments reflect the yellow rays, absorbing those of other colors. The air content of opaque tissues influences their specific gravity as well, opaque tissues being lower in this respect than the translucent. It has been found that fruits with translucent tissues will sink in water to an extent of 98 to 100 per cent, while those with opaque tissues will float to an extent of 80 per cent.

The total acid content of pineapple fruits varies to a great extent with the physical properties of the tissues, opaqueness being associated with high acidity and translucency with low. The accumulation of great quantities of organic acids in pineapple tissues is the result of abnormal metabolic conditions, this having been proven experimentally, but it has not yet been definitely proven whether the development of a high acidity is the cause of opacity or vice versa.

The palatability of pineapple fruits varies with the balance of sugar to acid, those containing great quantities of acid being as objectionable as those containing very little. Fresh fruits with a ratio of sugar percentage to citric acid percentage of about 28, and canned ones with a ratio near 33 are more palatable than those with values much above or below these figures. We have introduced the term "index of sweetness" to express the ratio of sugar percentage to citric acid percentage.

We have canned a number of fruits with different index-of-sweetness values. The cans were opened after two months and their contents submitted to experts for opinion. The results indicated that fruits with an index sweetness of 33 ± 5 received a higher grade than did those either side of this value. (Illustrated with slides and charts.)

PROTEASE ACTIVITY IN THE VEGETATIVE TISSUES OF THE PINEAPPLE PLANT

By

Ross S. Bean

The expressed and filtered saps of leaves and stems of pineapple crowns were more effective than equal amounts of fresh fruit juice in digesting either freshly coagulated egg albumin or commercial blood-fibrin. Sap and juice of natural acidity were more efficient than that neutralized with sodium hydroxide.

When partially purified by successive precipitations with alcohol, the enzyme from a definite volume of fruit juice digested more egg albumin than a similar preparation from the sap of the leaves of actively growing plants.

The immature leaves and the senescent leaves constituting respectively the upper and lower thirds of the total number on actively growing plants were much less active than the mature middle third of the leaves. This was true whether the amount of albumin digested by the purified enzyme was referred either to equal volumes of expressed sap or to equal weights of green tissue. For the senescent leaves the amount of albumin digested increased regularly with the concentration of enzyme in the preparation. Such differences were less marked in the mature leaves for the time period used, though the amounts digested by all concentrations were greater. This suggests that the slight differences noted were due to early retardation of the reaction by accumulated products.

In the higher enzyme concentrations, the particles of albumin retained their original sharp outlines throughout the digestion process, but in the lower concentrations the substratum assumed the form of a viscous slime that was very difficult to filter. This change of state progressed regularly through the varying concentrations of enzyme.

Purified enzyme from leaves and bracts of a mature plant bearing a half-grown fruit was comparable in activity to that from the fruit juice.

Variations in hydrogen ion had little influence in the activity of the purified enzyme between pH 3.0 and pH 6.0. At pH 7.0 and pH 8.0, however, the activity was much higher than in the acid medium. (Illustrated with charts.)

PRESERVING THE RARE PLANTS OF HAWAII

By

GEORGE C. MUNRO

This is an appeal to those interested in things Hawaiian, and especially in the endemic flora of Hawaii, to promote some work looking toward saving and rendering accessible the straggling remnants of the very ancient flora of these islands, and making a growing collection of these rare and interesting plants.

The dry land, open country, and forest border plants will be taken care of by a plantation started a year ago by the Board of Agriculture and Forestry in coöperation with the University of Hawaii at Waahila, on the ridge between Manoa and Palolo valleys, Oahu.

The plants of the rain forests and open marshes of the higher elevations are equally worthy of attention, though more difficult to make accessible. In the rain forest we have the *Gunnera,* many varieties of banana, loulu palm, and woody-stemmed violet, the rare *Hesperomannia,* numerous species of Lobelioideae, *Cyrtandra, Stenogyne* and many other interesting forms. On the open moss-covered bogs and on their borders there are violets, lobelias, *Plantago, Wilkesia, Lagenophora* and others, including the silver sword of western Maui. Most of these plants can be grown on the ridges leading up to and on the top of the higher peaks of Oahu or even on some of the lower and more accessible peaks.

The open marshes are at elevations of 3700 to 6000 feet, but the present bog flora probably extended much lower down before being crowded out and driven to a last stand in the high open bogs by taller and thicker foliaged trees and shrubs. The extremely wet condition is not absolutely necessary for their existence, but light is certainly essential, and by preventing taller plants from interfering with them they do very well on Lanai, whither plants from the high bogs of western Maui have been transplanted, in situations much lower in elevation and with but a fraction of the annual rainfall of their former location.

BIOLOGICAL RECORDS BY MEANS OF MOTION PICTURES

By

RAY J. BAKER

The "talk" consisted of the showing of two reels of motion pictures, with a few brief words of explanation. The first reel showed the germination and early seedling growth of cowpeas and barley grains, speeded up to 400 times their actual rate. The second reel, taken with a microscope replacing the lens in the camera, showed rotifers, minute worms, and several kinds of protozoa in action. The magnification, on the film, was about 500 diameters, and that on the screen about 10,000.

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NINTH ANNUAL MEETING

MAY 3-5, 1934

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Ninth Annual Meeting were held in Dean Hall, University of Hawaii, May 3 and 4, 1934, ending with a banquet at the Pacific Club, May 5.

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PROGRAM OF THE NINTH ANNUAL MEETING

THURSDAY, MAY 3, 7:30 P. M.

Preliminary announcements.
Election of members.
Appointment of committees.
Presentation of papers:

Dr. Thomas C. McVeagh: Laboratory examination of criminal evidence.

Dr. Andrew W. Lind: Some refinements of vital indices in Hawaii.

Dr. John W. Coulter and Mr. Chee Kwon Chun: Social life and institutions on a rice plantation in Hawaii. (Presented by Mr. Chun.)

Dr. Elizabeth D. W. Brown: The preparation of breadfruit *po'poi* in the Marquesas, and its relation to Polynesian migrations.

Mrs. Ethel K. Allen: The microbiological aspects of the fermentation of Marquesan breadfruit *po'poi*.

Mr. Austin E. Jones: Earthquakes of Hawaii.

Dr. Royal N. Chapman: An experimental study of fluctuations of animal populations.

FRIDAY, MAY 4, 7:30 P. M.

Dr. J. L. Collins: Pineapple taxonomy viewed in the light of the genetics of the pineapple.

Dr. C. P. Sideris, Miss B. H. Krauss and Mr. H. Y. Young: The formation and movement of the carbohydrate and organic nitrogen products in the various organs and tissues of the pineapple plant. (Presented by Dr. Sideris.)

Dr. Leonora N. Bilger and Mr. J. N. S. Williams: Cellulose from bagasse. (Presented by Mr. Williams.)

Dr. Earl M. Bilger and Mr. Robert Thompson: Copper content of Hawaiian foods. (Presented by Dr. Bilger.)

Dr. Nils P. Larsen and Miss Olga Fulton: Some serological observations. (Presented by Dr. Larsen.)

Mr. Ray J. Baker: Biological records with motion pictures.

SATURDAY, MAY 5, 6:45 P. M.

Pacific Club banquet.
Constitutional order of business.
Installation of new officers.
Presidential address: Builders of the sea.
Adjournment.

ABSTRACTS OF PAPERS

BUILDERS OF THE SEA

(Presidential Address)

By

CHARLES H. EDMONDSON

Fringing reefs have their origin about the shores of islands or continents, building seaward on foundations of their own making or on submerged shelves previously formed. They grow outward as a flat platform, the outer rim of which is often slightly higher than the intervening area, which is always covered by comparatively shallow water. Barrier reefs extend for a considerable distance from shore, the intervening water or lagoon having a depth of from 10 to 50 fathoms. Atolls consist of narrow and usually interrupted rims of land surrounding a lagoon ranging in depth down to about 50 fathoms. The principal reef structures are found in the western section of the Atlantic Ocean, in the central and western areas of the Pacific Ocean, in the East Indian region and widely distributed throughout the Indian Ocean and the Red Sea, their limitations being in general between 30 degrees north and south latitudes.

While corals are widely distributed throughout the seas, ranging from the shore to great depths, reef-building forms are confined to an equatorial belt extending around the world and limited to depths of about 50 fathoms. They belong for the most part to the group Madreporaria which developed during the Mesozoic Era, but few present-day species are found as fossils earlier than the middle Tertiary.

An increase in the number of coral colonies is effected by free-swimming planulae produced within mature polyps. The planulae become attached, usually within 30 days if suitable conditions prevail and proper foundations are found. A basal plate of limestone is then laid down and a calyx or cup of limestone is built up in which the polyp rests. By budding, if it is a compound form, new polyps are added to the colony and the volume of the skeleton is increased. The coral animals always maintain a position at the surface of the colony. Polyps one fourth of an inch high may lay down deposits of limestone of indefinite thickness.

In Hawaii massive types of corals like *Porites* add from 5 to 8 mm of limestone to the surface annually and eventually may build up huge masses. Branching forms like *Pocillopora* may add nearly 2 inches to their fronds annually, but have a life span of but 15 to 20 years, during which time colonies 15 to 20 inches in diameter are produced.

Unicellular algae (Zooxanthellae) are lodged within the tissues of most reef-forming corals. The plant cells give color to the corals and mutual benefit results in this relationship by way of exchange of oxygen and carbon dioxide. Nearly all shoal water corals are hosts of filamentous green algae which bore into the skeleton, dissolving the carbonate of lime and thereby weakening the entire mass.

Among other important reef builders are hydroid corals, foraminifera and nullipores. The nullipores are marine plants secreting calcitic skeletons. They form branching clumps or are encrusting and assist in binding coral colonies together and filling crevices. On many reefs like those of Johnston Island nullipores predominate over corals; on other reefs like those of Wake Island they play a minor role. A semicalcareous alga, *Halimeda,* is of considerable importance as a reef builder. Carbonate of lime may also be precipitated in sea water by various physical and chemical conditions. Decomposition of the soft parts of organisms may result in the precipitation of carbonate of lime by the reaction of ammonium carbonate with calcium salts.

As the organic builders are responsible only for the superficial structures, the foundation of a reef is an important consideration. The subsidence theory of the origin of reefs as presented by Darwin in 1842 was strongly supported by Dana, Jukes, and other contemporary naturalists as well as by numerous investigators of more recent date. Alexander Agassiz, Admiral Wharton, and others were convinced that barrier reefs and atolls were formed not as a result of crustal sinking but by the planing down of islands and land areas into undersea platforms which became foundations for growing reefs, or by ash islands built up by volcanic action and subsequently cut down to subsurface levels as suitable supports for reef-forming organisms. The history of Falcon Island and the recent eruption of Krakatoa point to pyroclastic action as a probable source of islands in the southwest Pacific and the East Indies. Many atolls may have been formed in this manner.

The glacial control theory of reef formation has been favored by many investigators during recent years. According to this theory, during the glacial ages the polar ice caps received water from the ocean, thereby lowering the sea level 180 to 300 feet. Land areas yielding to the action of the waves and erosion were greatly reduced and platforms were cut about islands resting on a static foundation. As the ice floes melted, the level as well as the temperature of the sea rose and reef-forming organisms began to develop on the platforms at depths of from 30 to 50 fathoms. Existing reefs are assumed to be post-glacial in age.

Recently the late W. M. Davis presented a masterful defense of the general principle of subsidence in his book, "The Coral Reef Problem" (1928). This view assumes that reefs are formed during sinking of land masses and that deep embayments of shores and drowned valleys result from the slow subsidence of crustal foundations. The small atoll which rests on a peak instead of a platform is also cited as evidence of a subsiding condition. Almost-atolls, in which numerous islands remain above the surface of a lagoon, represent, in the viewpoint of some observers, the remnants of a subsiding land mass.

Different interpretations of natural phenomena are not to be looked upon with disfavor but welcomed, for they are certain to clear up doubtful points and lead toward the truth. Frequently proponents of generalized theories are partly in the right and partly in the wrong; so in all probability will be found the conflicting views regarding the development of coral reefs. (Illustrated by lantern slides showing polyps, corals, and types of reef in various parts of the world.)

THE LABORATORY EXAMINATION OF CRIMINAL EVIDENCE

By

THOMAS C. MCVEAGH

Laboratory examination of criminal evidence is based upon the axiom: "For every result a cause." Given a complete picture of the physical results constituting a situation, whether criminal or not, it should be possible, theoretically, to reconstruct the preceding chain of events, by application of the recognized processes of deductive logic.

In the attempt to secure this complete picture of physical results, we examine such elements in the situation as are capable of acting upon our physical senses. We weigh, measure, smell, taste, feel, and compare. When we have done our best, the picture we have secured is the raw material upon which the detective's deductive faculties are to be exercised.

The examination of physical evidence for this purpose by the unaided physical senses dates dack to the misty past. The modern laboratory assists only by reënforcing our physical senses. As every piece of scientific apparatus has just this for its purpose, it becomes evident that the range of laboratory apparatus applicable to the examination of criminal evidence is practically coextensive with the range of apparatus available in all the sciences.

A classification of the work of a criminological laboratory was attempted, upon the basis of the material examined, as follows:

1. Original relics: material actually found upon the scene or related thereto, as dusts, fibers, hairs, blood, weapons, etc.
2. Derivative relics: traces left by deformation, such as fracture edges, scratches, impressions, and imprints. This division includes such extensive fields as criminal ballistics and document examination.

Lack of time prevented any exposition of actual methods of examination, but a few illustrations of methods of approach were given. Some probably fruitful research projects were also pointed out. (Illustrated with demonstrational material.)

SOME REFINEMENTS OF VITAL INDICES IN HAWAII

By

ANDREW W. LIND

Striking abnormalities in the age and sex structures of Hawaii's immigrant groups make comparisons of their fertility and viability on the basis of crude birth and death rates a somewhat questionable procedure. The low death rate of 8.5 per 1,000 in a racial group, of whom 44 per cent are in the healthy years from 20 to 30, may conceal a serious health problem. A relatively high crude death rate of 14.0 per 1,000 may merely indicate a population of old men ready to shuffle off.

Fertility rates of the several racial groups in Hawaii are altered markedly when correction is made for age and sex. From a position near the bottom of the list of crude birth rates, the Filipinos shift to first place when rates are figured on the basis of the women of childbearing age. Further refinements according to the age of the mothers give the following corrected rates of births per 1,000 women, 15 to 44 years of age, for the year ending June 30, 1932: Hawaiian and part-Hawaiian, 206; Portuguese, 156; Puerto Rican, 255; other Causasian, 79; Chinese, 150; Japanese, 188; Korean, 180; Filipino, 289. The Oriental and European immigrant groups are still in the stage of active biological expansion and their rates may be expected to decline as maturation and stabilization proceed.

Death rates in Hawaii in 1931, corrected for the age structure of the population, are as follows: Hawaiian and part-Hawaiian, 21; Portuguese, 11; Puerto Rican, 15; other Caucasian, 9; Chinese, 10; Japanese, 9; Korean, 12; Filipino, 13. The three groups with the highest corrected birth rates show likewise the greatest corrected death rates. Death rates, at least of the other Caucasians, Filipinos, and Chinese, are artificially lowered due to the emigration from the islands of those about to die.

A further analysis of death rates suggests the possibility of using the specific causes of death as indices of the state of biological equilibrium achieved by each of the immigrant groups. The diabetes rate, for example, appears to be positively correlated and pneumonia negatively correlated with the progress made along the way towards economic and social stabilization. (Illustrated with charts.)

SOCIAL LIFE AND INSTITUTIONS ON A RICE PLANTATION IN HAWAII

By

JOHN WESLEY COULTER AND CHEE KWON CHUN

This paper is part of a chapter from a study of rice farming in Hawaii as it was carried on by immigrant Chinese in the heyday of the industry. The account is taken from kamaaina Chinese rice planters, very few of whom can speak English. Social institutions on rice plantations were in part carried over to the islands from China, and in part an adjustment to the new environment. As a result of the intermingling of rice farmers and natives, many Chinese learned to speak Hawaiian and used the language in social intercourse as well as in business dealings. Acquaintance between the two peoples led to interracial marriages which have markedly affected the population of the islands. New Year's was a time of unusual gaiety and hilariousness on a rice plantation. Its observances lasted three days, were accompanied by feasting and fireworks, the exchange of social calls between friends and relatives and working men and bosses. Hawaiians also entered into the spirit of the occasion and, arriving at Chinese homes early on the first day of the celebrations, were the recipients of favors from the Chinese.

Social and benevolent institutions played an important role in rice-farming communities. They took care of the aged and infirm and sent some of them back to China. A few societies, orginally formed as part of a concerted movement to overthrow the old Chinese monarchial system, became in Hawaii more significant for their social functions. The village store in a Chinese community was a social center as well as a place for business. Rice farmers gathered there during leisure hours, conversed agreeably, swapped news from near and far, smoked, and played cards.

THE PREPARATION OF BREADFRUIT PO'POI IN THE MARQUESAS, AND ITS RELATION TO POLYNESIAN MIGRATIONS

By

ELIZABETH D. W. BROWN

The purpose of this study is to present an accurate account of the making of breadfruit *po'poi,* stressing the relationships which throw light upon the leading biological conditions contributing to the success of the long transoceanic migrations of the Polynesians.

Breadfruit *po'poi* was the staff of life of the ancient Marquesan. At the time of discovery, the Marquesas supported a density of population comparable with that of the most densely populated countries, suggesting that the Marquesan diet was as efficient for living under insular conditions as that of other races for living under mainland conditions. This seems due in no small degree to the discovery of how to prepare breadfruit *po'poi* and related fermented foods which sustained the dense population in times of plenty and during long unforeseen periods of famine. Early accounts, supported by later scientific investigations, show that, on a leading diet of breadfruit *po'poi*, the Marquesan attained a remarkable physical and intellectual development.

Po'poi is composed of cooked *ma* (fermented breadfruit) and freshly roasted breadfruit in the proportion of half and half, if fresh *ma* is used, or one third *ma* to two thirds freshly roasted breadfruit if old *ma* is used. Its preparation compares in complexity with that of bread and many other modern foods. The evolution of the process must have required prolonged thought and experimentation extending far back into the unwritten history of the Polynesian race.

It seems unlikely that the Polynesians would ever have reached the mid-Pacific islands without their fermented foods, because efficient foods which could be kept without deterioration must have been indispensable on the long outrigger canoe voyages. On this assumption, fermented foods of the Polynesians must be classed among the requisites leading to the discovery and successful colonization of the islands of Polynesia.

THE MICROBIOLOGICAL ASPECTS OF THE FERMENTATION OF MARQUESAN PO'POI

By

ETHEL K. ALLEN

Ma is the preserved breadfruit commonly used as a starter for the promotion of fermentation in Marquesan *po'poi*. The samples of *ma* used in this study were part of a collection obtained in 1922 by Dr. E. D. W. Brown. The present investigations were concerned with a two-fold objective: the isolation and classification of the microorganisms responsible for the fermentation, and the ascertaining of similarities or differences in the microflora in comparison to that of Hawaiian taro *poi*.

Only rod-shaped bacteria were demonstrated in the stained smears of *ma* samples examined prior to the cultural studies. Cultural studies also failed to show the presence of yeast, mycoderms, or similar microorganisms. The numbers and kinds of bacteria were best demonstrated by plating samples of the *ma* on a triple sugar nutrient agar. Colonies were visible on this medium after 3 days incubation at 35 degrees centigrade. Satisfactory isolations of the colonies were obtained in triple sugar nutrient broth after 48 hours' incubation at 35 degrees centigrade. Forty pure cultures were isolated in the course of the study.

All bacteria isolated and studied were, on the basis of morphological and cultural tests, species of the genus *Lactobacillus*. Classification of the isolated organisms was based upon their reactions in various media with special emphasis upon their ability to ferment 14 different carbohydrates in a nutrient broth base. The extent of the hydrogen-ion change in the carbohydrate media was determined electrometrically.

At the present time two species, *Lactobacillus delbrücki* (Leichmann) Holland and *L. leichmanni* (Henneberg) Bergey and others, and numerous varietal strains of each have been definitely classified. Recently completed tests indicate the presence of *L. pastorianus* (van Laer) Bergey and others and several closely related forms. Results to date indicate marked similarity between the fermentation of Hawaiian taro *poi* and Marquesan breadfruit *po'poi* with respect to microorganisms concerned as well as by-products formed. (Illustrated with charts and slides.)

EARTHQUAKES OF HAWAII

By

Austin E. Jones

It has been possible to locate about 40 per cent of the earthquakes recorded at the Hawaiian Volcano Observatory in 1933. Of these 14 per cent have been located on the undersea slopes of the island.

Of the epicenters, two thirds have been located on the active volcanoes of Kilauea and Mauna Loa, and one third on the volcanic mountains Hualalai, Mauna Kea, and Kohala.

A considerable number of the epicenters have been located on the known rifts of the island and a slight concentration has occurred near the volcanic centers and craters.

Many epicenters have fallen in apparent lines away from known rifts. No topographic features have been found that indicate faults in these places, which radiate north, northeast by north, northeast, southeast by east, southeast by south, and southwest from the Mauna Loa summit crater.

The eruption of December 2, 1933, started with 12 recorded shocks. Six were well located, the first being slightly deeper than the following shocks, which were near or above sea level.

The numbers of earthquakes that have occurred each week form the basis of another sort of study. This seismicity became large for earthquakes of Mauna Loa distance, six weeks prior to the 1933 eruption. The same increase was noted two months prior to the Mauna Loa summit eruption of 1914. (Illustrated with maps.)

PINEAPPLE TAXONOMY VIEWED IN THE LIGHT OF THE GENETICS OF THE PINEAPPLE

By

J. L. Collins

Botanists who have worked upon the classification of pineapples are not in agreement in regard to the number of species. Some have considered all to constitute a single polymorphic species. Others divide them into six or more species.

Classification is further complicated by the asexual mode of reproduction common to many of the forms.

In a number of obscure taxonomic relations in other genera, genetic studies with species hybrids have supplied information which led to the solution of the difficulties.

Accordingly, hybrids produced by crossing the two so-called species *Ananas comosus* (L.) Merr. with *A. microstachys* Lindl. have been examined for evidence bearing on this taxonomic problem.

Five pairs of character contrasts have been studied. The two characters, amount of anthocyanin in the leaves and spininess of the leaves, are inherited in an alternative manner. This indicates a single gene difference for each of them. This type of inheritance is typical for variety hybrids and is seldom found in species hybrids.

The differences in acid content, Brix content (sugars), and weight of fruits have each shown a polymeric (blending) type of inheritance which indicates that these characters depend upon a number of interacting genes.

This polymeric type of inheritance is characteristic of crosses between species. It is also frequently met with in varietal hybrids involving such quantitative characters as size, weight, or quantity.

The two forms (species ?) considered here each have 50 chromosomes as the diploid number and the hybrids are fertile.

In morphology, the two forms appear to be sufficiently distinct to justify specific classification, but the weight of genetic evidence at present available is in favor of a varietal classification. (Illustrated with specimens and charts.)

THE FORMATION AND MOVEMENT OF THE CARBOHYDRATE AND ORGANIC NITROGEN PRODUCTS IN THE VARIOUS ORGANS AND TISSUES OF THE PINEAPPLE PLANT

By

C. P. Sideris, B. H. Krauss, and H. Y. Young

Analyses of the various tissues of pineapple plants have given us results which indicate that different groups of leaves and tissues of the same leaves function differently in their rate of carbohydrate and nitrogen metabolism, the older tissues functioning more slowly than the younger tissues. The assimilation of carbohydrates, namely sugars, and of amino-acid nitrogen increases toward the basal tissues of the leaves and decreases toward the apical ones on account of the synthesis of new tissues in the basal portions, and the synthesis of sugars and possibly amino acids in the apical.

Treatments with different quantities of ammonium sulfate are reflected in the tissues of pineapple plants by the formation of somewhat corresponding quantities of amino acids. With greater quantities of amino acids, the sugar content at the basal tissues of young leaves decreases because of an increased rate of assimilation; with lower quantities of amino acids this condition is reversed.

The production of sucrose seems to be inhibited by great concentrations of amino acid nitrogen in the tissues. The results, if we interpret them correctly, indicate that sucrose is formed in tissues with and without chlorophyll. In these investigations we have found certain leaf tissues lacking entirely in sucrose but containing great quantities of reducing sugars, which tends to support the theory that the first sugar of photosynthesis is a hexose.

The curves which we have obtained for the distribution of amino-acid nitrogen are almost identical with those we have obtained for sugars. This condition suggests the possibility of amino acid formation in the leaves. We wish not to make a definite statement to this effect, however, until we have accumulated more information. (Illustrated with charts.)

CELLULOSE FROM BAGASSE

By

LEONORA NEUFFER BILGER AND JOHN N. S. WILLIAMS

The fine fractions of bagasse produced in the crushing of cane were investigated for their cellulose value. The Cross and Bevan method, with modifications, was used to obtain cellulose from dry samples of bagasse. The product was shown to be a ligno-cellulose. The yield was about 50 per cent. The procedure involved boiling the dry material with approximately 2 per cent sodium-hydroxide solution, treating the product first with sulphurous acid and then with chlorine gas, washing, and drying at 60 to 70 degrees.

The "Cross and Bevan cellulose" thus obtained was separated into alpha, beta, and gamma celluloses, and their percentages found to be 59.06, 36.08, and 5.71 respectively. The determination was made by dissolving the beta and gamma forms in 17.5 per cent sodium-hydroxide solution and weighing the undissolved alpha which was filtered off. Beta and gamma were then determined together on one portion of the filtrate by titration with ferrous ammonium sulphate in the presence of potassium dichromate and sulphuric acid, using potassium ferricyanide as an indicator. Beta cellulose was precipitated from a second portion of the filtrate and the gamma form determined by titration. The per cent of beta was obtained by difference. The results showed that cellulose from bagasse compares favorably in its alpha cellulose content with western yellow pine.

The economic possibilities of utilizing the fine fractions of bagasse as a source of cellulose were discussed in connection with the quantities of fresh water that would be needed to carry on the project. (Illustrated with samples.)

COPPER CONTENT OF HAWAIIAN FOODS

By

EARL M. BILGER AND ROBERT R. THOMPSON

Since 1929 a number of workers have demonstrated that copper is a valuable supplement to iron in the building of hemoglobin. Foods are the primary source of copper for most people. Consequently a knowledge of the amount of copper present in foods may make it possible to supplement diets low in copper, as milk, cereals, and cereal products.

The presence of copper in Hawaiian foods in small amounts is to be expected, as copper is found in the analyses of 15 out of 18 volcanic rocks of the islands. A basalt from the Waianae Mountains of Oahu contains as much as 0.48 per cent copper oxide.

In the present investigation McFarlane's modification of the Callan and Henderson colorimetric method, using sodium diethyldithio-carbamate was adopted. This reagent produces a copper salt which gives with isoamyl alcohol a deep golden-yellow solution.

The procedure involved was: 1, washing the samples to remove adherent dirt; 2, drying to expel moisture; 3, ashing to destroy carbonaceous matter; 4, treating chemically to remove interfering substances and to transform the copper to the yellow carbamate; 5, comparing in a colorimeter the depth of color of the isoamyl solution with solutions containing known amounts of copper.

Twenty-three food products were analyzed. The percentages of copper in the food materials dried to constant weight at 100 degrees centigrade were found to be: ginger, 0.00120; bean sprouts, 0.00177; poi, 0.00020; egg plant, 0.00148; watercress, 0.00061; string beans, 0.00169; lima beans, 0.00235; Chinese cabbage, 0.00114; carrots, 0.00175; sweet potatoes, 0.00107; Irish potatoes, 0.00055; squash, 0.00175; lettuce, 0.00156; tomatoes, 0.00420; coffee beans (green), 0.00184; guava, 0.00065; bananas, 0.00059; yams, 0.00082; lotus, 0.00054; pineapple, 0.00020; avocado, 0.00058; papaia, 0.00020; opihi, 0.00042.

The results indicate the presence of copper in Hawaiian vegetables and fruits in quantities which compare favorably with those of mainland products. (Illustrated with charts.)

SOME SEROLOGICAL OBSERVATIONS

By

NILS P. LARSEN AND OLGA FULTON

The vast economic importance that venereal diseases assume in any community is indicated in table 1. Doctors in Honolulu, though required by law to report every case of chickenpox, are supposed to regard syphilis as a great secret sin and it is therefore kept hidden.

Table 1. Number of Sick Days from Various Diseases, U. S. Navy, 1932. (Annual Report of the Surgeon General)

Average daily strength of the Navy, 110,717

Gonococcus infection	120,410
Syphilis	56,061
Tuberculosis	37,956
Appendicitus, Acute	30,665
Pneumonia	7,992
Measles	1,857
Mumps	2,126
Scarlet Fever	1,426
Chickenpox	1,305
Typhoid Fever	874
All Injuries	154,408

Table 2 shows the variation in race groups in Hawaii. The social status of the people tested is approximately the same except for the white American. If we consider race improvement as one of the projects worth while in human effort the knowledge of the prevalence and spread of this disease (syphilis) is necessary.

Table 2. Comparison of Positives in Different Racial Groups.

	Per cent
Hawaiian	30.62
Puerto Rican	16.07
Part-Hawaiian	13.72
Korean	12.96
Chinese	10.17
Filipino	9.87
Japanese	7.60
Portuguese	5.63
White American	3.22

Table 3 is an analysis of proven hereditary cases in a study of the blood of 2,344 newborns at Queen's Hospital. Recently in a Japanese journal records were given from two maternity hospitals showing positive percentages of 7.26 and 8.90 in the newborns. Why the total positive percentage is so low in our newborns we do not know, but the results of this work open many new and interesting possibilities for future study.

Table 3. Results of Tests on 2,344 Placental Bloods

95.20 per cent negative in both Kolmer and Kahn tests
1.10 per cent positive in both Kolmer and Kahn tests
1.58 per cent positive in either Kolmer or Kahn test
2.12 per cent anti-complementary or doubtful

A fourth table was shown which indicated variations due to the personality equation of the technicians. Such tables may be of use in evaluating workers. (Illustrated with charts.)

BIOLOGICAL RECORDS WITH MOTION PICTURES

By

RAY J. BAKER

The "talk" consisted of the showing of two reels of motion pictures, with a few brief words of explanation. The first reel showed the life histories of the Monarch butterfly (*Danaus archippus*) and the silkworm (*Bombyx mori*). The second reel showed the development of the flowers of the pineapple, speeded up 6,000 times, condensing the events of 20 days into a few minutes. This reel ended with views of the opening and closing of the flowers of hibiscus and night-blooming cereus.

MEMBERS

Abel, Francis A. E.
Abel, Marjorie G.
Adams, Romanzo
Agee, Hamilton P.
Aitken, Robert T.
Allen, Oscar N.
Andrews, Carl B.
Arnold, Harry L.
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Davis, Arthur L.
Davis, Lannes E.
Dean, Arthur L.
Degener, Otto
Denison, Harry L.
Dickey, Lyle A.
Dillingham, Frank T.
Donaghho, John S.
Doty, Ralph E.
Edmondson, Charles H.
Eguchi, George M.
Ehrhorn, Edward M.
Eller, Willard H.
Emory, Kenneth P.
Erwin, Ada B.
Farden, Carl A.
Fennel, Eric A.
Fletcher, Desmond R.
Ford, Alexander Hume
Fosberg, F. R.
Fronk, Clarence E.
Fujimoto, Giichi
Fullaway, David T.
Fulton, Olga
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Gregory, Herbert E.
Hadden, Fred C.
Hamre, Christopher J.
Hance, Francis E.
Handy, Edward S. C.
Harry, John V.
Hartt, Constance E.
Hammond, W. H.
Henke, Louis A.
Holmes, Henry
Hosaka, Edward Y.
Illingworth, J. F.
Ito, Kiyoshi
Jaggar, Thomas A., Jr.
Johnson, Horace
Jones, Austin E.
Jones, Martha
Judd, Albert F.
Judd, Charles S.
Katsuki, Ichitaro
Keller, Arthur R.
Kerns, Kenneth R.
Kim, Bernice B. H.
King, Norman
Kirkpatrick, Harry A.
Koehler, Lucy J.
Krauss, Beatrice H.
Krauss, Frederick G.
Kutsunai, Yakichi
Lam, Margaret
Larrabee, Louise M.
Larrison, G. K.
Larsen, Nils P.
Lennox, Colin G.
Lind, Andrew W.
Linford, Maurice B.
Livesay, T. M.
Loomis, Charles F.
Loveland, Robert M.
Lyon, Harold L.
Lyon, Maude F.
MacNeil, Wilbur J.
Magistad, O. C.
Mangelsdorf, A. J.
Marlowe, R. H.
Martin, Joseph P.
Mason, Arthur C.
Masunaga, Eichi
McAllep, Will R.
McBride, O. C.
McCullough, R. N.
McGuire, Thomas R. L.
McKay, William
McLennan, Ronald H.
McVeagh, Thomas C.
Miller, Carey D.
Mirikitami, Clifford
Miyake, Iwao
Moe, Kilmer O.
Mumford, Edward P.
Munro, George C.
Neal, Marie C.
Nikaido, Raymond
Northwood, J. d'A.
Odgers, George Allen
Oliveira, Juliette M.

Ostergaard, Jens
Palmer, Harold S.
Payne, John H.
Pemberton, Cyril E.
Pinkerton, F. J.
Pope, Willis T.
Renton, George F.
Ripperton, John C.
Robbins, Ruth
Rosa, Joseph S.
Russ, Glen W.
Sakimura, Kay
Satterthwaite, Anna Y.
Shaw, Harold R.
Shepard, Oscar F.
Sideris, Christos P.
Sinclair, Gregg M.
Slattery, Mabel
Smith, Madorah E.
Smith, W. Twigg
Spalding, Philip E.
Spiegelberg, Carl H.
St. John, Harold
Stokes, J. F. G.
Straub, George F.
Swezey, Otto H.
Takahashi, Tokue
Tam, Richard K.
Thompson, Henry O.
Tinker, Spencer
Titcomb, Margaret
Topping, D. Le Roy
Van Zwaluwenburg, R.H.
Voorhees, John F.
Wadsworth, Harold A.
Wakabayashi, S.
Waterman, T. T.
Webster, James N. P.
Weeber, Lorle S.
Weinrich, William
Welch, d'Alte A.
Weller, Daniel M.
Wentworth, Chester K.
Westervelt, William D.
Westgate, John M.
Wilder, Gerrit P.
Wilder, Helenor C.
Willard, Harold F.
Williams, Francis X.
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PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

TENTH ANNUAL MEETING

1934-1935

BERNICE P. BISHOP MUSEUM

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1935

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Tenth Annual Meeting were held in Dean Hall, University of Hawaii, October 24 and 25, 1934, and May 16 and 17, 1935, ending with a banquet at the Pacific Club, May 18.

OFFICERS

1934-1935

President, Edwin H. Bryan, Jr
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PROGRAM OF THE TENTH ANNUAL MEETING

WEDNESDAY, OCTOBER 24, 1934, 7:30 P. M.

Mr. O. H. Swezey: Some highly concentrated populations of species of endemic insects.

Dr. Romanzo Adams: Myths and morale.

Dr. O. N. Allen, Mr. F. A. E. Abel and Dr. O. C. Magistad: Decomposition of pineapple trash by bacteria and fungi.

Dr. H. S. Palmer: Heights and ruggedness of the Hawaiian islands.

Mr. R. K. Tam, Dr. O. N. Allen and Dr. O. C. Magistad: The nitrogen fixing characteristics of Rhizobia. (Read by title.)

Mr. R. K. Tam, Dr. O. N. Allen and Dr. O. C. Magistad: The fermentative characteristics of Rhizobia. (Read by title.)

Dr. C. K. Wentworth: Types of marine benches on Oahu shores. (Read by title.)

THURSDAY, OCTOBER 25, 1934, 7:30 P. M.

Dr. C. K. Wentworth: Alaskan glacier studies.

THURSDAY, MAY 16, 1935, 7:30 P. M.

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

Dr. J. L. Collins and K. R. Kerns: Origin and significance of triploid and tetraploid hybrid pineapples.

Dr. C. K. Wentworth: The geologic structure of Nuuanu Valley.

Dr. J. W. Coulter: A gazetter of the Territory of Hawaii.

Dr. O. N. Allen and Dr. O. C. Magistad: A comparison of the *Aspergillus niger* and replaceable potash methods for the estimation of available soil potash.

FRIDAY, May 17, 1935, 7:30 P. M.

Dr. T. A. Jaggar: Shipboard plane-table and azimuth camera: an experiment in navigation.

Dr. M. E. Smith and J. Masuoka: Some factors influencing the language development of preschool bilingual children of Japanese ancestry in Honolulu.

Dr. H. A. Kirkpatrick: The red shift and the velocity of light.

Mr. C. S. Judd: Seed dispersal.

Dr. L. N. Bilger and Mr. E. Watanabe: A study of papaya carotene. (Read by abstract.)

Dr. C. P. Sideris and Miss B. H. Krauss: Oxidation-reduction systems of the pineapple plant. (Read by title.)

Mr. K. R. Kerns: The sequence of flower development in the pineapple. (Read by title.)

SATURDAY, MAY 18, 1935, 6:45 P. M.

Pacific Club banquet.
Constitutional order of business.
Installation of new officers.
Presidential address: Hawaiian birds.
Adjournment.

ABSTRACTS OF PAPERS

HAWAIIAN BIRDS

(Presidential Address)

By

EDWIN H. BRYAN, JR.

About 100 species of birds were known to the Hawaiians, most of them by native names, prior to 1778. At that time, on Captain Cook's third voyage, specimens were collected of about 16 species, some of which were given popular descriptions by John Latham, and technical descriptions by Forster, Gmelin, and others. The types of many of these early species were lost, leading to much later confusion.

Collections by Andrew Bloxam, 1825, J. K. Townsend and Herr Deepe, 1836-7, and the United States Exploring Expedition, 1840, increased the known species to about 30, of which 16 were land birds including 14 perching birds. Sanford B. Dole listed 53 species in 1879. Dr. Leonhard Stejneger described specimens sent to the U. S. National Museum by Valdemar Knudsen of Kauai.

Encouraged by the enthusiasm of Professor Alfred Newton of Cambridge, Scott B. Wilson and Walter Rothschild became interested in Hawaiian birds. The extensive collections made by Wilson in 1887-8 resulted in the magnificent monograph, "Aves Hawaiienses", and in important anatomical studies by Dr. Hans Gadow, which indicated the true relationships of the Drepanididae. The 1,832 specimens obtained by Rothschild's collector, Henry Palmer, in 1890-3, furnished the basis for the even more elaborate "Avifauna of Laysan . . . ", published 1893-1900. R. C. L. Perkins collected for a decade, beginning 1892, and published a section of the "Fauna Hawaiiensis" on the birds, in 1903. Contributions have been made by W. A. Bryan, H. W. Henshaw, E. L. Caum, and others.

My check-list of Hawaiian birds numbers 218 species: 73 endemic or long indigenous, 18 sea birds, 11 regular migrants, 27 chance arrivals, and 89 exotic species. Of these last about 54 are probably established and 35 probably not established. More foreign birds are being brought in.

Sea birds include 2 albatrosses, the frigate, 3 boobies, 5 terns, various shearwaters and petrels, and red- and white-tailed tropic birds. For these, in 1909, was established the Hawaiian Islands Bird Reservation on islets to the northwest of Kauai.

The regular migrants include the golden plover, turnstone, wandering tatler, sanderling, curlew, various wild ducks, and other species. Most of these do some little good by eating insects and scavenging the beaches, and should receive more protection.

The flightless rail and native hawk are probably extinct; the native duck and goose are becoming rare; the mudhens, stilt, owl and night heron seem to be holding their own in the lowlands.

All of the 50 to 55 species in the mountain forests are native perching birds. Of these, 23 of the 24 genera are also endemic, only Corvus being found elsewhere. These are all thought to have evolved from six or seven former immigrants, which arriving and becoming established over a long period of time have given rise, in the various environments, to the diverse forms of today. These include 6 species of thrushes, 3 flycatchers, 5 honey-eaters, and 35 to 40 native honey creepers or drepanids. The drepanids are thought to have developed from a common ancestor related to the Coerebidae of tropical America.

Many native species are becoming rare or extinct. A reason for this may be the sudden upsetting of the "balance in nature" by the coming of man with his cattle, sheep, goats, foreign plants and agriculture, which changed conditions in the native forest, and by the arrival of foreign birds with diseases against which the native species had no immunity.

Territorial laws protect native and useful birds and regulate the importation of exotic species. The introduction and liberation of additional species without adequate study by experts to determine their possible effect upon existing conditions is not advocated. (Illustrated with slides and specimens.)

SOME HIGHLY CONCENTRATED POPULATIONS OF SPECIES OF ENDEMIC INSECTS

By

OTTO H. SWEZEY

Although the list of species of Hawaiian endemic insects is long, yet the entomologist is usually disappointed by the scarcity of insect life in the native forests. Occasionally, however, even the rarest specimens or those not previously collected are discovered in quantities in the mountain forests. In my own experience some such discoveries concern the following species:

Nesotocus giffardi Perkins, Kaimuhonu, Oahu, November 17, 1918, on a recently fallen *Cheirodendron gaudichaudii; Nesotocus munroi* Perkins, Kohala Mountains, Hawaii, October, 1929, on a standing dead tree of *Cheirodendron gaudichaudii; Oodemus corticis* Perkins, Nauhi Gulch, Hawaii, October, 1931, on a standing dead trunk of *Acacia koa; Rhyncogonus saltus* Perkins, Kolekole Pass, Oahu, February 10, 1924, on the foliage of *Bidens sp.; Rhyncogonus simplex* Perkins, Makapuu, Oahu, February 11, 1934, on the foliage of *Gossypium tomentosum; Deinocossonus nesiotes* Perkins, Haleauau Valley, Oahu, December 1, 1929, on broken twigs of *Pteralyxia macrocarpa; Oegosoma reflexum* Karsch, Puu Oo trail, Hawaii, July 25, 1934, in rotten logs of *Acacia koa; Plagithmysus pulverulentus* (Motschulsky), Koolau Range, Oahu, on several occasions, in fallen trees of *Acacia koa; Plagithmysus varians* Sharp, Kilauea, Hawaii, July, 1934, in standing and fallen dead trees of *Acacia koa; Plagithmysus bilineatus* Sharp, Kilauea, Hawaii, July, 1934, in recently cut logs of *Metrosideros polymorpha; Plagithmysus blackburni* (Sharp), Nauhi Gulch, Hawaii, October 3, 1931, in a recently dead tree of *Sophora chrysophylla; Plagithmysus molokaiensis* Perkins, Kamiloloa, Molokai, December 20, 1925, in dead trees of *Pipturus albidus; Nesithmysus bridwelli* Perkins and *Nesithmysus haasii* Perkins, near Puu Kaaumakua, Oahu, February 9, 1931, in *Pelea clusiaefolia; Callithmysus microgaster* (Sharp), Waikane, Oahu, January 19, 1930, in a dying tree of *Bobea elatior; Proterhinus subplanatus* Perkins and *Xyletobius timberlakei* Perkins, Marsh trail, Oahu, December 10, 1933, in a dead trunk of *Straussia mariniana; Scotorythia paludicola* (Bulter), Olinda, Maui, January, 1926, on the foliage of *Acacia koa; Hyposmocoma latiflua* Meyrick, Waianae Range, Oahu, December 29, 1929, on the leaves of *Pittosporum cauliflorum.*

(Illustrated with lantern slides.)

THE DECOMPOSITION OF PINEAPPLE TRASH BY BACTERIA AND FUNGI

By

O. N. Allen, F. A. E. Abel and O. C. Magistad
(Tropical Agriculture, Vol. 11, pp. 285-292, 1934.)

The decomposition processes of entire pineapple stumps and of coarsely and finely cut stumps and leaves were analyzed by chemical and microbiological methods. The greatest difference between the decomposed and the original plant material was accounted for by the decomposition of sugar, starches, and cellulose. Other chemical changes in the pineapple material were slight. The nitrate nitrogen content of the soil was increased and much carbon dioxide was evolved. The numbers of fungi, actinomyces, and bacteria were increased. (Illustrated with charts.)

HEIGHTS AND RUGGEDNESS OF THE HAWAIIAN ISLANDS

By

HAROLD S. PALMER

(University of Hawaii, Occ. Papers, No. 23, 1935.)

A comparison of the ruggedness of regions may be based on a comparison of maximum heights or range in elevation. On these two counts the Hawaiian islands are exceeded in ruggedness by several states. But using the ratio of the number of feet in the range to the number of thousands of square miles in the area of each unit, or comparing the number of feet in the elevation of the range to the number of miles in the side of a square having the same area, the ruggedness of all eight of the Hawaiian islands is proved to be greater than that of any state. (Illustrated with charts.)

THE FERMENTATIVE CHARACTERISTICS OF RHIZOBIA

By

R. K. TAM, O. N. ALLEN AND O. C. MAGISTAD

Four strains of Rhizobia (nodule-forming bacteria) isolated from nodules on the roots of *Vigna sinensis* Enderlein, four strains from nodules of *Crotalaria juncea* Linnaeus, and eight strains from nodules of *Cajanus cajan* (Linnaeus) Millspaugh were studied culturally in three basic liquid media, a, without a source of nitrogen, b, with yeast extract as an organic source of nitrogen, and c, with potassium nitrate as an inorganic source of nitrogen. Fifteen carbohydrates were used as carbon sources in combination with the above media.

The best growth attained by each strain, as evidenced by turbidity tests and changes in hydrogen-ion concentration, occurred in the media with the organic nitrogen source. In like manner the growth in the inorganic nitrogen media exceeded that in the nitrogen-free media. These data resulted regardless of the source of carbon.

The hexose sugars afforded the best source of carbon for the growth of Rhizobia. Of the four hexose sugars studied, glucose, galactose and mannite were more readily utilized than was fructose. Following the hexoses the other carbohydrates were utilized in the following descending order regardless of the nitrogen source: disaccharides (sucrose, lactose, maltose), trisaccharides (raffinose, melezitose), pentoses (rhamnose, arabinose, xylose), polysaccharides (starch, dextrin), and a glucoside (salacin). All strains of the Rhizobia produced alkaline reactions in litmus milk without the formation of serum zones.

THE NITROGEN-FIXING CHARACTERISTICS OF RHIZOBIA

By

R. K. TAM, O. N. ALLEN AND O. C. MAGISTAD

Cross-inoculation experiments have been completed using Rhizobia (nodule-forming bacteria) isolated from *Cajanus cajan* (Linnaeus) Millspaugh, *Vigna sinensis* Enderlein and *Crotalaria juncea* Linnaeus as inocula for the seeds of these plants. Nodules were formed on the roots of all of these test plants regardless of the host inoculation, thus confirming the classification of these plant species within the cowpea cross-inoculation group.

The strains of Rhizobia varied greatly in their abilities to fix atmospheric nitrogen and to promote plant growth. The range in percent nitrogen fixed in plants of *Crotalaria juncea* varied from 0.72 percent to 2.22 percent, in *Vigna sinensis* from 1.71 percent to 2.68 percent, and in *Cajanus cajan* from 1.36 percent to 2.17 percent. The amounts of fixed nitrogen were determined by the Gunning-Kjeldahl method modified to include nitrates. The percentages of nitrogen are expressed on a dry weight basis.

All strains of the Rhizobia studied, irrespective of their host isolation, inoculated *Vigna sinensis* with greater ease than they did *Crotalaria juncea* and *Cajanus cajan*.

TYPES OF MARINE BENCHES ON OAHU SHORES

By

CHESTER K. WENTWORTH

Interpretation of emerged marine benches is dependent on knowledge of bench-forming processes and the relation to sea level in which they are being concurrently formed. Studies in progress reveal the following types. 1. Bench surfaces made level by water-level weathering. Elevations are variable, are within the spray catchment zone, and determined fundamentally by other processes. 2. Organic veneer benches formed at 0 to 3 or 4 feet above mean sea-level as determined by level of overwash sufficient to support marine forms. Found on calcareous rock costs where higher benches have been reduced by solution-pitting to apparent level of sea-water saturation and then invaded by mechanical wave action at the veneer bench level. 3. Beach pediments rising inland to several feet above sea level and conforming to the equilibrium curve or adjacent or partially coextensive beaches of sand or gravel. Due to mechanical action under control of the beach profile. The level of water-cut nips is likewise controlled by the beach curve rising to several feet above tide at the heads of gravelly pocket beaches. 4. Benches of earlier origin in process of concurrent reduction by potholing, where moderate amounts of coarse debris are available. 5. Benches produced by strong wave-quarrying as influenced by rock structure. Tend to be steep-sloped and to rise to a broadly rounded nip well above sea level.

Other locally distinctive types will probably appear on further study. Each of the above occurs in pure form and also somewhat merged with or partially destroyed by the invasion of other processes. Nature of coastal exposure, type of rock, amount of debris, stream source of land-derived debris, are among the factors fixing the local combination.

THE ORIGIN AND SIGNIFICANCE OF TRIPLOID AND TETRAPLOID PINEAPPLES

By

J. L. Collins and K. R. Kerns

The diploid number of chromosomes for the pineapple is 50. Plants containing 75 (triploid) and 100 (tetraploid) chromosomes have appeared in hybrid cultures.

The triploids are believed to originate from the formation of diploid egg cell gametes containing 50 chromosomes which are fertilized by the normal 25 chromosome pollen grains. The ratio of triploid to diploid plants in the Cayenne $\times$ Wild Brazil F_1 hybrid population indicates that Cayenne produces one diploid egg gamete per 1,000 haploid egg gametes. The 13 different clons of triploid plants are divided according to chromosome content as follows: eight clons, each derived from a single triploid plant having 50 Cayenne and 25 Wild Brazil chromosomes; two clons have 50 Cayenne and 25 Monte Lirio chromosomes; one clon has 50 Cayenne and 25 Pernambuco chromosomes; one clon has approximately 62 Cayenne and 13 Ruby chromosomes; one clon has approximately 62 Cayenne and 13 Wild Brazil chromosomes. The triploid plants and their various parts are larger than the diploids. The cells of the triploids have the volume increased by 40 percent.

Fruit size shows variation depending upon the size of the fruits of the parental types; the fruits of triploids having 25 chromosomes from Wild Brazil being smaller than diploid Cayenne fruits but larger than the fruits of diploid hybrids between these varieties. Two triploids produced fruits with an average weight of two pounds greater than Cayenne.

Of the 10 clons of tetraploid plants, 9 represent the complete progeny obtained by pollinating Cayenne flowers with pollen from the triploid which had approximately 62 Cayenne and 13 Ruby chromosomes. Each of these tetraploids are probably genetically different, but all contain approximately 82 Cayenne and 13 Ruby chromosomes, since they appear to have originated from the fertilization of normal 25 chromosome egg gametes from Cayenne with 75 chromosome pollen grains from the triploid male parent. One tetraploid clon originated from a single plant in the F_1 Pernambuco $\times$ Monte Lirio population and apparently contains 50 chromosomes or the complete diploid number from each variety.

The increase in plant size and in size of cells and parts of the plant is carried still further in the tetraploid plants than in the triploids.. The volume of the tetraploid cells is 60 percent greater than that of the diploid cells. Triploid pineapples are sterile to a very high degree; only a few among very many pollinations have resulted in seed formation. The tetraploids on the other hand appear to be as fertile as the diploid form. By crossing tetraploid and diploid forms, sterile, seedless, triploid forms should be produced in large quantities. This promises to supply a new method of plant breeding which has never before been used purposely.

Polyploidy confers some characteristics not possible in diploid forms. Three of these are: 1—greater tolerance to environmental conditions, permitting a wider geographical range; 2—a greater genetic stability and less frequent appearance of off-type mutations; 3—a greater degree of expression or development of those characters dependent upon the cumulative action of multiple genes than is possible in the diploid form. (Illustrated with charts and lantern slides.)

GEOLOGIC STRUCTURE OF NUUANU VALLEY

By

CHESTER K. WENTWORTH

Nuuanu Valley is one of more than thirty valleys by which the leeward slope of the Koolau Range of Oahu is dissected. This dissection discloses a remarkable general unifomity of thickness and slope of the thin basalt flows of which the leeward portion of the mass is composed. Nuuanu Valley differs from many of the valleys in its nearly uniform bottom gradient from Honolulu to the Pali gap and in its flat or slightly convex transverse bottom profile. This configuration is due to the filling of a once much deeper valley by several thick lava flows of a new series, which came from two vents now marked by cinder cones, and located 1.2 and 1.8 miles seaward from the head of the valley. The new lava is markedly different petrographically from the basalt of the main range.

Diamond drilling, carried to over 400 feet in five holes, and to lesser depths in ten others, reveals a basalt fill of the valley in excess of 300 feet, overlying an impermeable floor of weathered alluvium more than 100 feet thick. Near one of the source vents, nearly 300 feet of cinder tuff was penetrated, revealing additional details of structure. From this drilling and older artesian well borings nearer the coast it is now known that Nuuanu Valley was once eroded 400 to 800 feet below its present bottom at a time when sea level was upward of 1,000 feet below its present position. In addition to the lava flows revealed by drilling there were apparently large alluvial contributions to the fill, increasing toward the coast, and forming along the coast the cap rock which restrains the artesian water under Honolulu. (Illustrated by maps and demonstrational material.)

A GAZETTEER OF THE TERRITORY OF HAWAII

By

JOHN WESLEY COULTER

(University of Hawaii, Research Pub., No. 11, 1935.)

The gazetteer is compiled from available maps and contains an index to place names located by latitude and longitude. (Illustrated with maps.)

A COMPARISON OF THE *ASPERGILLUS NIGER* AND REPLACEABLE POTASH METHODS FOR THE ESTIMATION OF AVAILABLE SOIL POTASH

By

O. N. ALLEN AND O. C. MAGISTAD

The present study has involved the comparison of results of a strictly chemical method with those of a biological method for the estimation of soil potash available to plants. The replaceable potash method is based upon the principle that the potassium is released from the soil by ammonium acetate, is precipitated as potassium cobaltinitrite, and estimated by titration with standard potassium permanganate. With the *Aspergillus niger* method the amount of available potash in a soil is determined by the weights of the fungal mycelium when the mold *Aspergillus niger* is grown in a nutrient solution under specified conditions. Throughout these tests the Niklas strain of the mold was used.

Eighty-three pineapple soils have been tested by these two methods. These soils, taken from potash field experiments, have ranged from a low limit of 50 pounds of available potash to a high limit of 2,600 pounds per acre foot of soil, based on 2,400,000 pounds of soil per acre foot. In the majority of tests conducted to date there has been shown mathematically to be a high degree of correlation between the results of the two methods. Acceptable agreement has also been obtained between the results from these methods and yield responses from actual field tests with pineapples. However, as a general rule the *Aspergillus niger* method has given a slightly larger potash content in the soil than has the chemical method, a fact possibly due to the greater solution and absorption by the mold of the less readily available soil potash in the citric acid medium. Work is in progress to determine mathematically an equation which will make possible the conversion of the results of one method into the other within an accepted degree of accuracy. (Illustrated with charts and demonstrational material.)

SHIPBOARD PLANE-TABLE AND AZIMUTH CAMERA: AN EXPERIMENT IN NAVIGATION

By

THOMAS A. JAGGAR

The zenith star locates a place in latitude and longitude, if accurate time is read at the instant of observation. The zenith point on a star map may be found by three-pointing other stars, by the method of the topographer. A timed observation, by eye, of the zenith point among the stars may locate a practised observer within 30 nautical miles. All navigation schools should train students to recognize declination belts and meridian belts among the stars. A student so trained, flying an airplane, could tell, by merely looking up at night, the half-degree belts of latitude between 19 degrees and 22 degrees North, from the south end of Hawaii island to the middle of Kauai island.

The experiment with an F. 1.9 camera directed to the zenith, one minute exposure, super-sensitive film, photographed numerous stars, each 1 mm long on a 3¼ × 4¼ inch film. One minute of time is 15 miles of longitude. For finding the zenith point among the stars, the camera was rotated in azimuth 180 degrees, and exposed for a second time on the same stars, the epoch of the observation being the instant of rotation between the two exposures. Joining identical stars across the print for this instant with ruled lines, the intersection point was the zenith. This was matched to a star map for that instant of sidereal time Greenwich. The declination is the latitude. The difference of the right ascension, from Greenwich, is the longitude.

At sea the essentials of the method are: 1, a basic azimuth for the time of observation; 2, simultaneous azimuth for three or more stars; 3, corrected

Greenwich time reading for the epoch; and 4, a strictly equiangular or photographic star projection map, wherein azimuth lines are of first importance. Possibly the stereoscopic projection is the best.

A shipboard plane-table was exhibited as a first experimental attempt to use a mirror, and rule star azimuths with a hard pencil. The instrument is a rebuilt theodolite hung in gimbals. The telescope, converted to a sighting tube, is hung with a mercury cup floating a star mirror, and straight edges mark the star azimuths on a ring card. The ring card, with stretched silk threads on the azimuths, is set over the star map. A voyage to Kauai was used for tests. The gimbals hold the star image in the sights in a seaway, and a compass card checks the steersman's holding of the base azimuth. Preliminary trials gave errors of from 6 to 15 miles, and tests of technique are in progress. These involve reversals and repetitions for averaging out error, improvements in lighting, sighting and clamping for securing simultaneous record, and calibration of the mirror leveling, for holding the zenith. It is believed that a simpler instrument will result, accurate within about 10 miles on an airplane and possibly 5 miles on a steamship. Incidentally the star map gives local time and total compass correction directly. (Illustrated with instruments and charts.)

SOME FACTORS INFLUENCING THE DEVELOPMENT OF LANGUAGE IN PRESCHOOL BILINGUAL CHILDREN OF JAPANESE ANCESTRY IN HONOLULU

By

MADORAH E. SMITH AND JITSUICHI MASUOKA

Fifty sentence samples of the conversation of 125 bilingual children of Japanese ancestry living in Honolulu and ranging from 18 to 78 months of age, were recorded verbatim by bilingual university students and compared with similar conversations of 200 monoglot American children.

The bilingual children were found to be behind the monoglot on all measures used, especially after three years of age. They used shorter sentences, fewer compound and complex sentences, fewer connectives, and asked fewer questions pertaining to the causes and reasons of things, but asked more questions requiring the repetition of remarks made to them. In all of these measures the backwardness was not due to the faulty English most of them heard. This corrupt English showed its influence by an even greater discrepancy between their performance and that of the monoglots in those measures which considered performance in English only. Thus the bilingual children used fewer articles, conjugated verbs less often, made many more errors per hundred English words spoken, and used a larger proportion of interjections, much more frequently a part of infant than of adult speech. Their use of Japanese was also very incorrect.

The amount of English used increased with age after four years. At the lower ages, about 40 percent of the sentences and a little more of the words used were English. Between 20 and 30 percent of the sentences recorded at all ages, included words from more than one language.

Factors influencing the amount of English used and the correctness of speech were sex (boys using more English than girls), residence (children living among other racial groups using more English), and especially the amount and quality of English used in the home. It was also found that later-born children used more English than did the eldest and second children of the family. (Illustrated with charts.)

THE RED SHIFT AND THE VELOCITY OF LIGHT

By
HARRY A. KIRKPATRICK

In the study of the spectra of stars and nebulae, spectral lines are commonly found to be shifted from their normal positions toward either the red or the violet end of the spectrum. This is interpreted as a Doppler shift due to motion of recession or approach. Hubble and Humason with the Mount Wilson 100-inch telescope have photographed spectra of more than eighty nebulae at distances from one million to 150 million light years. In 1929 they announced that all distant nebulae are receding with velocities directly proportional to their distances from us, and that the rate of recession is about 550 km/sec/megaparsec. This indicates that the universe is doubling its diameter every 1,300 million years, which involves velocities greater than the physicist's limiting velocity, that of light.

Various other explanations have been offered to avoid this, including Zwicky's "gravitational drag" to account for the loss of energy by the photon and the consequent increase in wave-length, since Energy = hc/wave-length, where h and c are constants. Wold has recently proposed that the velocity of light has been decreasing during the passage between the nebula and the observer, which would account for the red shift.

It is shown that a small acceleration of approximately 20 cm/sec/yr in the velocity of light will account for the red shift without any change in the energy of the photon, and that it is theoretically possible to make certain experimental tests of this theory. Practically it would be difficult to gather enough light to perform the experiments. No other theories seem subject to direct test. (Illustrated with slides and charts.)

SEED DISPERSAL

By

CHARLES S. JUDD

Plants with the best means of seed dispersal are the ones which have wandered farthest and invaded new territory most successfully. Methods and results of seed dispersal in Hawaii by wind, water, birds, animals, man, gravity, and the "step-ladder method" or slow inland migration from the sea, are discussed.

(This paper is listed for publication in the Mid-Pacific Magazine.)

A STUDY OF PAPAYA CAROTENE

By

LEONORA N. BILGER AND ERNEST WATANABE

Carotene is the plant pigment which has been established as the precursor of the vitamin A of animal tissues. The vitamin A activity of papaya, fed to rats, has been found by Miss Carey Miller to be relatively high. One gram of papaya is equivalent to 40 gamma of carotene.

The authors found carotene very difficult of isolation from papaya by the methods that result in high yields of beautifully crystalline carotene from carrots. Colorimetric determinations showed one gram of papaya to contain 0.015 milligrams of carotene, the equivalent of 15 gamma of vitamin A activity. The presence of xanthophylls was noted during the preparation of papaya carotene.

From 1931 to 1934, a number of authors have attributed vitamin A activity to chlorophyll and xanthophylls. If further experimentation establishes the vitamin A activity of xanthophylls, it is probable that the high vitamin A activity found in the nutrition laboratory for papaya is consistent with the low carotene content determined colorimetrically in this study. Whole papaya may owe its vitamin A activity to three or more substances including chlorophyll, xanthophyll and carotene.

OXIDATION-REDUCTION SYSTEMS OF THE PINEAPPLE PLANT

By

C. P. Sideris and B. H. Krauss

The different tissues of the leaves of pineapple plants possess different degrees of oxidation-reduction properties. The terminal tissues reduce methylene blue and indigo-tetrasulphonate at a very great rate, whereas the basal ones reduce it very slowly, or not at all. The experimental procedure is as follows.

The sap of the tissue under investigation is neutralized and well buffered to pH 7.0 to minimize the possible effect of hydrogen ions before the dye is subjected to the influence of the extracted sap. The sap and the dye are mixed and placed in an incubator and examined at different intervals for discoloration of the dye. The rate of discoloration of the dye indicates the reducing efficiency of the sap. Oxidation-reduction potentials may also be determined by means of a potentiometer using a bright platinum electrode in an oxygen-free atmosphere. The reduction of 5 cc of tetrasulphonate (100 mg per liter) by one cc of sap from the different tissues of the longest leaves of the pineapple plant during a period of 24 hours was as follows: Basal, 0 percent; intermediate basal, 0 percent; intermediate medial, 10 percent; intermediate apical, 95 percent; terminal, 100 percent. The chemical properties of the reductant are similar to those of ascorbic acid or vitamin C.

THE SEQUENCE OF FLOWER DEVELOPMENT IN THE PINEAPPLE

By

Kenneth R. Kerns

The meristematic area of the pineapple leaf is small in relation to the diameter of the stump at the apex of which it is centrally located. The first visible evidence of leaf development is a bulge or small ridge composed of a number of cells at one edge of the circular growing point. After the primordium of one leaf has grown for a time the next leaf primordium becomes evident on the opposite side of the growing point. The time interval between the origination of successive leaves is apparently uniform, as is the circular distance around the growing point between successive leaf points of origin. This is shown in the size relations between the young growing leaves.

In order to create a greater number of new growing points beyond those afforded by an apical meristem originating leaves, it is necessary for the meristematic area to widen. This widening of the growing point is the first evidence of the transition of the growing point from the purely foliar meristem to a fruit bud meristem. Averages of 25 plants dissected weekly indicated that this change occurs 38 days previous to any evidence of redness in the heart of the plant, which is the first field evidence of flowering.

After the increase in diameter of the apical meristem, leaf-like primordia appear around its margins. These become the bracts, subtending the individual flowers. Directly above each of the bract primordia appears a convex area of thin walled meristematic cells. At equidistant points on this convex area there appear small protruding masses of cells, not unlike leaf primordia, which produce the sepals. Inside these sepal primordia there occur successively the primorida of the petals, stamens and carpels.

The flower parts originate in sets of three. The members of each set grow simultaneously and the different sets in succession. The sepals and petals grow upward at an acute angle with the base and form a double closed tent over the essential flower organs. The six stamens start also as leaflike primordia. The pistil with its three carpels originates in a similar manner within the circle of stamens.

All the floral parts originate at the same level and grow away from this point of origin. The central portion of the growing point, around which the floral parts originate, does not share in this growth but remains at the original level. The growth of the parts around this area thus produces a cup or cavity. The growth rate of the different whorls of the flower appears to be different, the outer ones growing faster, causing the walls of the cavity to grow together at the top. The growth and development of the carpels then fills up this cavity, becoming folded in a characteristic fashion. The apex of each carpel grows upward between the stamens and there fusing into a single unit becomes the style and stigma of the pistil.

The edges of the carpel primordia not only come together during growth but are forced to curl back upon themselves, causing the edges to be turned in opposite directions. When growth and development of the carpels is completed this twin nature of the placental area is not evident, unless the fusing is incomplete at some point, causing intercarpellary fissures. Defective spots in the mature fruit are often caused by such fissures.

NECROLOGY

Yakichi Kutsunai, a charter member of the Hawaiian Academy of Science, was born in Japan on January 10, 1883, and died in Honolulu on December 27, 1934. The son of an immigrant plantation laborer, Mr. Kutsunai was a graduate of the University of Hawaii in agriculture, cum laude, a member of several local scientific societies, and had been connected with the Experiment Station of the Hawaiian Sugar Planters' Association for 22 years, holding the position of Associate Agriculturist at the time of his death. Mr. Kutsunai was a keen mathematician. His work in the mathematical evaluation of statistical data was outstanding. He also made valuable contributions to sugar cane breeding and culture. Surviving are the widow and five children.

Burt Adams Tower	1878-1927
Frederick Charles Newcombe	1858-1927
Edgar Wood	1861-1928
Walter Le Montais Giffard	1856-1929
Benjamin Davis Bond	1853-1930
Albert Burkland	1873-1930
Lorrin Andrews Thurston	1858-1931
Stuart Gardner Wilder	1890-1931

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PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

ELEVENTH ANNUAL MEETING
1935-1936

BERNICE P. BISHOP MUSEUM
SPECIAL PUBLICATION 30

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1937

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Eleventh Annual Meeting were held in Dean Hall, University of Hawaii, November 14 and 15, 1935, and May 14 and 15, 1936, ending with banquets at the Pacific Club on November 16 and May 16.

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PROGRAM OF THE ELEVENTH ANNUAL MEETING

THURSDAY, NOVEMBER 14, 1935, 7:30 P. M.

Dr. Andrew W. Lind: The cost of island civilization.

Mr. Edward Y. Hosaka: Floristic and ecological studies in Kipapa Gulch, Oahu.

Miss Carey D. Miller and Mrs. Ellen Masunaga: A study of the diet of sampan fishermen while at sea.

Dr. Royal N. Chapman and Miss Bertha Hanaoka: Predatory habits as causes of fluctuations in insect population.

Dr. T. A. Jagger: Instrumental methods at the Volcano Observatory.

FRIDAY, NOVEMBER 15, 1935, 7:30 P. M.

Mr. Austin E. Jones: Earthquakes and earth movements at Kilauea Crater, first half of 1935. (Presentation by title only.)

Mr. R. J. Baker: Some social aspects of American cities. (Presentation by title only.)

Mr. Charles S. Judd: The airplane in forestry. (Presentation by abstract.)

Dr. C. Montague Cooke, Jr.: The extinction of the Mangareva land shell fauna. (Presentation by abstract.)

Mr. F. R. Fosberg: A study of the Hawaiian genus, *Gouldia.*

Dr. C. J. Hamre and Miss C. D. Miller: The influence of splenectomy on recovery of nutritional anemia rats.

Miss Ruth Robbins and Miss C. D. Miller: Variation in calcium and chloride content of papayas grown at different altitudes.

Dr. Roswell H. Johnson: A preliminary study of sex education in Hawaii.

THURSDAY, MAY 14, 1936, 7:30 P. M.

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

Miss Carey D. Miller and Dr. Francis G. Benedict: Basal metabolism of normal young men and women of various races in Hawaii.

Mr. Edward Y. Hosaka: Phytogeography and ecology of Oahu. (Presentation by abstract.)

Dr. W. W. Krauss: A German-Japanese family—a study in race biology.

Dr. Stephen B. Jones and Mr. Rolland Bellair: Koppen and Thornthwaite classification applied to Hawaiian climates. (Presentation by title.)

Mr. F. R. Fosberg: Flora of Vostok Island.

Dr. Harold St. John and Mr. F. R. Fosberg: Flora of Flint Island.

Dr. C. H. Edmondson: Studies of fouling organisms in Kaneohe Bay.

Dr. M. B. Linford: Capture and destruction of nematodes by Hawaiian field and garden fungi.

Mr. Bruce Cartwright: Recording our ancestors.

FRIDAY, MAY 15, 1936, 7:30 P. M.

Dr. Harold S. Palmer: Geology of Lehua and Kaula.

Mr. K. R. Kerns and Dr. J. L. Colliins: The uses of acetylene to stimulate flower formation—a technique in pineapple breeding.

Mr. Otto Degener: Pages from a new illustrated flora of the Hawaiian Islands.

Dr. T. M. Livesay: Racial comparisons in performance on the American Council of Psychological Examination.

Dr. Peter H. Buck: Stock taking in ethnology. (Invitational paper.)

SATURDAY, MAY 16, 1936, 6:30 P. M.

Pacific Club banquet.

Constitutional order of business.

Installation of new officers.

Presidential address: Modern bench-forming processes on Oahu shores.

Adjournment.

ABSTRACTS OF PAPERS

MODERN BENCH-FORMING PROCESSES ON OAHU SHORES

(Presidential Address)

By

CHESTER K. WENTWORTH

Four chief bench-forming processes are distinguished: (1) wave quarrying, (2) wave abrasion, (3) water-level weathering, (4) solution benching. The level at which the deepest landward cut, or nip, is formed by wave quarrying is thought to depend not only on the profile of equilibrium against wave attack, but on the height of the zone of alternate wetting and drying as determined by splash vigor, and on the failure of supporting water pressure above a certain level. Wave abrasion is closely dependent on hard debris fragments for tools. Water-level weathering is not a primary cliff-notching process but smoothes and levels earlier benches at any level spray can reach. It is probably due to the physical effects of wetting and drying and is chiefly displayed on tuff formations. Solution benching is the result of the solution pitting of reef formations down to the level at which sea water regularly washes over the rock. The level thus set is higher on exposed points, lower in protected places. The chemical basis of the solution is not yet fully determined; land and rain water probably are important, but organic factors may enter in and there is some evidence of effects of agitation on the carbon dioxide content, and hence solution capacity of the sea water. This process forms strikingly level benches one to four feet above sea level on calcareous reef rock or sandstone coasts. Much work remains to be done on the exact physical and chemical character of each of these modern processes before it is possible to accurately interpret ancient cut benches.

THE COSTS OF ISLAND CIVILIZATION

By

ANDREW W. LIND

Judged by the more obvious criteria of western civilization such as public health and education, Hawaii rates high, particularly among the tropical colonial areas of the world. Infant mortality reached a low level of 64.5 per thousand live births in 1935, which compares favorably with the 1934 rate of 59.9 in the Birth Registration Area of continental United States. It was very much lower than the rates of any of the comparable colonial areas or of the regions from which Hawaii's labor population emigrated. Hawaii's ratio of literacy in the population 10 years of age and over (84.9 percent in 1930) exceeds that of all other major plantation areas.

These achievements of civilization, apparently requisite for full participation in the American commonwealth, have occasioned financial expenditures which are likewise considerably greater than those of comparable colonial areas. In 1930, the per capita outlay for public education reached the high figure of $15.19. The alleged moral costs of island civilization, due to the misplaced expectations of youth seeking preferred positions in a closing economic order, are probably normal where pecuniary standards are so greatly emphasized. Social malaise and personal disorganization, due to the misplaced expectations again, are universal in areas with an extensive experience under the capitalistic system. Thus far Hawaii has been spared the more serious overhead costs of civilization. Ratios of arrests and convictions for the more serious types of crimes are considerably lower here than in continental United States. Striking differences between the rates of dependency, delinquence, and insanity and the corresponding charges upon the community of the several racial groups vary according to the length of residence, abnormalities of age and sex distributions, and the stage achieved in the assimilative process. In general the latest arrivals cost the community the most. The Porto Ricans per capita constitute an exceptionally heavy charge upon the community, while the Japanese and Chinese cost least.

FLORISTIC AND ECOLOGICAL STUDIES IN KIPAPA GULCH, OAHU

By

Edward Y. Hosaka

By the principles of the relation of nature to man, conservation is not merely a matter of food but it is the only means by which man can deliberately prolong the life of his civilization. To obtain some light on the problems of conservation of soil and vegetation, Kipapa Gulch was chosen and the floristic, climatic and edaphic data were collected.

Kipapa Gulch can be divided into six distinct vegetational zones, namely the Maritime, Lowland, Guava, Koa, Ohia, and Summit Zones. The Maritime Zone is characterized by the *Batis-Scirpus* association and the vegetation is heterogeneous. The Lowland is characterized by the growth of xerophytic plants. This zone is classified as *Opuntia-Acacia-Heteropogon* Association, and the vegetation is nearly homogenous. The vegetation of the

Guava Zone is characterized by the uniform stand of *Psidium Guayava* and *Lantana Camara*. The area is classified as *Psidium-Lantana* association, and the vegetation is homogeneous. The most characteristic features of the Koa Zone are the pure stands of *Acacia koa, Aleurites Moluccana* and *Gleichenia linearis*. This area is classified as *Koa* association, and the vegetation is homogeneous. The Ohia Zone is classified as *Ohia* association, and the vegetation is homogeneous. Above 2,000 feet elevation an open low scrubby, moss-covered vegetation is found with no single dominant species, and the vegetation of this zone is heterogeneous.

In working up the floristic composition of the gulch, only the endemic, indigenous and naturalized introduced species were considered.

Figure 1. The floristic composition of Kipapa Gulch.

Plants	No. of species
mosses	34
Pteridophytes	75
Angiosperms	334

Figure 2. Summary of the flora of the different zones.

Species	Maritime	Lowland	Guava	Koa	Ohia	Summit
Endemic	2	8	12	35	194	144
Indigenous	13	12	24	28	43	14
Introduced	26	64	70	21	23	9

As to the problem of plant succession, the Maritime Zone is stable except for the drier places where *Prosopis juliflora* is coming in. The Lowland Zone is stable; Guava Zone, stable; Koa Zone, unstable; Ohia Zone, stable; and Summit Zone, unstable.

(This paper is listed for publication by Bernice P. Bishop Museum.)

PHYTOGEOGRAPHY AND ECOLOGY OF OAHU

By

EDWARD Y. HOSAKA

The understanding of the vegetation of any region is important since the knowledge of the status of vegetation could be profitably used as a guide to the future utilization of the land. Each region is a distinct combination of geology, climate and topography, and results in a characteristic set of soil types. As a result a region will have a characteristic vegetation and the understanding of the plants could be used as an index to various agricultural possibilities.

In the Hawaiian islands very little work has been done on phytogeography. The islands could be divided into several climatic regions and these regions seem to have their own types of plant associations with definite life forms. The plants in Haiku Valley and Kipapa Gulch point to these conditions.

A STUDY OF THE DIET OF JAPANESE SAMPAN FISHERMEN WHILE AT SEA

By

CAREY D. MILLER AND ELLEN MASUNAGA

In order to make the study, we secured the cooperation of the operators of five sampans. There were four men on each sampan making a total of twenty men. The ages ranged from 17 to 65. Some of the men were born in Hawaii, some in Japan, and fishing had been their occupation from two to forty years. It was possible to secure exact records regarding the kind, quantity, and cost of foods taken for three consecutive trips to sea. The duration of the trips was from 11 to 13 days. One man on each boat kept a record of the quantity of fish eaten and of any food that was left when they returned. The height and weight of the men were known and their energy expenditure was based on a detailed twenty-four hour record of their activity on the boats.

Using the data collected, the intake of various food constituents was calculated. The calories, protein, phosphorus, and iron were found to be adequate and the calcium and vitamin B inadequate. The calcium was only about half of the recommended standard and the calcium-phosphorus ratio was 4:1 instead of 2:1. The vitamin-calorie ratio calculated by the Cowgill method was 1.3, whereas it should have been 1.65. A list of foods was then prepared to provide a diet which was adequate in every respect with the calcium and vitamin B greater than the standards. In general, legumes and vegetables were stressed and the men were urged to take more evaporated milk.

It was believed that the muscular pains from which a number of the men suffered might be due, at least in part, to the inadequacy of their diet, and consequently, they were greatly interested in improving the diet if it did not mean increased cost. It was not possible to make an exact check six months after the experiment ended, but we found they were using more vegetables, more legumes, and more milk than they had previously used.

METHODS OF THE HAWAIIAN VOLCANO OBSERVATORY

By

T. A. JAGGAR

(Hawaiian Volcano Observatory, Volcano Letter 434, 435, 437, 1936.)

The work since 1911 has centered about the recording, quantitatively, of the physical changes at a crater, always aiming to see underground. Three main projects have resulted: (1) discovering earthquake origins, (2) measuring secular strain, and (3) measuring gas emission, probably hydrogen. The projects have in view the forecasting of eruptions.

(1) Mr. Jones' study (University of Hawaii Research Publication No. 9) shows a sample of our earthquake record book, and the method of using locally determined travel times, in order to map and profile highly localized earthquake origins.

(2) Mr. Wilson's study (University of Hawaii Research Publication No. 10) shows the elevation and opening of angles from 1912 to 1921; the opposite from 1921 to 1927. The work was critically done with a precise level and transit.

(3) Mr. Jaggar's study (Annual Address, Hawaiian Volcano Research Association, Honolulu, 1924) makes a systematic forecast for the Mauna Loa flow expected (and arriving) about December 1935, with the average interval, migration of vents, seismometric data and intensity in the past for criteria.

The tools have been seismographs, shock recorders and annunciators, tilt-meters, cameras, weather instruments, pyrometers, gas collectors, borings and time-keepers checked by radio. All assistance has been volunteered.

GROUND SURFACE DISPLACEMENTS AND EARTHQUAKES AT KILAUEA, HAWAII, FIRST HALF OF 1935

By

AUSTIN E. JONES

Various measurements that have been carried on at the Hawaiian Volcano Observatory are examined for accuracy. The errors are $\pm$ 2 mm for precise levels; $\pm$ 38 mm or $+$ 2″ of arc for angles; and $\pm$ 6″ of tilt for seismographic measurements. The crack points in the floor of the crater are about 0.2 mm in error. The cracks measured weekly are compared with the angle, level and tilt measurements, with the anomalous result that the crack opening appears least when the angles show the greatest opening. A better result was obtained in a direct comparison to days of tilt-determined crustal elevation and depression. Here there was a much more rapid crack opening with 3 to 7 days elevation than there was with 10 to 20 days depression.

Measurements of angles between the crater walls and levels of the crater floor are not interchangeable methods of measuring crustal movement. During the period of examination the points on the crater floor continually sank with to and fro motions of the crater walls. This has led to the explanation that craters are areas that sink more rapidly than does the surrounding country. Levels are undoubtedly useful outside the crater.

The small percentage of located shocks appears to have little to do with the movements studied, though the frequency of all shocks does. Several seismicity curves were constructed. Seismographic tilt determinations of crustal elevation and depression are best; angle and luni-seismic methods are second and third best. Angle measurements cannot be made at close enough intervals of time, while luni-seismic methods are inherently bad in that several days may elapse after the initiation of a crustal movement before it can be shown in the studies. A daily local earthquake maximum for the six months period comes when the sun is over the eastern Pacific. The above is a separation based upon tilt. With a separation based upon the luni-seismic determination of crustal movement, no difference in the daily curves can be found. In the period under study and with the methods used, days of crustal uplift appear as seismic as days of crustal depression. From the foregoing it appears that a seismographic cellar, properly equipped and located on the slopes of an active volcano, is as good an all-around instrument as the volcanologist can obtain.

SOME SOCIAL ASPECTS OF AMERICAN CITIES

By

JEROME BAKER

Changes of far-reaching consequences and of profound significance have been, in the recent past, and still are taking place in American cities. There is evidence that industry is decentralizing, moving to less costly sites and less congested areas. Traditionally, industry has clung to centers of population and accessible reservoirs of labor. Electric power and improved transport has made it possible to move industry to less crowded locations.

Economic conditions arising out of the recent depression have brought about a series of important social changes. Populations, always moving, changing and making readjustments, have been particularly restless during this trying period. Families of unemployed or partially employed workers have doubled up or moved to the country, thus causing vacancies and depressed real estate values. Apartment house owners who have built or refinanced their properties during boom times, are unable to meet principal and interest payments with lower rents and fewer apartments rented. Pretentious real estate projects which have been developed in suburban areas, far beyond immediate needs and absorbing useful agricultural land, have been abandoned and their shoddily laid out streets and cement walks have become overgrown with weeds. New and successful office buildings are considered fortunate if seventy-five percent filled, while older and less attractive ones may be from one third to one half filled with tenants. Gangsterism and large scale robbery as a social phenomenon has become conspicuous, and armored trucks for transporting valuables have become a familiar sight. The park benches are filled with those in ill health, deficient strength or skill, or for other reasons unable to stand the industrial strain, unemployed or unemployable, homeless,—and the community evades its social responsibility by leaving them sitting there.

Pictures to illustrate this talk consisted of the great office buildings of Chicago and New York, industrial subjects, street traffic, shopping areas, street markets in the East Side of New York and Maxwell Street of Chicago, armored trucks, negroes seeking employment in the north, mounted police and dwellings in stable and disorganized communities.

THE AIRPLANE IN FORESTRY

By

C. S. Judd

In the rapid development of the use of airplanes for commercial purposes, such as the speedy carrying of passengers, mail, and articles of commerce and for war maneuvers, foresters have not been slow in adopting them for forestry purposes.

Among these may be classed the taking of vertical aerial photographs for the preparation of topographic maps showing forest limits and forest types, a detection of forest fires and the rapid transportation of fire fighters and supplies to burning areas, the searching for lost parties, the transportation of building materials for mountain cabins, and the sowing of seed on areas in need of reforestation.

The first observed results of the use of airplanes for sowing seed in Hawaii originated on July 2, 1926, when Assistant Forester L. W. Bryan in three flights in a Loening amphibian generously supplied by the U. S. Army, scattered from an elevation of 1500 feet, 600 pounds of seed of 35 different species of forest trees on a recent 700-acre burn in the Panaewa forest near Hilo. Less than two years later Mr. Bryan discovered 24 *Melochia indica* trees from 3 to 10 feet high and one *Lagerstroemia speciosa* 18 inches high, the undoubted results of this seed sowing from the air.

On Oahu, 31 flights dating back to May 28, 1922, have been made by the U. S. Army in cooperation with the Experiment Station of the H.S.P.A. under the immediate direction of Forest Supervisor G. A. McEldowney and approximately nine tons of seed have been scattered from the air over forest regions on this island.

Results of this sowing observed thus far show at least four tree species established in this manner: African tulip 10 feet high, Moreton Bay fig, 8 feet high, *Barringtonia asiatica,* 6 seedlings 14 inches high, and Java plum, 10 plants 2 feet high occurring on two acres from seed dropped 3 years previously.

The most spectacular results have been secured on Kauai from the seed dropped from the Fokker plane C-2, generously supplied by the Army on November 15, 1929 when Assistant Forester A. W. Duval in three flights liberated 1,686 pounds of tree seeds at an elevation of 2,000 feet over western Kauai. In September of this year, some CCC boys prospecting for new trails through the Alakai swamp, discovered about 400 trees of the New Zealand Karaka tree from 5 to 8 feet high growing in a narrow strip through the swamp. These undoubtedly are the result of the sowing made six years previously.

The results noted above prove that reforestation by airplane seed sowing is feasible when the seed finds a favorable germinating bed. For every day use, however, this method is not practical because of the high cost of operating airplanes and the waste of the huge quantity of expensive seed which does not find a favorable site for germination.

EXTINCTION OF LAND SHELL FAUNAS OF THE MANGAREVA ISLANDS

By

C. Montague Cooke, Jr.

Nearly a dozen species belonging to six or seven genera of endemic land shells have been reported from the Mangareva Islands. A few of these species were alive in the late 60's or early 70's of the nineteenth century. Due to the destruction of practically all the native forests the endemic land snails have been almost entirely wiped out. None of these endemic species were found alive when we visited these islands in 1934. Two new endemic species were found on the face of one of the southern cliffs, where only a few dozen native trees exist today.

Fortunately, on four of these islands and islets rich fossil beds containing recent land snails were found by our party. These beds were five to eight feet above sea level, and the shells were embedded in a mixture of beach sand and soil from a few inches to one or two feet below the surface of the ground. Most of the species in these beds probably belong to new subgenera peculiar to this group of islands. From these specimens it is clear that this group of islands had at one time a highly endemic shell fauna distinct from any other faunas inhabiting other groups of islands in this portion of the Pacific.

THE INFLUENCE OF SPLENECTOMY ON RECOVERY OF NUTRITIONAL ANEMIA RATS

By

C. J. HAMRE AND C. D. MILLER

In 1935, the authors published their observations on changes of the spleen induced in nutritional anemia rats by the feeding of adequate supplements of copper and iron or other supplements containing adequate quantities of those elements. The spleen was found to become temporarily enlarged during the recovery period and while in the enlarged condition to be transformed into an erythropoietic organ. Both the enlargement and the erythropoietic process disappeared as the normal blood conditions were reached. This suggested that the spleen was an important factor in recovery of erythrocytes and it was decided to determine to what extent erythrocyte recovery was due to that organ, and in what ways it might influence the recovery of the animals in general.

Twenty-five albino rats were made anemic by being placed on an exclusive diet of milk. When they had developed severe anemia, they were divided into two groups of thirteen and twelve animals. The first group was splenectomized and fed daily doses of 0.5 mg. iron in the form of ferric chloride, and 0.25 mg. copper in the form of copper sulphate in addition to the basal milk diet. The second group of anemic animals was submitted to operation but the spleen was not removed. This group was then fed similar quantities of copper and iron to induce recovery from the anemia. White and red blood cell counts and hemoglobin determinations were made daily for each animal. Blood smears and differential counts of nucleated cells were also made daily.

Growth and hemoglobin recovery were similar and nearly identical for the two groups of animals. Erythrocyte recovery was slightly retarded for the splenectomized group though complete recovery was not prevented by removal of the spleen. The greatest difference between the two groups was found in the number of nucleated cells of the blood stream. Large numbers of nucleated cells appeared on the second and fifth or sixth day of recovery for both groups of animals. The number of nucleated cells on the second day was much greater for the splenectomized group than for the control group, the average number of cells for the two groups being 44,000 and 15,000. The number of nucleated cells appearing on the fifth or sixth days of recovery was also greatest for the splenectomized animals, the average being 16,000 and 10,000.

A differential study of the nucleated cells of the blood smears showed that the great increase of cells was due to increases of neutrophiles and lymphocytes and the appearance of large numbers of normoblasts in the blood stream, the latter in some animals constituting more than 50 percent of the total number of nucleated cells. This suggested that the removal of the spleen had unstabilized the hemopoietic system, for normoblasts appeared in small numbers only in the control group and never are found in the blood under normal conditions. The results indicate that the spleen acts as a check or stabilizer on the bone marrow causing the latter to liberate only mature erythrocytes into the blood stream. Since normoblasts disappear from the blood of splenectomized animals on continued recovery, it is suggested that some other hemopoietic organ assumes the function of the spleen in preventing the liberation of immature cells by the bone marrow.

VARIATION IN THE CALCIUM AND CHLORIDE CONTENT OF PAPAYAS FROM KNOWN REGIONS

By

RUTH COBURN ROBBINS AND CAREY D. MILLER

Seven samples of papayas grown in known regions of the Hawaiian islands were collected and analyzed at the nutrition laboratory of the University of Hawaii. The moisture, total ash, calcium, and chloride content of the fresh material was determined by standard methods. For comparison, the results were recalculated to the dry basis, yielding the following figures:

The calcium and chloride content of papayas from known regions
(calculated on the dry basis)

Source of Sample	Ash percent	Calcium percent	Chloride percent
Kailua uplands, Oahu	3.19	0.106	0.284
Wahiawa, Oahu	3.31	0.118	0.292
Kaneohe uplands, Oahu	3.09	0.107	0.423
Kona, Hawaii, 1500 feet	2.87	0.104	0.432
Puualoa, Oahu	3.54	0.132	0.792
Kauai	5.22	0.089	0.902
Wailupe, Oahu	8.05	0.299	1.703

On the fresh basis, the calcium content varied from 0.010 percent to 0.026 percent with an average of 0.016 percent, which indicates that papaya is a good fruit source of calcium in the diet.

The chloride content of these papayas on the fresh basis varied from 0.037 percent to 0.147 percent. The upper figure is near that published for milk, bananas and other "unsalted" foods. Sweet potatoes and oranges are also known to vary even more in chloride content, so this variation is not excessive. In view of the fact that recent vitamin tests at the nutrition laboratory show papayas to be an excellent source of vitamins A and C, and the average chloride content to be no greater than that of many other fruits and vegetables, there appears to be little foundation for the belief that papaya should be excluded from a salt-free diet. Because of its general excellence, wider use of the papaya is recommended.

(This paper is listed for publication in the Biochemical Journal.)

BASAL METABOLISM OF NORMAL YOUNG MEN AND WOMEN OF VARIOUS RACES IN HAWAII

By

CAREY D. MILLER AND FRANCIS G. BENEDICT

(Med. Soc. of Hawaii, Trans., 40th Ann. Mtg., 1936.)

As part of the world-wide survey of basal metabolism fostered by the Nutrition Laboratory of the Carnegie Institution of Washington, located in Boston, tests have been made during the past six years on various racial groups in Hawaii. The work has been supported by the Carnegie Institution of Washington and the University of Hawaii.

The Benedict "field respiration apparatus" was used for all tests. The subjects slept at home and came to the laboratory each morning without breakfast and rested from 30 to 40 minutes before the tests were made. Three, and occasionally four tests were made on each subject in one morning; the average of two or three that agreed best being used as representing the basal metabolism for that day. Tests were made on two different days, usually not more than two weeks apart. If the results of the tests on two different days did not agree within 5 percent, a third test was made with few exceptions.

For each subject the following data were secured: previous diet, hours of rest and sleep, physical activity the previous day and evening, mouth temperature, blood pressure, height, weight, sitting height, birth date, birthplace, length of living in Hawaii, and parentage. Every care was taken to eliminate apprehension and nervousness.

The majority of the subjects were students at the University of Hawaii. The aim was to secure subjects who were born in Hawaii or who had lived here most of their lives.

A chart was presented that summarized a portion of the data for 237 subjects—115 men and 122 women—between the ages of 18 and 30 for the following racial groups: Japanese, Chinese, Caucasian, Chinese-Hawaiian, and Hawaiian mixtures.

The average figures for all racial groups showed a minus deviation from the Harris-Benedict prediction as follows: for men, Caucasian, -6.6; Japanese, -2.8; for women, Caucasian, -7.9; Chinese, -15.0; Chinese-Hawaiian, -13.7; Hawaiian Mixed, -7.3; and Japanese, -10.8.

All females showed a greater minus deviation than the males. Of the female group, the Chinese showed the greatest deviation from the prediction standards, which confirms previous work of Benedict and co-workers that Chinese women have a definitely lower basal metabolism than Caucasian women. In 1928, Benedict suggested that the prediction standards for women should be lowered by about 5 percent. The data given above show that even if this were done, women of all races in Hawaii tend to show a low metabolism.

The averages for the men all show a minus deviation less than 10 percent, but because they are all in the direction of minus values, it would appear that men in Hawaii tend to have a basal metabolism somewhat lower than normal if present prediction standards are correct.

A detailed report of this work will be published by the University of Hawaii.

A GERMAN-JAPANESE FAMILY IN HONOLULU
A STUDY IN RACE BIOLOGY

By

WILHELM W. KRAUSS

The German-Japanese family, Kufferath, consists of the German father, Carl Theodor Jakob Kufferath (72 years), the Japanese mother, Shin Hori (63 years), and eleven children, six sons (23-38 years) and five daughters (32-42 years).

The father is the son of a musical director in northwest Germany; the mother is the daughter of a baron's steward and belonged to the low nobility (Shizoku class) of Japan.

The cross family was founded in Japan in 1893 and moved to Germany, Tasmania, Japan and, in 1910, to Hawaii.

The father was formerly a clerk and is now a piano tuner. All the children are small professionals.

Except the youngest two sons, all the children are or were married. Their husbands, or their wives respectively, are two white North Americans, two Portuguese, four white-Hawaiian crosses and one Japanese-white cross.

There are only five grandchildren, two boys and three girls, among them, however, only one grandson of the male line.

The three generations are mostly Protestants; only the eldest two sons, the wives of three sons, and one granddaughter are Catholic.

Many measurements of head and body were taken, and the most important qualitative characteristics (colors, morphology) were observed. The psychical quantities were stated according to Ernest Kretschmer's "Psychobiogramm", simplified by the author. Scientific photographs were taken of the single members. Only the eldest two daughters living on the American mainland could not be measured.

The father seems to be a Nordic-Alpine hybrid (Nordic: tall stature, 5 feet, 10 inches; Alpine; dark eye and hair color, broad, short head—cephalic index 83,67, low face—morph. face index 78,52[1]); his body build seems to be predominantly leptosomous.

The mother (small stature, 4 feet, 10 inches, short skulled—cephalic index 82,80) shows the narrow and high-faced Japanese Chosiu type (morph. face index 94,07); her body build seems to be pyknic.

The children: eye and hair colors are very dark, more like the mother's. Intermediate between the parents are: skin color, stature and morph. face index. The cephalic indices of all the children examined are higher (83,85-94,89) than those of the parents.

[1] Small resorption of lower jaw.

The strong Mongoloid fold of the mother occurs only in one son; another son has hardly any Mongoloid fold (like father); the other children show different variations of the Mongoloid fold.

Three sons look predominantly "Europoid" (deep-lying eyes, Europoid nose and cheek profiles), one son predominantly Mongoloid, another son and the daughters show about intermediate types.

Of the constitutional types both the leptosomous (two sons, one daughter) and the pyknic (one daughter) occur, while the other children represent intermediate types.

The parents and the children seem to be of predominantly schizothymous character; only one of the daughters seems to possess a strong cyclothymous component.

A coincidence of body build and temperament in the sense of Kretschmer was observed, the three most leptosomous children being the most schizothymous, the pyknic one showing the pronounced cyclothymous note.

A characteristic of the whole family seems to be "tenacious will."

No "hybrid vigour" ("Luxurieren") could be found.

The father's German and the mother's Japanese environmental influences on the children are insignificant; the children show about the same type of behaviour as the white Americans of the same social group.

KOPPEN AND THORNTHWAITE CLASSIFICATIONS APPLIED TO HAWAIIAN CLIMATES

By

Stephen B. Jones and Rolland Bellaire

Quantitative classification provides a means of comparing climates and of studying relationships of climate to vegetation and agriculture. Applied to the island of Oahu, the Koppen system is found unsatisfactory, because the classification is based largely upon temperature and seasonal distribution of rainfall, whereas total precipitation seems to be the outstanding distinction between different parts of the island. Because "precipitation-effectiveness" and "temperature-efficiency" are treated separately but concurrently, the Thornthwaite system gives a better representation of the climates of Oahu. However, the Thornthwaite system requires modification, in two respects, for application to Hawaiian climates. First, seasonal distribution of temperature-efficiency must be expressed, in order to distinguish the nearly isothermal Hawaiian climates from middle-latitude climates having similar total temperature-efficiency with high summer concentration. Thornthwaite provided for this factor but did not employ it on his maps. Second, it is found that evaporation under very rainy conditions differs greatly from that of the interior United States, upon which Thornthwaite based his equation for precipitation-effectiveness. The coefficient of the Thornthwaite equation must be increased by amounts varying from 40 to 400 percent. This increase is consistent with results obtained by Forbes, in an application of the Thornthwaite system to Atlantic coastal stations, and by Isozaki, in an application to the climates of Japan.

With the foregoing modifications, maps of the four larger islands of the Hawaiian group are constructed. These maps show fifteen climatic types, including every precipitation type except "arid" and every temperature belt except "perpetual frost." Reasonable correspondence with forest areas is observed, considering the wide spacing of stations in some parts and the many factors, other than climate, that affect vegetation distribution. The "BB'ra" climates seem to be favored for pineapple culture. Unirrigated sugar cane is found in "A" climates or in the rainier parts of "B" climates.

(This paper is listed for publication in the Geographical Review.)

VEGETATION OF VOSTOK ISLAND, CENTRAL PACIFIC

By

F. Raymond Fosberg

Vostok Island, lat. 10° 06′ S., long., 152° 23′ W., is a tiny, isolated, flat coral island. Although the Mangarevan Expedition of the Bernice P. Bishop Museum in 1934, was unable to land, a careful examination with powerful binoculars revealed no other vegetation than a dense forest of *Pisonia grandis*. In 1935, Captain W. J. Anderson landed on the island and spent several hours in a careful examination of the vegetation. He brought back and turned over to me specimens of the only two plants which he found. The island, with the exception of the beach, is entirely covered by a forest of *Pisonia grandis* R. Br., so dense that almost no sunlight can penetrate. The ground between the great trees is covered to a considerable depth with dried leaves.

Just outside the forest, at the top of the beach, are a few plants of the prostrate *Boerhaavia diffusa* Linnaeus. The leaves of some of the specimens of *Boerhaavia* are infested with white rust, *Albugo* sp. The extreme paucity of the flora is remarkable, even for a coral island.

A STUDY OF THE HAWAIIAN GENUS, GOULDIA

By

F. Raymond Fosberg

Gouldia, the *"manono"* of the Hawaiians, is one of the three commonest genera of Rubiaceae in the Hawaiian forests, and one of the important constituents of the forest cover in many areas.

In all probability the genus is endemic to the Hawaiian islands, although a species has recently been assigned to it from New Guinea. I have not had access to the type specimen of this species, but from the description I would judge that it did not belong in *Gouldia*.

This investigation has brought out the fact that there are only three distinct species in the genus. One of these species, *Gouldia terminalis*, has a large number of varieties and forms, differing only in minor vegetative characters.

Hybridism, both between species and lesser divisions seems to be common wherever the ranges of two or more forms overlap. This complicates the taxonomy of the genus.

One species is confined to the Koolau Range of Oahu, and to Lanai. Another is found on Molokai, Maui and Hawaii, with a different variety on each. The other, *Gouldia terminalis*, has varieties on the six major islands. Of these the Kauai varieties are rather distinct from those of the other islands, but rather closely related among themselves. Several closely related series of varieties run through the other islands.

With my present understanding of the genus, no phylogenetic arrangement is possible. The only suggestion as to its past history is that there may have been several widely distributed types in the past, which have differentiated into many local variations, these having subsequently become more widely distributed.

The evident relationship of *Gouldia* is with the genus now known in the Hawaiian islands as *Kadua*. It has probably been derived from *Kadua* at a rather remote period in the past.

Gouldia is much in need of further collecting, especially on islands other than Oahu. I will be glad to attempt to identify any specimens submitted to me.

(This paper is listed for publication by Bernice P. Bishop Museum.)

VEGETATION OF FLINT ISLAND, CENTRAL PACIFIC

By

HAROLD ST. JOHN AND F. RAYMOND FOSBERG

(B. P. Bishop Mus., Occ. Papers, vol. XII, no. 24, 1937.)

Flint Island, lat. 11° 25′ 43″ S., long. 150° 48′ W., is a small, isolated, flat coral island. Plants were collected there by the Mangarevan Expedition of the Bernice P. Bishop Museum in 1934.

The original vegetation of the island has been almost completely destroyed, and the island is entirely devoted to raising copra. Little can now be ascertained concerning the original distribution of the plants, as the planting has eliminated most of the individuals of many species and doubtless some species in their entirety. Of the 36 species of plants collected 13 are apparently indigenous, 13 are cultivated, 9 are recently introduced weeds, and one was possibly introduced by the ancient Polynesians.

STUDIES OF FOULING ORGANISMS IN KANEOHE BAY

By

C. H. EDMONDSON

Investigations of the fouling organisms in Kaneohe Bay, Oahu, have been carried on for more than a year, the object being to study their rate of growth, their life cycles, their periods of maximum development, and to gain as much information as possible about their habits and behavior. For collecting the organisms panels of wood, metal, glass and composition materials of various kinds have been used. Colored plates of glass and panels coated with commercial paints both non-toxic and toxic have also been utilized. The station established in Kaneohe Bay is at the end of the pier extending for a quarter of a mile into the bay from the Fish and Game Farm of the Territorial Board of Agriculture and Forestry on Mokapu Peninsula. The principal groups of fouling organisms found here are similar to those reported wherever work of this nature has been carried on. Barnacles, bryozoa, serpulid worms, certain mollusks, hydroids and ascidians prevail among the animals, and algae among the plants. Each locality, however, has its peculiarities with respect to the kinds of fouling organisms prevailing there. Differences are to be seen, both in quality and quantity, between the organisms of Kaneohe Bay and those of the leeward side of Oahu where observations have been made.

Seasonal variations are also observed. Each of the principal groups of fouling organisms shows periods of maximum development alternating with periods of depression. At times all have shown rapid growth and again all have been retarded. During the spring of 1935 the accumulation of organic material on panels in Kaneohe Bay was noticeably greater than for the corresponding period of 1936. For the first three months of 1936 there was a marked lack of fouling by all of the organisms, recovery from this depression being indicated only during the latter part of April.

It is known that larvae of barnacles just before attachment are negatively phototropic and attracted by dark surfaces, if non-toxic. The nature of the phototropism of other fouling organisms at the time of attachment is unknown. The efficiency of numerous anti-fouling paints and compositions is being tested. At the time of this report it can be stated that the toxicity of some of the paints employed is sufficiently lost in from 10 to 12 weeks to permit the attachment of some kind of fouling organism. Although there does not seem to be a solution of the problem at this time, it is suggested that a record of the responses of the larvae of each of the principal fouling organisms to a considerable number of highly toxic chemical agents may be a step in the right direction.

CAPTURE AND DESTRUCTION OF NEMATODES BY HAWAIIAN FIELD AND GARDEN FUNGI

By

M. B. LINFORD

Beginning late in 1935, fungi have been investigated by me as natural enemies of plant parasitic and free-living nematodes in soil. During this time, over two dozen distinct fungi have been found which destroy nematodes in devious ways. Eleven distinct forms, representing both Fungi Imperfecti and Phycomycetes, have been found capturing live nematodes, holding them, finally killing and digesting them, and using them as food. The remaining fungi are non-trapping parasites.

This paper deals with organs of capture and with the actual capture and destruction of nematodes by representatives of the eleven nematode-trapping fungi. Some of these fungi are identical with organisms observed and reported elsewhere, chiefly from the vicinity of Washington, D. C.; some of them appear new to science. None of the eleven has formerly been reported from Hawaii.

Three of these fungi capture nematodes in irregular nets composed of anastomosing hyphae with meshes of various sizes exposed at all angles.

Nematodes are caught, apparently by adhesion, when they enter a mesh. The fungus then penetrates the nematode through one or more points of adhesion, and grows through the nematode, digesting the internal organs.

Two fungi trap with simple rings borne on delicate stalks. Nematodes are caught when they thrust either head or tail into such a ring. They may be held fast, or may tear the ring from its stalk and carry it away as a tight-fitting necklace. In either case, the fungus grows from one of the three cells constituting such a ring, penetrates the nematode body, and digests its organs.

Five of the eleven fungi produce small spherical or ovoid adhesive cells at the tips of delicate stalks. Nematodes are captured by adhesion to such cells, and may be held fast or may tear these cells from their stalks. In either case, the fungus penetrates through the point of adhesion, killing and digesting the nematode. One of these fungi also bears simple rings.

Two fungi capture nematodes by adhesion to simple, straight hyphae. Again, the fungus penetrates through one or more points of adhesion, killing and digesting the captured nematode.

Fungi with similar types of trapping organs differ in details of traps, as well as in forms of conidia or other spores. For the most part, these fungi have not yet been identified specifically. One of the net trappers is *Arthrobotrys oligospora* Fresenius, and another is either identical with or very similar to *Stylopage hadra* Drechsler.

RECORDING OUR ANCESTORS

By

BRUCE CARTWRIGHT

A simple, compact, concise and elastic system of recording ancestors has been developed by Merton Goodrich, genealogist, of Keene, N. H. The person whose ancestry is being traced is given the numeral (1); his father (2). The number of every male ancestor is double that of the child. The mother is (3). Every female ancestor has the number of her husband plus 1, except where she is a second wife, then she takes a number double that of her child plus 1, while the father retains the first number assigned to him.

The data are assembled into sections called "lines". The number and name of each line is that of the mother with which it begins. If two lines have the same surname the mother's full name is used. Each line is divided into two parts. The summary shows on one page all ancestors of the line, connections with other lines and most important dates and localities. A collection of summaries alone will form a family tree. The ancestors in a direct line are at the left. The father preceded by his number in parenthesis is directly below the child. The mother, preceded by m. and followed by her number, is set in about half an inch to the right just below the father. Dates of birth, marriage and death, and residence follow each name. Her number is a reference to her line.

The detailed accounts of each individual, origin of family, et cetera, form the second part of each line and are called "family history". An accepted separate page is assigned to each subject. Family trees without accepted reference are worthless.

The only equipment necessary is a loose-leaf binder and plain pages, to be written or typed on. Using this system the Cartwright line has been worked out.

THE GEOLOGY OF LEHUA AND KAULA

By

HAROLD S. PALMER

(B. P. Bishop Mus., Occ. Papers, vol. XII, no. 13, 1936.)

Through the courtesy of the U. S. Lighthouse Service I was enabled to travel on the tender *Kukui* to the rather inaccessible islets of Lehua and Kaula. Lehua is a mile north of the north end of Niihau, and Kaula is 23 miles southwest of the south end of Niihau.

Both are parts of the arcuate rims of basaltic tuff craters. Lehua, a lateral cone of Niihau, was built in three eruptive epochs separated by erosion intervals during which unconformities were made. During the second interval a reef grew in the crater and supplied limestone blocks to the last series of tuff. All three tuff series include a variety of basalt blocks torn from the walls of the volcanic conduit.

Kaula stands on a shoal, 5 by 8 miles, made by the bevelling of a lava dome. Kaula has two series of tuffs separated by one unconformity. The blocks are of the same varieties as those of Lehua, but also include some boulders of lava which are well rounded as if by wave erosion on the shoal.

Both islets have considerable amounts of a low, wave-cut bench along the more sheltered parts of their shorelines, but have very little bench on the exposed parts. Presumably this bench was cut at a time when the sea level was higher than now.

Lehua is 702 feet high and includes about 291 acres. Its crest line is about 9,250 feet long and approximates closely to an arc of 260° of a circle of 1,975 feet radius. Kaula is about 540 feet high and includes about 136 acres. Its crest line is 5,500 feet long and approximates closely to an arc of 170° of a circle of 1,750 feet radius.

THE USES OF ACETYLENE TO STIMULATE FLOWER FORMATION: A TECHNIQUE IN PINEAPPLE BREEDING

By

K. R. Kerns and J. L. Collins

Over 33 years ago the pineapple growers of the Azores Islands discovered that pineapple plants could be forced into flower by smudging their glass houses with smoke from burning trash. Later the same practice was used in Puerto Rico. Small areas of prematurely fruiting pineapple plants found in the plantations in Hawaii during 1930, and later, were attributed to trash having been burned to the windward side of these areas. In 1932 it was shown by Rodriguez at Cornell University, that ethylene gas could cause flowering. It was shown by the Pineapple Producers' Cooperative Association's Experiment Station in Hawaii that other members of the unsaturated hydrocarbons, namely, acetylene and propylene, would act also in this way. Acetylene, because of its relative inexpensiveness and ease of handling, was used in pineapple breeding to force into simultaneous flowering varieties which do not normally flower at the same time. After it had been used for some time for this purpose it was discovered that water saturated with acetylene, when applied to the plants, would also stimulate them into flowering. This change in the method of using acetylene had important results. It then became possible to treat large numbers of plants for the purpose of forcing flowering of plants on the plantations and to cause fruiting of the plants according to a predetermined schedule. It also furnishes a starting point for the attack upon a series of problems related to fruit formation and growth; problems which are distributed in the fields of pathology, physiology, chemistry and genetics.

PAGES FROM A NEW ILLUSTRATED FLORA OF THE HAWAIIAN ISLANDS

By

OTTO DEGENER

In reading various floras, we note cases where different writers have ascribed different names to the very same plant. There are two reasons: (1) outright errors and (2) differences of opinion. Hillebrand called the common prickly-pear *Opuntia tuna* instead of *O. megacantha*; and our native poppy, the Mexican poppy. These are mistakes in identification. I described and named a new *Schiedea,* carelessly neglecting to add a Latin diagnosis. As this is contrary to new rules of nomenclature the proposed name, instead of standing for all time, is relegated to obscurity. This was an error in technique. Evaluating differences of opinion is more complex.

A floristic work in general, and especially for an imperfectly known region like Hawaii, is unfortunately not a precise account of the diverse species, varieties, and forms growing within a given geographical area. It is rather a treatise expressing the author's opinion as to the categories into which the plants of his region belong. As all taxonomists (writer and reader excepted) are, according to botanical jargon, either "lumpers" or "splitters", a regional flora by a "lumper" contains fewer species than one written by a "splitter". Their opinions simply differ regarding the interpretation of what species, varieties and forms should be. (Hence to quibble about whether a little-known Hawaiian plant should be considered a species or a variety is a pedantic waste of time, particularly when so many others on the verge of extinction can yet be collected before it is too late.) No contemporary worker is qualified to decide this question—his criticism would simply express one more opinion that might or might not come nearer the truth. When we keep in mind the steady advance of taxonomy since 1753, the almost ephemeral duration of opinions regarding the placing of plants into various categories is striking. How many of the species studied by Linnaeus remain in the genera to which he assigned them—the majority have fled as the (L.)'s, standing for the father of Systematic Botany, found in parentheses after plant names prove! Systematic Botany simply has not yet reached its ultimate goal of being an exact science like Mathematics.

The Flora Hawaiiensis, being in loose-leaf form, allows for the correction of errors by replacement of obsolete pages. It concentrates on illustrated descriptions, on the present writer's opinion regarding the plant's status and, in the form of synonymy, on the opinions of disagreeing other workers. The advanced, critical student can thus choose from the long list of synonymy the name he considers correct. Others had better follow the writer, who trusts that time will substantiate his findings.

RACIAL COMPARISONS IN PERFORMANCE ON THE AMERICAN COUNCIL PSYCHOLOGICAL EXAMINATION

By

T. M. Livesay

This study presents data for 265 Caucasians, 178 Chinese, 292 Japanese, and 97 part-Hawaiians on racial differences in performance on the five subtests and total scores of the American Council Psychological Examination for the 1931, 1932, and 1933 editions used as an admissions criterion at the University of Hawaii.

The Caucasian group is superior to the other three groups in Completion, Analogies, Opposites, and Total Score; superior only to the part-Hawaiian group in Artificial Language.

The Chinese group is superior to the other three groups in Artificial Language and Arithmetic; superior to the Japanese and part-Hawaiian in Analogies, Opposites, and Total Score; and superior only to the Japanese in Completion.

The Japanese group is superior to the Caucasian and part-Hawaiian in Artificial Language, and superior only to the part-Hawaiian in Analogies, Arithmetic, Opposites, and Total Score.

The part-Hawaiian group is superior to the Chinese and Japanese in Completion and inferior to all the other in everything else.

The critical ratios indicate complete reliability of the differences in twenty of the thirty-six comparisons.

(This paper is listed for publication in the Journal of Educational Psychology.)

STOCK TAKING IN ETHNOLOGY

By

Peter H. Buck

At a recent stock taking of the individual objects in the Polynesian collection of Bishop Museum, a fair number of errors was discovered. The errors affected not only locality but the use of the objects. An even worse condition with regard to Polynesian material exists in the museums of the United States and Europe. As ethnologists usually accept museum labelling, the museum errors have been perpetuated in ethnological literature. The distressing part is that no organized effort has been made to correct the errors that are capable of being corrected. Unless stock taking is conducted in each ethnographical area with the assistance of experts, the errors will continue to exist indefinitely and so continue to be a source of danger to ethnologists who rightly consider that the ethnographical museums should be regarded as the laboratories of their science. Furthermore a science which uses erroneous material without checking its accuracy is in danger of losing its claim to be regarded as a science.

The erroneous information conveyed by inaccurately labelled museum artifacts applies also to ethnological literature. Theories constructed on wrongly localized artifacts are as houses built on shifting sand. Stolpe's theory that the geometrical patterns on the carved ceremonial adz hafts of Mangaia were due to degradation of the human form rested on carved human figures on Austral Islands paddles which were inaccurately labelled in the European museums as belonging to Mangaia. The Austral Islands paddles are still labelled as Mangaian or Hervey Islands in most museums and Stolpe's theory founded on this error is still accepted by most ethnologists.

The writings of early voyagers and missionaries who came into direct contact with a functioning native culture have often been blindly accepted without thought of checking the accuracy of the statements made. Many of those writers had had no scientific training as to the importance of accurate detail. Their vision had been focussed by their own cultural background and they wrote in terms of it. Even men who had had scientific training did not always accurately describe what they actually saw. Thus a Dr. Marshall in describing two Maori women weaving a cloak, stated that they worked the weft lines in from each end toward the middle. What really happened was that one woman worked the weft line from the left to the middle and the other woman took it on from there to finish it at the right border. Meanwhile the first woman commenced a new weft line on the left. The Maori technique did not admit of what Dr. Marshall thought he saw. Banks, the botanist with Cook's first expedition, accurately described an ornamental pin that he saw hanging from the shoulder of a Maori cloak. It was of curved bone with a hole at one end through which a piece of cord fastened it to the cloak. Stirred by admiration, he complimented the forethought of the Maori in carrying a threaded needle on his cloak with which to repair any tear that might accidentally occur. The sewing function was derived by Banks from his own culture for the ornament was never so used by the Maoris themselves. Banks evidently did not ask the Maori the use of the object. Why? Two reasons are apparent. First, the use was so obvious to Banks that he did not need vocal confirmation. Second, Banks could not ask because he did not know the language. The reasons sum up the causes of common errors in many of the early European writing. The observer did not know the language and therefore rationalized from his own cultural background.

What applies to material objects becomes still more marked when subjects such as customs, social organization, and religion are involved. If the written statement does not fit into the cultural complex of which it is supposed to form a part, there is something wrong with the statement. If it does not check, it should not be accepted. Thus the statement that the ceremonial adzes of Mangaia were used to celebrate peace between warring tribes does not fit into the detailed account of the method of concluding war in Mangaia. One of many reasons is that the victorious tribe continued to hunt the remnants of the defeated tribe until they were so reduced in number that they could not recommence hostilities. It was not necessary to make peace with them and hence the peace-making function of a carved adz haft does not fit into the Mangaian cultural background.

The accepted statement in the literature that the Maoris ate the flesh of slain warriors or chiefs to acquire their inherent valor and prestige (*mana*) does not fit with the Maori psychology as I sense it. The victor proved his valor and greater prestige by conquering his enemy but he ate his flesh to degrade his enemy's family by converting the flesh of their leader into common food. The practice hinges on the antithesis between the sacred attributes of a chief (*tapu*) and the common nature of food (*noa*). The victor added to his prestige by killing his enemy and the enemy lost prestige through being eaten. Though the enemy was dead, his record lived on and the depreciation in prestige affected his family and his descendants.

Examples could be multiplied to show how unchecked statements in the literature are as erroneous as some of the labels on museum artifacts. The literature needs stock taking as much as do museum collections. Unchecked statements are a menace to accurate scientific study and so long as they are accepted, the status of ethnology as a science must remain open to question.

THE MAUNA KEA EXPEDITION

Early in 1935, plans were laid by several Academy members to establish, during August of that year, a camp near the summit of Mauna Kea which would serve as a base for studies of various natural features of the higher summit area. It was hoped that by combining forces in a cooperative camp it would be possible for botanists, geologists, and other naturalists, even during a period of two weeks only, to add greatly to scientific knowledge of this little known region.

While the preliminary discussions were being held the suggestion was made by H. A. Wadsworth, that the venture merited financial support by the Academy, and on his motion before the council the sum of $100 was appropriated for it. At the same time it was stipulated that the project be known as the Hawaiian Academy of Science Mauna Kea Expedition and Chester K. Wentworth was appointed leader. Subsequently the Hawaiian Department of the U. S. Army, Parker Ranch, and C.C.C. officials in Honolulu and on Hawaii, as well as various other institutions, individuals, and territorial and federal agencies cooperated most cordially in making the expedition a success.

Transport and camp arrangements were supervised and carried on by an Army party of ten men under the command of Captain H. A. Meyer. Much of the early planning was done by E. H. Bryan, Jr. of the Bishop Museum. The summit camp at Lake Waiau was occupied by from four to eleven persons between August 6 and August 20th, and the station house at Humuula by an average of ten or twelve persons from July 29 to August 21st. A total of sixteen scientists took part in the work, including members of the federal soil survey party then at work on Hawaii. A brief narrative of the expedition has been published in the Mid-Pacific Magazine (vol. 48, pp. 291-296, 1935) and a general account of findings in various fields is practically completed. Members of the party, as well as other specialists to whom collections have been referred, are at work on a number of more technical reports, which will collectively constitute a substantial and fairly well rounded addition to knowledge of the summit area of Mauna Kea. The Mauna Kea Expedition proved so successful and met with such cordial interest and general assistance from various agencies that it is hoped that similar expeditions can be conducted to other regions in the future.

(The report is listed for publication by Bernice P. Bishop Museum.)

NECROLOGY

Gerrit Parmile Wilder, a member of a kamaaina family and a charter member of the Hawaiian Academy of Science, was born in Honolulu on November 5, 1863, and died in the city of his birth on September 29, 1935. He was one of Hawaii's leading horticulturists, and had devoted many years to the development and improvement of both ornamental and economic plants, notably hibiscus, mangoes and avocados. He introduced into Hawaii numerous varieties of breadfruit from Tahiti, and as a result of his many botanical explorations in the islands of the south Pacific as well as in the West Indies and other parts of the tropics the exotic flora of Hawaii has been greatly enriched. He published, a number of years ago, a beautifully illustrated work on the fruits of the Hawaiian Islands, and more recently his explorations furnished the material for his floras of several of the less well known islands of the south Pacific. He is survived by the widow.

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PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

TWELFTH ANNUAL MEETING

1936-1937

BERNICE P. BISHOP MUSEUM

SPECIAL PUBLICATION 31

HONOLULU, HAWAII

PUBLISHED BY THE MUSEUM

1937

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Twelfth Annual Meeting were held in Dean Hall, University of Hawaii, December 3 and 4, 1936, and May 6 and 7, 1937, ending with a banquet at the Pacific Club on May 8.

OFFICERS

1936-1937

President, Harold A. Wadsworth
Vice-President, Walter Carter
Secretary-Treasurer, Mabel Slattery
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Councilor (1 year), Edward L. Caum
Councilor (ex officio), Chester K. Wentworth.

1937-1938

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PROGRAM OF THE TWELFTH ANNUAL MEETING

THURSDAY, DECEMBER 3, 1936, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

David T. Fullaway: The fruit fly parasite introduction project under the AAA and its results to date.

Nils P. Larsen, Jane Giles, and Olga Fulton: A study on one phase of human metabolism.

Edna C. Wentworth: Living standards of plantation Filipino families in Hawaii.

Charles S. Judd: Staghorn fern invasion. (Presentation by title only.)

Joseph E. Alicata: Trichinosis in Hawaii.

FRIDAY, DECEMBER 4, 1936, 7:30 P. M.

Preliminary announcements.

Amendments to constitution (page 26).

Election of members.

Presentation of papers:

C. E. Pemberton: Local quarantine against insects in view of clipper ship service.

Romanzo Adams: The Hawaiian census classifications of population before 1900.

Harold T. Stearns: Geologic history of the island of Lanai, Hawaii.

Edwin H. Bryan, Jr.: Plant associations on Guam.

Stanley S. Ballard and Paul L. Gow: An improved vacuum type tube for collecting volcanic gas.

THURSDAY, MAY 6, 1937, 7:30 P.M.

Preliminary announcements.

Appointment of committees.

Presentation of papers:

Edwin H. Bryan, Jr.: When the sun casts no shadow.

David T. Fullaway: On the genus Echthromorpha (Hymenoptera).

Thomas A. Jaggar: New model seismograph for Mauna Loa earthquakes.

F. R. Fosberg: An aggressive Lantana mutation.

Chester K. Wentworth: The Diamond Head black ash. (Presentation by title only.)

Thomas A. Jaggar: Trends in the philosophy of science.

FRIDAY, MAY 7, 1937, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

Oscar C. Magistad: Some accomplishments arising from research financed by sugar processing taxes.

J. L. Collins and K. R. Kerns: Studies on the causes of seediness in the Cayenne pineapple.

Nils P. Larsen: Intestinal parasitism in Hawaii.

Stanley S. Ballard, Paul E. Chu, and Paul L. Gow: The use of the arc spectrum in qualitative analysis.

Elvin A. Hoy: An algebra of approximations.

Arnold K. Balls: Some modern aspects of enzyme catalysis.

SATURDAY, MAY 8, 1937, 6:30 P. M.

Pacific Club banquet.

Constitutional order of business.

Election of members.

Installation of officers.

Presidential address: Comparative irrigation institutions in Hawaii and in continental United States.

ABSTRACTS OF PAPERS

COMPARATIVE IRRIGATION INSTITUTIONS IN HAWAII AND IN CONTINENTAL UNITED STATES[1]

(Presidential Address)

By

H. A. Wadsworth

Conceptions of water law in Hawaii and the irrigation institutions founded upon them differ as markedly from those in continental United States as the islands themselves differ from the less favored parts of the mainland. Under local conceptions, water is considered as real property, subject to all virtues and responsibility of ownership. In spite of all the confusion of water law in continental United States, one point stands clear —water is the property of the State and its use by individuals is restricted under strict license by the State.

Regardless of the social equity behind these two conceptions, it is clear that the irrigation organizations operating under them would be dissimilar; and indeed they are. In Hawaii, water has been developed and used by private enterprises; new enterprises have been financed from increased earnings of older ones. Never has the long arm of governmental subsidy aided in the costly works necessitated by difficult local topography.

Contrasted with this highly individualistic philosophy is the paternalistic aid for irrigation on the mainland. Such aid may not be overly apparent but is none the less real. At times great irrigation enterprises are governmental projects. Sometimes the credit of the State is extended to groups of landowners who desire the benefits of irrigation but lack the necessary capital. Sometimes States provide irrigation facilities on government land toward the end of subsequent resale to settlers at the cost of improvements.

It is recognized that different forces have been at work in the formation of irrigation institutions in these two widely separated parts of the United States.

In Hawaii, water became real property through a series of laws and decrees which are perhaps unique in history. In continental United States, water is considered a national resource to be administered by governmental agencies toward the end of national wealth and social equity. Under Hawaiian conditions, the local code has worked well with a minimum of water

[1]Address of retiring president of the Hawaiian Academy of Science, Annual Meeting, May 8, 1937.

litigation. The fact that such a code has, in large measure, escaped recognition must not detract from our appreciation of its soundness.

(This report has been published in full in The Hawaiian Planters' Record, Volume XLI, no. 3, 1937.)

THE FRUIT FLY PARASITE INTRODUCTION PROJECT UNDER THE AAA AND THE RESULTS TO DATE

By

D. T. FULLAWAY

A renewal of interest in the possibility of achieving a better control of fruit flies in Hawaii resulted from the generous disposition of part of the sugar processing tax monies collected under the AAA to uses calculated to benefit general agriculture in the islands. A biological control project, formulated by a committee of local entomologists and calling for additional and comprehensive investigation of the natural enemies of the fruit flies of the tropics, was presented to the Secretary of Agriculture, approved by him, and referred to the United States Bureau of Entomology and Plant Quarantine for execution. Working under the supervision of the Chief of the Division of Foreign Parasite Introductions, expeditions went to East and West Africa, South America, and the Far East or Oriental Region. As a preface to the account of the different parasites and predators found by the present expeditions, the development of the fruit fly problem in Hawaii is sketched, and previous efforts to control the ravages of the fly, particularly the efforts made to secure control by biological methods, are recounted. The problems presented by the necessity of transporting the useful insects found over long distances, propagating them to secure increase of numbers, and acclimatizing or establishing them in the face of a severe competition coming from the natural enemies already present in the islands are fully discussed; the probable outcome or result of the work and further possibilities are briefly stated.

A STUDY ON ONE PHASE OF HUMAN METABOLISM

By

NILS P. LARSEN, JANE GILES AND OLGA FULTON

The paper was a report on a continuation of studies made in Queen's Hospital laboratory on the possible effect of acid-base values in the diet. A review of certain work done in eastern laboratories was given, showing how body calcium can be effected by the ingestion of acid radicals; also a suggestion of its effect on Vitamin C. Total ammonia and total acid measurements were made on all the specimens of urine of two subjects of equal weight. One of the subjects had a natural tendency to a greater acid output and the other to a greater ammonia output in the urine. Vitamin C studies, as well as the acid-base studies, were made and a variation in the output of Vitamin C was shown. With the addition of Vitamin C to the diet a very marked rise in urine Vitamin C was shown. This rise did not occur in two ill patients in the hospital; the reason for this was shown. A marked rise after ingestion of guavas was also demonstrated. The results were given in a series of graphs.

These studies are continuing as part of the laboratory studies of the Queen's Hospital Research Department, whereas the field work is continuing on Ewa Plantation under the direction of Dr. Charles Wilbar. During the year, he has substituted guava juice in place of orange and lemon juice in the infant's diet. This has been very satisfactory.

LIVING STANDARDS OF FILIPINO PLANTATION FAMILIES

By

EDNA CLARK WENTWORTH

Under Institute of Pacific Relations auspices, a survey of incomes and expenditures of 101 Filipino families living on an Oahu sugar plantation was conducted in 1934. A combination of the account and questionnaire methods was used, each family being visited every other day for four weeks in order to secure the food records. Other items in the budget were recorded on questionnaires covering a year's expenditures ending during the summer of 1934. Records of medical treatment were secured from the plantation hospital, and plantation payrolls were examined to verify the earnings of the husbands.

Of the 101 families, 77 were Visayan and 24 Ilocano. They averaged 10 years' residence in the Territory. There were 575 persons in the households, all but 16 of whom are included in the records. Of the 341 children, only 21 were self-supporting. Seventy-six husbands were employed in the fields, 17 in the mill, and 8 in other work. Thirty-four of the 48 on long-term contract work received the "big pay" during the year covered.

Family income ranged from $243 to $1,492, averaging $683, plantation income of husbands amounting to $498. Cash received from the plantation amounted to less than 30 percent of the wages, the remainder being deducted to settle accounts handled through the office.

Perquisites provided by the plantation, including house, water, fuel, and medical service, were estimated at $210 per family. The 101 families averaged a deficit of $13 for the year. Total value of living averaged $1,014, of which $742 represented cash expenditures not including savings or payment of back debts.

Expenditures of Filipino families are unique and only slightly influenced by local customs. Diet was exorbitantly high in rice and low in fruits, vegetables, and fat. Expenditures were marked by relatively high amounts for street suits and hair oil for men, for yellow gold jewelry for women and girls, and for high electric light bills in some cases due to the desire to ward off evil spirits by burning lights all night. There were few chairs, and beds in only 71 percent of the homes, while every home had a sewing machine and half the homes had large framed pictures and cabinet type victrolas. There were baptismal ceremonies, which throw families in debt for several years, Saints' celebrations, funerals and their anniversaries, and gifts far beyond what would seem to a Westerner a reasonable relationship to other items in the budget.

(Illustrated with slides.)

STAGHORN FERN INVASION

By

CHARLES S. JUDD

Although the *uluhi* or staghorn fern (*Gleichenia linearis*) makes a fair cover for water conservation, it has two undesirable qualities. It invades the native forest with a dense mat which prevents natural reproduction, and in dry seasons this mat presents a serious fire menace.

To seek more information on the behavior of this fern, an experiment was undertaken at Waiahole, Oahu, on January 19, 1933, to determine six points, as follows:

1. The best method and tools to use for the complete clearing of staghorn fern. 2. The rate at which the fern may be cleared by human labor. 3. The effect of removing only the living fern. 4. The effect of leaving some of the fern in uncut windrows. 5. The rate at which fern encroachment takes place from the sides. 6. The occurrence of erosion on steep slopes after fern removal.

This experiment has now run for three and three-fourths years and the results to date are as follows:

1. It was found that the most feasible way to clear the fern was to start at the top of the hill and cut the fern with cane knives and roll it downhill, using prying sticks of forked guava.

2. The fern on a .71 acre plot was cleared in this manner by 15 men in a five hour day. At this rate one man can clear .047 acre in a day or one acre in 21 days. At a daily wage of $2.00, therefore, one acre of staghorn fern may be cleared for $42.00.

3. The effect of removing the living fern, generally speaking, discouraged its growth, and it did not renew itself except by creeping in from the sides. It has been replaced in parts with natural seedlings of *koa, naupaka,* lantana, guava, hala, horseweed, sedge, and with *mauu laiki* grass.

4. Leaving some of the fern in windrows resulted in its being discouraged somewhat but the fern in the bulk of the windrows has grown together and formed a solid mass.

5. To determine the rate of encroachment, ten stakes were placed at intervals at the edge of the original clearing and the edge of the advancing fern front was carefully measured from these stakes. It was found that the fern advanced uphill faster than downhill. After three and three-fourths years the greatest invasion was 26 feet and the least 11 feet from the stakes. This gives annual rate of invasion of 6.9 to 2.9 feet. The average rate of invasion on the whole cleared area has been 3.78 feet a year.

6. The heavy mat of dried fern stems and roots and a voluntary new cover of seedlings mentioned above (3) have prevented any sign of erosion on the steep cleared area.

TRICHINOSIS IN HAWAII

By

Joseph E. Alicata

Trichinella spiralis, a parasite occurring in carnivorous mammals in many parts of the world, was recently discovered to be present in Hawaii. The finding was made April 16, 1936, in examining a sample of pork product made from "wild" hogs captured on the island of Hawaii. This product was submitted to the writer for examination by Dr. E. A. Fennel of Honolulu, and was believed to have produced symptoms of trichinosis in several individuals that had eaten it uncooked.

On April 27, 1936, Dr. W. N. Bergin of Hawaii reported to the Territorial Board of Health two cases of human trichinosis which he diagnosed from clinical symptoms. Later, May 6, 1936, he reported another human case based on clinical symptoms which was confirmed by Dr. E. A. Fennel by the finding of trichina larvae in the muscle of the patient. Recently (October 26, 1936) Dr. Fred Irwin of Olaa, Hawaii, reported to the writer two cases of human trichinosis which he diagnosed from clinical symptoms in January 1936.

Under the auspices of the Territorial Board of Health, a survey conducted on the island of Hawaii to determine the extent of trichinosis in various animals, revealed the parasite present in all districts of the island except Puna. The various animals examined and found infested with trichinae are as follows:

Kind of animal	Number examined	Number infested	Percentage
Rats (four species)	2,130	57	2.6
Mice (*Mus musculus*)	306	0	0
Mongoose (*Mungos birmanicus*)	70	17	24.2
Domesticated hogs (*Sus scrofa domestica*)	61	1	1.6
"Wild" hogs (domesticated hogs gone wild)	41	6	14.6

The results for each species of rat examined are as follows:

Species of rat	Number examined	Number infested	Percentage
Rattus norvegicus	820	39	4.7
Rattus rattus rattus	511	15	2.9
Rattus rattus alexandrinus	397	2	0.5
Rattus hawaiiensis	402	1	0.2

(Illustrated with lantern slides.)

LOCAL PLANT QUARANTINE AND THE PRESENT EMERGENCY ARISING THROUGH TRANS-PACIFIC AIRPLANE SERVICE

By

C. E. Pemberton

Dr. R. C. L. Perkins states in "Fauna Hawaiiensis" (1913) that a total of about 3,325 species of insects was known to him in the Hawaiian islands. Since then there have been many introductions, both intentional and as intruders. Of this large number, practically all which may be classed as pests are of foreign origin. Insects transported from one country to another will usually, under suitable ecological conditions, thrive better in a new environment than in their original habitats; hence the introduction of foreign insect pests must be rigidly guarded against. Our principal food crops are still free from many of the worst pests that attack them elsewhere.

The danger attending the introduction of foreign insect pests to Hawaii was recognized as early as 1890, when King Kalakaua issued orders providing for the seizure of insect infested plant material; and in 1892 the ruling was amplified to protect livestock. Quarantine measures were further strengthened between 1892 and 1900. Since then the plant quarantine service has been developed to a high state of efficiency and excellence, and is now considered by visiting entomologists and plant quarantine officials as equal to the best in the world.

With the inauguration in 1936 of trans-pacific airplane commerce between California and the Philippines, via Hawaii and other Pacific islands, a new emergency has arisen. Insect stowaways, aboard planes which traverse thousands of miles of ocean in a few days, can live without food and escape far from their home countries in good condition. Regular plant quarantine systems are entirely inadequate to cope with such a situation. Recent inspections of planes arriving in Pearl Harbor from the Philippines reveal the presence of many foreign insects, some of which are serious pests in Oriental regions. These can escape as soon as the planes are opened to discharge passengers and baggage. Preventive measures must be taken before the planes reach Honolulu.

In order to completely eliminate insects before the planes reach Hawaii from the pest-ridden tropics to the southwest, the Hawaiian Sugar Planters' Association has placed a skilled entomologist on the island of Midway for the sole purpose of thoroughly spraying and otherwise treating the interior of all planes during their overnight stop at the island. Clipper ships traveling both east and west are treated. This work is done with the full cooperation and approval of the Pan-American Airways and the United States

Naval and Public Health authorities. Planes arriving in Honolulu from the Philippines, via Guam, Wake Island, and Midway since this work began on November 24, 1936, have been singularly free from insects.

An elaborate survey of the insects of Guam by O. H. Swezey for the United States Naval authorities of that island and financed by the H.S.P.A., has been included as part of the present quarantine program, in order that a better understanding may be had of the insect species, both harmful and beneficial, that occur there.

THE HAWAIIAN CENSUS CLASSIFICATION OF POPULATION BEFORE 1900

By

ROMANZO ADAMS

We owe much to the various Ministers of Public Instruction who served as directors of the censuses, 1849-1896. On the whole their work was reasonably well done and the data are of great value. But they were not professional statisticians, and when one uses the data he must be on the lookout to discover the meaning of the classificatory terms as they were used—he must not read his own meaning into them or assume that they had a constant meaning throughout the half century.

1. The classificatory terms are never defined, but in nearly all cases one can infer the definition from an inspection of the tables.

2. The tendency was to avoid terms of a clear racial meaning. Such terms as "white" and "colored" or as "Caucasian" and "Mongolian" were never used.

3. But the terms "native" and "foreigner" were used as racial terms. A native was a member of the "native race" no matter where he was born. A foreigner was a member of some other race and he might be Hawaiian born of Hawaiian born parents, all of whom were citizens of the Republic or subjects of the Hawaiian ruler.

There was a pretty constant tendency to change the implied definitions of terms and this was sometimes done without obvious notice. In 1849, the mixed-blood part-Hawaiians were called "half-caste" if they were found in the homes of foreign fathers, and they were "foreigners" also. In 1853, all the mixed-bloods were "half-caste", and they were "natives". In 1860 and 1866, the full white Hawaiian born children of American and British residents were classified as foreigners and as American and British, but in 1872-1890 they were not included among the Americans and British, but in a special class—"Hawaiian born, both parents being foreigners". Americans, British, and Chinese were all included without distinction of race. In 1884 and 1890, several hundred persons were called "Polynesians," but in 1896 they were "South Sea Islanders". In all censuses before 1900 the negroes and part-negroes born in the Cape Verde Islands were counted as Portuguese, but in 1900 they were classified as negroes so far as the information was available—probably about half of them were so classified. In 1890, the age class, one to six, included no persons who had reached the end of the sixth year, but in 1896 children six years of age and under seven were also included under this caption.

GEOLOGIC HISTORY OF THE ISLAND OF LANAI, HAWAII[2]

By

HAROLD T. STEARNS

Lanai consists of a single, partly eroded volcano built entirely of thin-bedded basalts which accumulated in the form of a dome. The sequence of events in the geologic history is summarized as follows:

LATE TERTIARY (?) TIME

1. Building of island over 3,800 feet high by basalt flows from northwest, southwest, and south rifts with the center of the activity at their intersection a little southwest of the present summit of Lanai. 2. Collapse along the south and northwest rifts and formation of a caldera at their intersection. 3. Diminished activity with most of the lava filling the downfaulted areas. Scattered eruptions on the southeast flank. Establishment of streams on the northeast side only.

EARLY (?) AND MIDDLE (?) PLEISTOCENE TIME

4. Cessation of volcanism. 5. Establishment of streams over entire island and formation of canyons on northeast slope. 6. Continued marine and stream erosion. 7. Gradual submergence of Lanai by at least 1,500 feet, resulting in the drowning of valleys. Continued erosion and growth of coral but not reefs. 8. Short halt and then gradual emergence. 9. Short halt after about 500 feet of emergence with development of a shore line at 560-foot altitude. (Possibly the emergence was somewhat more and then the island was resubmerged to an altitude of 560 feet.) 10. Emergence of about 850 feet and development of bench 300 feet below present sea level. 11. Sub-

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[2] Published by permission of the Director, United States Geological Survey.

mergence of about 400 feet and depositing of marine sediments approximately 100 feet above present sea level. 12. Emergence of about 160 feet and formation of calcareous dunes on the northeast slope. Vigorous marine erosion on west and south coasts. 13. Submergence of about 85 feet partly drowning dunes at Lae Hi Point.

LATEST PLEISTOCENE OR RECENT TIME

14. Emergence of 25 feet to present shore line, continued erosion and sedimentation of ancient caldera. Introduction of livestock causing greatly accelerated wind and stream erosion, development of large denuded areas, formation of narrow plain along northeast coast, and annihilation of near shore fringing reef organisms along windward coast.

Possibly a halt in the emergence occurred at about five feet above present sea level.

PLANT ASSOCIATIONS OF GUAM

By

E. H. BRYAN, JR.

Guam is an island 30 miles long and from 4 to 9 miles wide located at the southern end of the Marianas group, south of Japan, between latitudes 13°15′ and 13°40′ N., and longitudes 144°37′ and 144°57′ E. The northern half of the island is composed of limestone—a great section of reef, raised at the northern end to a height of 400 to 600 feet, sloping gradually southward to a low, narrow isthmus. In this region there is one grassy, volcanic hill. The southern half consists of a ridge of hills of volcanic origin, the highest elevation being 1,334 feet. It is bordered on both sides by raised limestone. On the west, this forms the Orote Peninsula; on the east, a series of flat-topped bluffs. The west slope is short and steep; the east slope, broader, more gradual, and cut by several valleys, carved out by streams. Near the center of the range some hills are mantled with limestone.

The climate is tropical, modified by trade winds. The average temperature is about 81° F., varying but little. The humidity is high. The rainfall at Agana is about 90 inches a year; that of the north end, a little more; that of the south end, markedly less. The hills are not sufficiently high to cause pronounced local variation.

Five natural plant associations can be noted: strand, limestone forest, savanna, modified forest in volcanic soil valley bottoms, and swamp and water. About 58 percent of 545 species of ferns and flowering plants are thought to have been introduced through the agency of man, including weeds, crops, and ornamental plants. About 31 percent are indigenous and 11 percent endemic. There are more than a hundred plants of American origin which probably reached Guam during two and a half centuries of yearly galleons from Mexico to Manila, 1571 to 1815. From 1815 to 1898 direct shipping with Manila gave opportunity for the importation of an equal number of introduced Malaysian species.

The strand plants are mainly species widespread in the Pacific and Indian oceans. The limestone regions, where not cleared for cultivation, are densely covered with moist forest. The heavy clay soil of the volcanic hills supports only a savanna of grass and herbs, dominated by swordgrass (*Miscanthus*). In the valleys of this region an open scrub forest develops.

AN IMPROVED VACUUM TYPE TUBE FOR COLLECTING VOLCANIC GAS

By

STANLEY S. BALLARD AND PAUL L. GOW

Volcanic gases were collected at Kilauea in 1912, 1917, 1918, and 1919 by Drs. A. L. Day, E. S. Shepherd, and T. A. Jaggar. The vacuum type gas collecting tubes used by them were not entirely satisfactory for two reasons. First, there was no sure way of breaking or melting the tips to allow gas to rush in at exactly the desired time. Second, after the collection was complete it was difficult to seal off the tubes without a certain amount of air leaking in and thus polluting the sample. It is hoped that in the tube being reported on, these two difficulties have been overcome. The new tube consists of an 800 cc. Pyrex glass Kjeldahl flask to the neck of which is joined one arm of a vacuum-ground stopcock. To the other arm of the stopcock is joined two to four feet of Pyrex glass tubing. The tubing is drawn out into a tip which can be broken off at the appropriate time by a wire, one end of which is fastened to the tip and the other end held in the collector's right hand, the tube being held in his left hand. The entire apparatus is originally pumped out to a rather high vacuum. When the tip is broken off, gas rushes into the evacuated bulb through the tubing. It is imprisoned there by shutting off the stopcock before the tip is withdrawn from the gas source. Thus air from the atmosphere is entirely excluded. One of these tubes was tested during the summer by collecting gas escaping from a vent in the Sulfur Banks near the Hawaiian Volcano Observatory. The tube performed entirely satisfactorily, so several more have been made and are ready for use in collecting the gas emanating from molten lava at the time of the next eruption.

WHEN THE SUN CASTS NO SHADOW

By

E. H. Bryan, Jr.

A knowledge of the yearly movement of the sun in latitude finds practical application in helping to explain insolation, the march of temperature, cycles of plant growth, and allied phenomena. It is also useful to architects and landscape gardeners, in the orientation of buildings, tennis courts and other athletic fields, the placing of solar heaters, and the laying out of gardens.

At any locality between the tropics the sun will pass through the zenith twice during a year, at which time a vertical object will cast no shadow. At Honolulu this occurs on about May 28 and July 17. At this time, maximum noon insolation is experienced. The total amount of insolation also depends upon the duration of sunlight or length of day, the distance of the earth from the sun, variability of the solar radiation, and local atmospheric conditions. It is a curious fact that on certain days, polar regions receive the highest daily insolation, but the equator has the greatest annual insolation as measured in thermal days. There is a lag in temperature due to secondary meteorological phenomena.

(Illustrated by charts showing the analemma, altitude and azimuth of the sun throughout the year as seen from Honolulu, and lines of equal percent of insolation at Honolulu during the year.)

ON THE GENUS ECHTHROMORPHA (HYMENOPTERA)

By

D. T. Fullaway

Echthromorpha is a genus of large-sized and often brightly colored parasitic wasps or ichneumon flies which has been the subject of much study. The genus is interesting from several points of view, particularly that of geographic distribution. It contains 27 described species and the range of distribution from Africa to the Australian continent and the Pacific islands, to Hawaii on the north and the Marquesas on the east, is quite extensive for such a homogeneous group.

Echthromorpha definitely links the Hawaiian fauna with those of other parts of Polynesia and indicates that there are older connections with the

Oriental region. For those seeking clues to the derivation of our fauna, it gives a lead with much corroboration from other examples. It does not tell us very much about mode or modes of dispersal, although the fact that these insects are fairly sturdy and large would indicate probability of wind carriage. Another favorable circumstance is their record of multiple rather than single host attachment. There is also the possibility of their being carried in drift or being transferred with host material in economic plants by human agency. An interesting fact about the genus is that several of the species are among the earliest described Pacific insects. Sir Joseph Banks accompanied Captain Cook on his first voyage in 1768-71 in the south Pacific (Tahiti, New Zealand, Australia, and the Dutch East Indies). Most of Banks' insect collecting was done while the ship *Endeavor* was stranded and laid up for repairs for four months near the present site of Cooktown, New Zealand. Banks was not with Captain Cook on the voyage in which he discovered the Hawaiian islands in 1778, but it is believed that when the ship was lying at anchor off Kauai near the mouth of the Waimea River, some insects were collected which eventually went into the Banksian collection deposited in the British Museum, as Hawaiian species were described from this collection only a few years later.

NEW SEISMOGRAPHS FOR MAUNA LOA

By

T. A. Jaggar

The Mauna Loa campaign is the aim of 1937 for Hawaiian Volcano Observatory. The Jaggar shock-recorder is a basis for a new design. This is a flexible, small three-compartment instrument fourteen inches square, ten inches high, with three-pound iron bars encased in wood for pendulum weights. It is flexible in the sense that it can be modified for special quests. The suspensions are upright flat steel, clamped for flexure as hinges, length determining period, the system an inverted pendulum for the horizontal components. The same system for vertical component is clamped horizontally, giving equivalent constants. All register on a single clock dial, which rotates and keeps time. The dial is covered with smoked, translucent paper. The smoking is wholesale and the sheets are packed ready-smoked in special containers and returned in the same to headquarters. Every part of the seismograph is detachable and cheap.

A special quest is a pen that will arrest electrically the first excursion of P, and lock off the rest of a seismogram. The object is to get this amplitude and direction for about twenty-five instruments covering a measured ground pattern. The object of all the new models is geographical and automatic. Some will be run by ranches, schools, or telephone stations. No burdens beyond what would lie in a thermograph are contemplated. Others will be in ground cavities visited by automobile. The underlying theory of the effort is to cover an area for getting uniform empirical data about a volcanic center known to be periodically critical.

AN AGGRESSIVE LANTANA MUTATION

By

F. R. Fosberg

A mutation of the common *Lantana Camara* L. was noticed as a small patch in 1933 on Manoa-Palolo ridge, Oahu. A year later it was noticed on Palolo-Waialaenui ridge. It has since spread until it now covers large areas in Manoa and Palolo valleys. A similar mutation was noticed between Hilo and Kilauea, Hawaii, in 1933, but it has evidently not spread.

The Oahu mutation is characterized by having the corolla white with a yellow tube, the white portion turning pale pink with age. The stems seem always more prickly.

It seems to be replacing the normal form at a rapid rate. Suggested reasons for this are: greater shade tolerance, greater seed production, and greater resistance to parasites. It may spread so as to cause *Lantana* to become a worse pest in the future.

An opportunity is thus presented for study of the rate of change in populations of plants, which may lead to facts of some evolutionary significance.

It seems well to point out the desirability of recording this and other such apparently insignificant beginnings of phenomena when observed, for the benefit of those who may be interested in the problems to which they lead in the future.

THE DIAMOND HEAD BLACK ASH

By

CHESTER K. WENTWORTH

Black ash, or cinders from explosive volcanic eruptions, form conspicuous surficial deposits in the Tantalus, Makiki, and other parts of Honolulu. The fine-grained black sand deposits southeast of Diamond Head and along the Black Point Coast have long been considered to be true black ash of explosive origin. Recently the Diamond Head material has been described as the product of wave action on coastal rocks, drifted inland by the wind to form dunes, hence a sand rather than a true ash formed by explosion. In order to determine which of these views is correct, I have repeated and extended earlier field and microscopic examination of the material in question. The result is a complete substantiation of the original view. About 98 percent of the fragments are glass, in vesicular, pulled, droplet forms, with delicate, unbroken points, and with no sign of abrasion. Structure, bedding, and distribution, as well as the composition, all strongly indicate formation by volcanic explosion, with but a minor part indicating some contemporaneous movement by the wind. Final proof of the volcanic interpretation is afforded by a one-inch layer of volcanic pisolites, or accretionary lapilli, which have been traced in the formation some five hundred feet along the Black Point coast. These pisolites are tiny mud balls about a half millimeter in diameter which were formed around raindrops which fell through the dust-laden air during a brief shower which accompanied the eruption. Such pisolites are well known at Kilauea, and their formation has been observed by many geologists. The black ash beds lie on a reef conglomerate containing rounded boulders derived from the earlier Black Point lava flow, and hence are the product of a second Black Point eruption. The explosive phase was probably induced when the molten lava entered the sea, the explosive eruption of the littoral type, like that which formed Puu Hou near Kalae, Hawaii, in 1868. It evidently took place when the sea stood no higher than at present and was much the most recent volcanic event in the Diamond Head area.

(Listed for publication in the Journal of Sedimentary Petrology.)

TRENDS IN THE PHILOSOPHY OF SCIENCE

By

T. A. Jaggar

(Hawaiian Volcano Observatory, Volcano Letter 447.)

How has science changed in a century? What is the definition of its present motives? It may be divided under:

1. Language, the chief promoter of science.
2. Experiment, the chief activity of science.
3. Reform, the chief goal of science.
4. The Earth, the chief subject of science.

Science deals with Nature: natural origins, progress and future of universe, earth, energy and life. Forecast of the future is the supreme test of success, predicting that under like conditions like results will ensue. The three fundamental concepts are uniformity, evolution, and value. With uniformity go symmetry and rhythm, all in Nature herself. With value goes number, both probably human. Evolution is a function of space-time, a human concept.

Language carries with it logic and mathematics. Language is supreme in thought and reasoning, is imperfect, and contains the history of all scholarship.

Experiment has grown so that all sciences have changed to experimental specialties. Geology changes to geophysics, botany and zoology to biometry, and so forth. The old physics of the nineteenth century was not complacent, but was progressive with great names. So with biology, medicine and astronomy.

Reform has been disguised as research. The real aim of science has grown to be extrovert. It needs to grow more responsible for extroversion of society.

The Earth is necessarily the chief subject of science for out of it comes civilization and man. Philosophical ultimates are not realities for man. Man is spreading out, and room for him will be made by the conquest of congestion through achievement of distribution; and science will discover materials and power, and invent extrovert education.

SOME ACCOMPLISHMENTS ARISING FROM RESEARCH FINANCED BY SUGAR PROCESSING TAXES

By

OSCAR C. MAGISTAD

Seven projects approved by the Agricultural Adjustment Administration to be financed by sugar processing taxes were assigned to the Hawaii Agricultural Experiment Station in the fall of 1935. A few of the accomplishments which have been achieved as a result of these projects are given below.

POULTRY

A disease of poultry rapidly spreading in 1935 and caused by gizzard worms was discussed. The life cycle and intermediate hosts of this worm have been established and control methods and methods of sanitation recommended. The intermediate hosts are grasshoppers, sand shrimps, and about ten varieties of beetles. The gizzard worm disease is now receding in the Territory and is no longer a terror to poultrymen. Research dealing with other parasitic diseases, such as the eye-worm, the proventricular worm, and intestinal worm was touched upon.

The work going on in cross-breeding to develop more meaty birds which are at the same time good egg layers was explained. With our relatively high prices for broilers and poultry meat this side of the picture needs to be emphasized.

Poultry rations containing mainly locally grown foods are under investigation and one can be recommended as an emergency ration. It will maintain body weight and egg production fairly well for a limited period of 5-6 months or more.

LIVESTOCK FEEDS

The great importance of our livestock industry and the research being done in this field were discussed. This includes pasture investigations, fattening trials, meat tests, and digestibility determinations of many local feeds. As regards swine, local feeds are being tried out, some of them with great success.

STUDIES OF THE CAUSES OF SEEDINESS IN THE CAYENNE PINEAPPLE

By

J. L. Collins and K. R. Kerns

The Cayenne variety of pineapple is seedless due to the failure of the pollen tubes to grow more than one-sixth the length of the pistil. This condition of self-incompatibility probably arose in one or more mutations from the normal seedy condition. Feral pineapples produce seeds while the majority of cultivated ones do not.

In the regularly seedless Cayenne variety occasional seedy fruits are found. Records made at the cannery over a period of twelve years show a gradual increase in the percentage of seedy fruits with a marked decrease in 1933 and 1934. During the years 1935 and 1936 the percentage of seedy fruits had again increased until it had reached the high peak of 1931 and 1932. The lower percentage for 1933 and 1934 may be directly correlated with the discarding of large quantities of planting materials from certain areas in 1931 and 1932.

In addition to these two features, the cannery data on percentage of seedy fruits revealed a regular annual fluctuation in the percentage of seedy fruits. Plants which were in blossom during the summer months produced approximately twice as many seedy fruits as did plants which blossomed during the winter months. This annual variation appears to be associated with temperature and sunshine for the corresponding periods.

Clons, which regularly produce seedy fruits, have been established from single plants producing seedy fruits. These clons differ in regard to kind and quantity of seeds produced. Some produce few, others many seeds; while others produce only abortive seeds. The pollen from seedy clons will cause seed to form in normal Cayenne plants. The seedy clons arose as dominant mutation in the normal seedless Cayenne variety and represent a reversion to the wild, ancestral pineapple.

Appropriate tests have shown that seeds in these clons are the result of self-fertilization and not due to parthenogenetic development of the egg cells. Self-pollination of the normal Cayenne does not cause seed development.

In this problem of seediness we thus have a genetic basis for self-fertilization, and superimposed upon it a fluctuating environment which exerts a favorable or unfavorable influence on seed development.

(Presented by Mr. Kerns. Illustrated with slides and charts.)

PARASITISM IN HAWAII

By

NILS P. LARSEN

Analysis of parasites as found in Hawaii was given in a series of tables showing the low incidence for people in Honolulu, and a higher incidence for people on the plantations. However, the various studies indicate that the amount of intestinal parasitism is less than popular belief has it.

The difference between infestation in small quantities in intestines of people coming here, and true infestation producing disease, was indicated.

A series of slides was also presented, showing the common types of intestinal parasites found here. The study covered series done in laboratories on Maui, Kauai, and Oahu. Dr. Wilbar's work at the Ewa Health Center, in an attempt to eradicate parasites, shows that this is a feasible proposition.

THE USE OF THE ARC SPECTRUM IN QUALITATIVE ANALYSIS

By

STANLEY S. BALLARD, PAUL E. CHU, AND PAUL L. GOW

An improved technic of qualitative chemical analysis by use of the arc spectrum has been developed. Many features of the technic were taken from the standard methods described in scientific books and journals, but some features were necessarily developed by us when the standard methods were found to be unsatisfactory, inapplicable or incorrect. Our procedure consists of burning a sample of the specimen in an arc run at five to seven amperes and of photographing the spectrum of the light from the arc with a quartz spectrograph. The photographic plate is then studied, and the presence or absence in the sample of some fifty elements can be established. We have taken elaborate precautions to prevent any contamination of the sample or of the electrodes. Electrodes of iron, carbon, and copper of the highest obtainable purity are used. Specially developed methods of cleaning and shaping the electrodes preserve their purity as much as is possible. A spectrum of the bare electrodes is photographed on each plate so that the presence of any impurities will be detected immediately. Samples of the specimen to be analyzed are ground in an agate mortar and weighed out into ten milligram portions. One of these portions is placed in a pit in the lower arc electrode by using a glass sleeve and small funnel arrangement devised by us. This method of introducing samples into the arc avoids the danger of contamination that is always present in the standard method of compressing the sample into a pellet. The spectrum taken with a weighed amount of sample placed in the arc permits a quasi-quantitative estimate of its composition to be made, while a second spectrum taken using a much larger specimen shows spectrum lines due to the smallest traces of elemental constituents.

AN ALGEBRA OF APPROXIMATIONS

By

ELVIN A. HOY

Definition 1: An approximation has n significant figures if the maximum error is numerically less than one-half a unit in the nth figure. For example, 16.50 has four significant figures with an allowable error of $\pm$ 0.005 while 18 has two significant figures with an allowable error of $\pm$ 0.5.

Zeros are not always significant and may be just fillers to the decimal point. Examples:

93,000,000 miles to the sun has only two significant figures and six non-significant zeros.

Charge on electron, 1.59×10^{-19} coulomb has 3 significant figures and 18 non-significant zeros.

Rule 1: To round off a decimal fraction:

(a) Drop, if it is less than one-half unit of the preceding digit.

(b) Increase preceding digit by one if greater than one-half unit.

(c) If exactly one-half unit, drop if preceding digit is even but add a unit to the preceding digit if odd.

Examples: (a) $18.32 = 18$; (b) $17.831 = 18$;
(c) $18.5 = 18$; $17.5 = 18$.

Thus each approximation represents an infinite set of rounded numbers.

Rule 2: (a) In addition or subtraction retain as significant figures in the sum or difference only to that uncertain figure occurring farthest to the left relative to the decimal point.

Ex. 1: $16.50 + 21.50 + 14.50 + 19.50 + 22.50 + 17.50 + 18 = 130. = 1.30 \times 10^2$

Ex. 2: $702.350 - 17.2 = 685.2$

(b) If there are n terms with uncertain end figures occurring at the same point farthest to the left relative to the decimal point, then the maximum error in the last figure of the sum may be $n/2$ units.

Ex. $16.4 + 21.6 + 14.2 + 19.8 - 22.0 - 17.2 = 32.8 \pm .3 = 33$

Rule 3: In multiplication, division, and powers, if the least accurate factor has n significant figures, the result has n or n-1 significant figures.

Ex. 1: $24.086 \times 320. = 7{,}710 \pm 12 = 7.7 \times 10^3$

Ex. 2: $460.50/2.10 = 219 \pm 0.52 = 2.19 \times 10^2$

Ex. 3: $(9.8)^3 = 940 \pm 14 = 9 \times 10^2$

Rule 4: If an approximation has n significant figures, its rth root has at least n significant figures.

Ex. $\sqrt{752.40} = 27.430$

since $\sqrt{752.395} = 27.42982$ or 27.430
and $\sqrt{752.405} = 27.43000$ or 27.430

Rule 5: In any combination of operations, observe the above rules in each part of the computation. In combinations between approximations and exact numbers the number of significant figures of the result depends only on the accuracy of the approximations.

Ex. $(1.276 \times 0.00056) - (1.2 \times 10^{-3}) - (0.0023456 \times 0.0128) = -0.0005 = -5 \times 10^{-4}$.

Rule 6: In a final published constant, whose probable error is included, retain no figures beyond the position of the first significant figure in one-half the probable error; keep two more places in all computations.

Ex. 1: Mean $= 2.201 \pm .016$ gm.

Ex. 2: Standard Deviation $= 0.287 \pm .011$ gm.

Ex. 3: Coefficient of Correlation $= 0.827 \pm .014$.

SOME MODERN ASPECTS OF ENZYME CATALYSIS

By

A. K. Balls

Enzymes are simply catalytic agents elaborated within the living cell, but they do not require the presence of living cells to perform their work. The reactions accelerated by enzymes are of two groups: reactions of hydrolysis and reactions of oxidation. Hydrolysis is essentially a process of breaking-down, oxidation results in movement, growth, building-up. Several of the enzymes have been crystallized. They consist of an active or functional group attached to a much larger colloidal particle or carrier. In catalysing reactions the active group of the enzyme combines with a particular characteristic group in the substrate. We thus have the phenomenon of enzymic specificity.

It has recently become evident that besides the presence of the characteristic group in the substrate, other factors may be involved in enzymic specificity. The characteristic group of the substrate may be shielded by surrounding groups thus preventing a combination between the substrate and enzyme, or the temperature might be too low as was found in the case of some of the fat-splitting enzymes.

Many enzymes occur in an inactive form and have to be activated before they will work, such is the case with papain and bromelin. The inactive form is the oxidized form and on reduction they become active. Such substances as hydrogen sulphide, sodium sulphite, cysteine, and hydrocyanic acid act as reducing agents.

Many of the enzymes seem to be able to reproduce themselves, that is, they appear to be alive, but actually it is a change from the inactive to the active form.

Enzymes have long been important laboratory reagents, and are now finding their way into industry. They are used in the fermentation industries, in the manufacture of cheese, in the tanning of leather, in the dyeing of cotton cloth, in soap making, in the chill-proofing of beer, and in medicine.

The enzymes as products of the living cell are agricultural products. If we are unmindful of them, they are the cause of spoilage, decay, putrefaction. If we handle them wisely and use them to advantage, they are chemical reagents that can revolutionize the industry of agriculture. I give you the enzymes.

AMENDMENTS TO THE CONSTITUTION

DECEMBER 4, 1936

Toward the end of simplifying the membership rolls of the Academy, the Council presented the following amendments to the Constitution:

(1) Delete Article III, Section 1, and Article III, Section 3.

(2) Rewrite the remaining section to read:

Article III, Membership

Any resident of the Territory of Hawaii interested in Science shall be eligible for election as a member. There shall be one grade of membership only.

(3) Article IV, Section 5. Delete the words "in either class." The section will then read: "Election to membership shall require a favorable vote from three-fourths (¾) of the members present."

(4) Article X, Section 1. Delete the words "Corresponding members shall pay no dues."

In order that the fall meetings of the Academy may have sufficient constitutional status to permit the transaction of business, the following amendments to the Constitution are recommended by your Council:

(1) Rewrite Article VIII, Section 1, to read:

Article VIII, Meetings

1. The Academy shall hold a stated meeting in April or May of each year, to be known as the Final Session of the Annual Meeting. It shall hold such other scheduled sessions for the presentation of papers and the transaction of business as the Council deems fitting, such sessions to be known as the First Session, Second Session, and the like, of the Annual Meeting in question.

Any session for the presentation of papers shall be announced by a preliminary circular at least six weeks before the date scheduled for the meeting, calling for papers for the program. Final announcement, giving dates and place of meeting, shall be sent out at least two weeks prior to each such session. The program, place and dates shall be determined by the Council.

(2) Rewrite Article IV, Section 1, to read:

Article IV, Nomination and Election of Members

1. Nomination to membership shall be made in writing to the Council at least two weeks before any scheduled session. Each nomination must be signed by three members of the Academy.

(3) Delete Article IV, Section 4.

(4) Renumber the present Section 4, Article IV, as Section 3, Article IV.

The above amendments to the constitution were carried by the majority and a motion passed that the amendments be incorporated into the Constitution.

MEMBERS

Honolulu

Adams, Romanzo
Agee, H. P.
Aitken, R. T.
Akau, G. H.
Alicata, J. E.
Allen, Oscar N.
Anderson, Donald
Andrew, K. L.
Andrew, Nancy
Andrews, Carl B.
Arnold, H. L.

Baker, K. F.
Baker, Ray J.
Ballard, Stanley S.
Barnhart, Geo. H. W.
Beaglehole, Ernest
Bean, Ross S.
Beaumont, J. H.
Bianchi, Fred A.
Bilger, Earl M.
Bilger, Leonora N.
Borden, R. J.
Bowles, Herbert
Britton, John
Brown, E. D. W.
Brown, F. B. H.
Brugger, Florence
Bryan, E. H., Jr.
Bryson, L. T.
Buck, Peter H.
Budin, Olga Fulton
Bull, Edythe
Burmeister, E. R.
Burrows, Edwin G.
Bush, William

Cady, H. B.
Campbell, Edward L.
Carpenter, C. W.
Carson, Max H.
Carter, Walter
Cartwright, Bruce
Catto, Robert J.
Caum, E. L.
Chapman, Royal N.
Chun, Edwin Y.
Chung, Mon Fah
Clark, Harold
Clark, William O.
Collins, George M.
Collins, J. L.
Cooke, C. M.
Cooke, Douglas A.
Cooke, Richard A.
Coulter, John Wesley
Crawford, D. L.
Curtis, Walter L.

Das, U. K.
Davis, Lannes E.
Dean, A. L.
Dean, Lyman A.
Denison, Harry L.
Devereaux, John W.
Dillingham, F. T.
Donaghho, J. S.
Doty, R. E.

Edmondson, C. H.
Egler, Frank E.
Eguchi, George
Ehrhorn, E. M.
Eller, Willard H.
Emory, Kenneth P.
Erwin, Ada B.

Fabius, Albert
Farden, Carl A.
Faus, R. B.
Fennel, E. A.
Ferguson, George E.
Field, Harry P.
Ford, A. H.
Fosberg, F. R.
Foster, Z. C.
Fronk, C. E.
Fujimoto, Giichi
Fullaway, D. T.

Giesen, Elizabeth
Gilbert, James
Gordon, Golda Hyde
Gordon, Maurice
Gotschalk, H. C.
Gow, Paul
Gregory, H. E.

Hadden, F. C.
Hammond, W. H.
Hamre, Christopher J.
Hance, F. E.
Harry, John V.
Hartt, Constance E.
Henke, Louis M.
Holmes, Henry
Holmes, W. G.
Hosaka, Edward Y.
Hoy, Elvin A.
Hutchinson, A.E.

Illingworth, J. E.
Ingram, William M.
Ito, Kiyoshi

Johnson, Horace
Jones, Austin E.
Jones, Stephen B.
Judd, Albert F.
Judd, Chas. S.

Katsuki, I.
Keller, A. R.
King, Norman
King, Robert D.
Koehler, Lucy J.
Krauss, Beatrice H.
Krauss, F. G.
Krauss, W. W.
Kunesh, Joseph F.

Lam, Margaret
Lam, Robert L.
Lamb, Alvin R.
Larrabee, L. M.
Larsen, N. P.
Lee, Robert
Lennox, Colin G.
Lessa, William A.
Ley, Gaston J.
Libbey, Valentine
Lind, Andrew W.
Linford, Maurice B.
Livesay, T. M.
Loomis, Chas. F.
Louis, James L.
Lyon, Maude F.
Lyon, H. L.

MacNeil, W. J.
MacVeagh, Thomas C.
Magistad, O. C.
Mangelsdorf, A. J.
Mason, Arthur C.
McAllep, Will R.

McBride, O. C.
McKay, William
McGuire, Thos. R. L.
Meinecke, Joseph B.
Meinecke, William H.
Metraux, Alfred
Meyer, H. A.
Millard, Robert
Miller, C. D.
Miller, Milton A.
Mirikitani, Clifford
Mitchell, Donald
Moltzau, Ralph H.
Morgan, Edward
Moss, L. C.
Munro, George C.

Nakamoto, G.
Neal, Marie C.
Nelson, Frances
Nightingale, G. T.
Nikaido, Raymond
Northwood, J. d'A.

Okimoto, Marion C.
Oliveira, Juliette M.
Olson, Gustaf W.
Ostergaard, Jens

Palmer, H. S.
Parris, G. Keith
Payne, J. H.
Pemberton, C. E.
Phillips, L. G.
Pinkerton, F. J.

Ripperton, J. C.
Robbins, Ruth
Rols, Edwin E.

Sakimura, Kay
Satterthwaite, Ann Y.
Schmidt, Carl T.
Shepard, Oscar F.
Sideris, C. P.
Sinclair, Gregg M.
Slattery, Mabel
Smith, Leslie R.
Smith, Madorah E.
Smith, Ronald Q.
Spalding, P. E.
Spiegelberg, Carl H.
St. John, Harold
Stokes, J. F. G.
Storey, William
Street, Alison Watt
Suehiro, Amy
Suzuki, Francis T.
Swezey, O. H.

Takahashi, Tokue
Tam, Richard K.
Thomas, A. R.
Tinker, Spencer
Titcomb, Margaret
Topping, D. LeRoy

Usinger, Robert L.

Van Zwaluwenburg, R. H.
Vernon, Mabel D.
Voorhees, George

Wadsworth, Harold A.
Wakabayashi, S.
Weidman, Arah
Weinrich, William
Welch, d'Alté A.
Welch, J. E.
Weller, D. M.
Wentworth, Chester K.
Wentworth, Edna C.
Westervelt, W. D.
Westgate, J. M.
Westgate, Mark
Wheeler, Mary
Whitney, Leo
Wicke, Henry
Willard, H. F.
Williams, F. X.
Williams, Frances
Williams, John N. S.
Wilsie, C. P.
Winstedt, Ruth M.
Withington, Paul
Work, Samuel H.

Yang, Y. C.
Yap, Ruth
Young, H. Y.

Zimmerman, E. C.

Rural Oahu

Atherton, Ballard

Budin, Harry M.

Cooper, Lucy V.
Cooper, Will J.

Davis, A. L.
Degener, Otto

Gantt, Paul A.

Kerns, Kenneth R.

Renton, George F.

Thompson, Henry O.

Wilbar, Chas.

Other Islands

Bond, K. D.
Bryan, L. W.

Dickey, Lyle A.

Elbert, Samuel H.

Giacometti, G.

Jaggar, T. A.

Lamb, Sam

Stearns, Harold T.

Waesche, Hugh H.
Webster, James N. P.
Wingate, E. G.

Mainland

Davis, Watson

Handy, E. S. C.
Louttit, C. M.

Wilder, Helen C.

PROCEEDINGS
HAWAIIAN ACADEMY OF SCIENCE

THIRTEENTH ANNUAL MEETING
1937-1938

BERNICE P. BISHOP MUSEUM
SPECIAL PUBLICATION 33

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1939

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Thirteenth Annual Meeting were held in Dean Hall, University of Hawaii, December 2 and 3, 1937, and May 5 and 6, 1938, ending with a banquet at the Pacific Club on May 7.

OFFICERS

1937-1938

President, Oscar C. Magistad[1]
Acting President, Willard H. Eller
Vice-President, Walter Carter
Secretary-Treasurer, Mabel Slattery
Councilor (2 years), Willard H. Eller
Councilor (1 year), Albert J. Mangelsdorf
Councilor (ex officio), Harold A. Wadsworth.

1938-1939

President, Walter Carter
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Secretary-Treasurer, Mabel Slattery
Councilor (2 years), Cyril E. Pemberton
Councilor (1 year), Willard H. Eller
Councilor (1 year), Ralph J. Borden.

[1] Resigned, March 1938.

PROGRAM OF THE THIRTEENTH ANNUAL MEETING

THURSDAY, DECEMBER 2, 1937, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

Willard H. Eller: Measurement of earth tilts.

Stanley S. Ballard and John H. Payne: Preliminary analyses of Kilauea solfataric gases.

Otto H. Swezey: Misidentity of immigrant insects in Hawaii.

George C. Munro: Preservation of our shore waterfowl and waders. (By title only.)

Nils P. Larsen: The relation of diet to infection.

FRIDAY, DECEMBER 3, 1937, 7:30 P. M.

Preliminary announcements.

Election of members.

Presentation of papers:

Chester K. Wentworth and Austin E. Jones: Intrusive rocks of the leeward slope, Koolau Range, Oahu.

Harold T. Stearns: Geologic history of West Maui, Hawaii.

Joseph E. Alicata: Recent contributions to the knowledge of human parasitism in Hawaii.

Edward Y. Hosaka: The life-forms of the flowering plants of Kipapa Gulch, Oahu. (By title only.)

C. E. Pemberton: Collecting wild sugar cane in New Guinea.

THURSDAY, MAY 6, 1938, 7:30 P. M.

Preliminary announcements.

Appointment of committees.

Presentation of papers:

Chester K. Wentworth, R. C. Wells, and V. T. Allen: Ceramic clay in Hawaii.

Constance E. Hartt: Sugar transformations in the cane plant.

Arthur R. Beach and Willard H. Eller: A study of the magnetic properties of Kilauea rock.

O. N. Allen and Ethel K. Allen: Strain variation and host specificity of Rhizobia within the cowpea cross-inoculation group.

Stephen B. Jones: The weather element in the Hawaiian climate.

Alvin Dougan: Tuberculosis in Hawaii.

FRIDAY, MAY 6, 1938, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

Nils P. Larsen: Analysis of certain factors entering into the material welfare of families.

Winston W. Jones: The physiology of oil production in the macadamia.

Stanley S. Ballard: Qualitative spectrochemical analysis in agriculture.

William B. Storey: Segregation of sex types in the papaya.

E. Y. Hosaka and J. C. Ripperton: Grasses in Hawaii. (By title only.)

M. B. Linford: Potential agents of biological control of plant-parasitic nematodes.

SATURDAY, MAY 7, 1938, 6:30 P. M.

Pacific Club banquet.[2]

Constitutional order of business.

Election of members.

Installation of officers.

Invitational address by Harold St. John: The jungles of Fiji.

[2] Acting president Willard H. Eller presiding in the absence of Vice-president Walter Carter.

ABSTRACTS OF PAPERS

MEASUREMENT OF EARTH TILT

By

WILLARD H. ELLER

Earth tilt is a change of the angular relation between some part of the earth's surface and the horizontal. It is usually slight, requiring the use of sensitive instruments for its measurement.

Probably the most accurate and sensitive method for tilt measurement is that devised by Merritt, utilizing the interference of light waves. Interference fringes are obtained in a thin wedge-shaped film of air contained between two plane surfaces, one of which tilts with the earth, while the other remains level. The magnitude of the tilt is obtained from a relation between the measured fringe separation and the wave length of the light used, and the direction of the tilt from the orientation of the fringes.

Most other methods of tilt measurement use some form of pendulum. A simple pendulum is not suitable, for to obtain one millimeter displacement of the lower end of the pendulum with even one second of tilt would require a pendulum 20,000 centimeters long. Magnification of the pendulum motion is possible, as is done with the pendulum-type tiltmeters in use at Kilauea, but this has its limitations.

A most satisfactory form of pendulum-type tiltmeter results from the use of the horizontal pendulum. I am now working toward the development of a high sensitivity tiltmeter of this type which will not be affected by earthquake shock, will record the tilt hourly, and require attention only once a week. A model of this device was installed at the Hawaiian Volcano Observatory in the summer of 1937. It is still performing satisfactorily (Dec. 1937), but is of too low sensitivity for most tilt measurement.

PRELIMINARY ANALYSES OF KILAUEA SOLFATARIC GASES

By

STANLEY S. BALLARD AND JOHN H. PAYNE

Collections of Kilauea solfataric gases were made in September 1936 and in August and December 1937. Most of the collections were made from the manifold connecting the three wells sunk some years ago at the Sulfur Bank near the Hawaiian Volcano Observatory. Other collections were made in this locality and at the Steaming Bluffs, using a field collection technique. The purpose of the program was to establish the identity of all constituents other than the obvious steam and sulfur vapor. A preliminary analysis of the gases was made by E. T. Allen of the Geophysical Laboratory of the Carnegie Institution in 1922. He reported finding 96.2 percent steam, .004 percent sulfur vapor, .096 percent sulfur dioxide, 3.7 percent fixed gases, and a trace of hydrogen chloride. We used a combination of chemical and spectroscopic methods of analysis. The chief constituent of our collections (other than steam) was carbon dioxide, which constituted as much as 95 percent of some samples. Sulfur dioxide was present in amounts equal to 2 to 3 percent of the carbon dioxide content. Oxygen and nitrogen were present always approximately in the normal atmospheric ratio, but in absolute amounts which varied widely from sample to sample, being larger in the field collections than in the wells collections. Argon was present in the nitrogen residues, but no other rare gases were detected. No significant trace of the combustible gases ordinarily associated with volcanism was detected in any sample. It is interesting to note that even the Steaming Bluffs sample showed a definite, though small, content of sulfur dioxide and carbon dioxide. In general these results do not seem to be incompatible with the partial analyses of Dr. Allen, if one interprets his 3.7 percent of fixed gases to consist of some carbon dioxide but chiefly air.

MISIDENTITY OF IMMIGRANT INSECTS IN HAWAII

By

O. H. Swezey

When an immigrant insect appears in Hawaii, entomologists immediately attempt to ascertain its identity and whence it came. This has been of special importance with those which are pests. Many new immigrants have been incorrectly identified, and have been known for a time by an erroneous name. This has resulted in considerable confusion in entomological literature especially in regard to geographical distribution. It is difficult to change the name of an insect when a name found to be incorrect has been used for a long time.

Herewith is a list of some of the commoner immigrant insects in Hawaii which have been misidentified, and the present accepted name for each. It is possible, however, that some future systematists may find that the correct names have yet to be established. The names as now given are on the authority of a number of entomologists who are experts in particular families or groups of insects. Some of these corrections have already been recorded in the Proceedings of the Hawaiian Entomological Society or in other publications.

Common name	Misnomer	Present accepted name
Sugar cane leafhopper	Dicranotropis vastatrix Bredd.	Perkinsiella saccharicida Kirk.
Chinese rose beetle (Japanese beetle)	Adoretus umbrosus (Fabr.) Adoretus tenuimaculatus (Waterh.)	Adoretus sinicus Burm.
Fullers rose beetle (Olinda beetle)	Pantomorus olindae Perkins Aramigus fulleri Horn Pantomorus godmani (Crotch)	Asynonychus godmani Crotch
Sweet potato weevil	Hyperomorpha squamosa Sharp Euscepes batatae (Waterh.)	Euscepes postfaciatus (Fairm.)
Small banana weevil	Calandra remota Sharp	Polytus mellerborgi (Boh.)
Carpenter bee (Bumble bee)	Xylocopa aeneipennis (DeGeer) Sylocopa brazilianorum (Linn.)	Xylocopa varipuncta Patton
Black megachilid	Lithurgus albofimbriatus Sich.	Lithurgus scabrosus (Smith)
Leafcutter bee	Megachile palmarum Perkins	Megachile gentilis Cresson
Shorthorned grasshopper	Oxya velox (Fabr.)	Oxya chinensis (Thunb.)
Coneheaded grasshopper	Atractomorpha crenaticeps Blanch.	Atractomorpha ambigua Bol.
Longhorned grasshopper	Xiphidium fuscum (Fabr.) Xiphidium varipenne Swezey	Conocephalus saltator (Sauss.)
Japanese katydid	Holochlora venosa Stal.	Holochlora japonica Brunn.
Preying mantis	Tenodora sinensis Sauss. Paratenodora sinensis (Sauss.)	Tenodora angustipennis Sauss.
Assassin bug	Zelus peregrinus Kirkaldy	Zelus renardii Kolenati
Pink sugarcane mealybug	Pseudococcus calceolariae (Mask.) Pseudococcus sacchari (Ckll.)	Trionymus sacchari (Ckll.)
Gray sugarcane mealybug	Pseudococcus sacchari (Ckll.) Pseudococcus saccharifolii (Green) Trionymus calceolariae (Mask.)	Pseudococcus boninsis (Kuwana)
Pineapple mealybug	Pseudococcus bromeliae (Bouche)	Pseudococcus brevipes (Ckll.)
Nutgrass armyworm	Spodoptera mauritia (Boisd.)	Laphygma exempta (Walker)

PRESERVATION OF OUR SHORE WATERFOWL AND WADERS

By

G. C. MUNRO

This is an appeal to all who are interested in doing what they can to gain better protection for the birds of the Territory: the native birds—hawk, owl, stilt, heron, mudhen, coot; migratory birds—pintail and spoonbill ducks, golden plover, wandering tattler, bristle-thighed curlew, turnstone, sanderling; and others that straggle here. They have claims for many reasons, scientific, material, sentimental, and aesthetic.

Government protection is not enough. The formation of sanctuaries where shooting is prohibited is important, and their care is equally so. Encroaching introduced plants and noxious animals must be kept in check or some of our shore birds cannot survive.

A careful study should be made of the life of the migrants when away, and especially of the probable effect on the birds of the recently introduced toad in denuding the ponds of the small fishes which no doubt are a regular food for some birds and a standby for the plover on their return when the moths and larva of cutworms and army worms are scarce. (See Fauna Hawaiiensis, vol. 1, pt. IV: "Vertebrata" pp. 449-450, by R. C. L. Perkins, on the plover's value in keeping down pests.)

Any introduction of new plants and animals, even when carefully studied, is attended with risk; on the other hand, without new introductions there is little progression. This emphasizes the necessity of a thoroughly trained ornithologist to keep up an exhaustive study of every phase of the bird life of the Territory and intended introductions which might affect bird life.

THE RELATION OF DIET TO INFECTION

By

NILS P. LARSEN

The words "protective food" have come into increasing use during the last few years. The "protective" nature of vitamins is well known and was briefly reviewed. These observations by The Queen's Hospital Research Department are an attempt to gather evidence as to whether we are justified in assuming that diet has a definite relationship either to preventing infection, or helping the patient to overcome it. This was a field study conducted during the past year on two groups of Japanese families. The diet values in relation to quantity of carbohydrate, protein, fat, calcium, iron, and other ingredients, were tabulated. The greatest difference in food quantities was the fact that one group had less than half the amount of fruit and vegetables consumed by the second group. There was also a difference in milk consumption.

During the time of study, a measles epidemic affected practically every child on the plantation. Those in the high fruit and vegetable group averaged one half as many days in bed per person as those in the low group. The latter group recorded 582 sick days in bed as against 196 sick days for the high fruit and vegetable group. There were three deaths in the low fruit and vegetable group, none in the other group.

I felt justified in stating that the evidence lent some support to the connotation "protective foods" used in relation to infections. Comment was also made on the ability of the body to vary the availability of certain food elements, depending on long continued low or high intake, or the increasing efficiency of use by the body if a certain element is taken in certain combinanations.

Special appreciation and thanks are given to A. Y. L. Ward and J. Matsuoko whose combined assistance made this study possible.

INTRUSIVE ROCKS OF THE LEEWARD SLOPE, KOOLAU RANGE, OAHU

By

Chester K. Wentworth and Austin E. Jones

Most dikes, with a few sills, of the Koolau Range are concentrated in the linear dike complex, windward of the topographic crest. Here dikes are subparallel to the trend of the range and complex and have a transverse spacing of 50 to 500 to the mile. Besides these dikes, which represent the main feeder system by which the Koolau dome was built, are scattered dikes throughout the mass of the dome. Detailed studies in the Honolulu area and more casual observations elsewhere show that the scattered dikes occur in linear systems, and that these systems and their component dikes trend down the dip of the lava flows from the crest of the range to the sea, and hence in a direction nearly at right angles to that of the dike complex. In the Palolo-Waialae area, traverses have been made with sufficient uniformity to permit plotting of a contour map showing the dike concentration at various points. In general concentration decreases progressively down slope from the dike complex and in a large part of the lower slope of the dome not over one dike per mile has been observed. A tongue of marked concentration extends southward from Kaau Crater, though the dikes found are all cognate with the ancient Koolau lava series and no nephelite-mellilite dikes related to the relatively recent Kaau basalt have been found. Columnar-jointed dikes occur at depths below two or three hundred feet; banded, vesicular dikes of more obscure lines are characteristic of shallow intrusion. Associated with some shallow dikes are intrusive masses here called "buds." They represent thickened, expanded and rounded parts of a dike where lava was extruded to the surface of the existing dome. Some are 20 by 40 feet in plan, with selvage and banded structure similar to the dikes.

GEOLOGIC HISTORY OF WEST MAUI, HAWAII

By

HAROLD T. STEARNS

West Maui is an eroded volcano 5,788 feet high connected by a narrow strip of low land to Haleakala Volcano, 10,025 feet high. These two masses make up the island of Maui. The important stages in the geologic history of West Maui follow:

Probably late Tertiary and early Pleistocene (?) time

1. Building of shield-shaped volcano of basalt flows and a few thin beds of agglomerate about 7,000 feet high in relation to present sea level over a northeast-southwest rift. Fissure eruptions were not confined exclusively to this rift, as numerous dikes radiate from the apex of the volcano.

2. Collapse stage with the formation of a caldera about 2 miles across and several hundred feet deep on the summit. This caldera slightly enlarged and with all of its floor eroded away now forms the amphitheater head of Iao Valley. A smaller crater perhaps a part of the caldera lay to the south as shown by the throat breccia exposed at the head of Waikapu Valley.

3. A relatively short rest period during which a thin soil formed and differentiation took place in the feeding magma reservoir.

4. Outpourings of thick trachyte flows from local vents located along fissures. These flows formed a veneer over most and perhaps all of the basaltic dome.

5. Cessation of volcanism followed by a long epoch of weathering and erosion. A drainage pattern was established and canyons as much as 4,000 feet deep were carved. The parts of the shore exposed to strong wave action were cliffed.

Pleistocene time

6. Submergence of an unknown but large amount, perhaps as much as 2,500 feet, causing the mouths of the valleys to be drowned and their floors to be alluviated.

7. This submergence culminated in short halt at about 1,200 feet above present sea level.

8. Gradual emergence of possibly as much as 1,500 feet, or to about 300 feet below the present strand with probably several short halts. One of these halts about 250 feet above present level is named the Olowalu shore-line from the fossiliferous marine deposits at this altitude near Olowalu.

9. Resubmergence to about 100 feet above present level causing a new period of valley alluviation. Thick conglomerates were laid down at the foot of the east slopes of the mountain.

10. Reemergence of about 160 feet or to about 60 feet below present sea level leaving shore flats dry and much loose sand exposed to wind. Large dunes of calcareous sand were formed near Wailuku and some sand drifted about 6 miles across the neck of land connecting East and West Maui to the lee shore. Scattered eruptions produced short flows and cinder cones, chiefly of nephelite basalt, near Malaaea, Olowalu, and Lahaina about this time.

11. Resubmergence of about 85 feet and the formation of a shore-line about 25 feet above present sea level during which some of the dunes were drowned and others cliffed.

12. Reemergence of about 20 feet with the formation of a fringing shore bench about 5 feet above the present strand.

13. Further emergence to the present strand.

The periods of emergence were times of stream erosion and the periods of submergence were times of stream deposition except in the steep heads of the valleys. Marine erosion continued throughout the Pleistocene along the parts of the shore exposed to rough seas.

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RECENT CONTRIBUTIONS TO THE KNOWLEDGE OF HUMAN PARASITISM IN HAWAII

By

JOSEPH E. ALICATA

(Public Health Repts., vol. 53, no. 10, 1938; Jour. Am. Med. Assoc., vol. 110, 1938)

During 1936 and 1937, three important parasitic diseases of man have been found in the Territory, namely, trichinosis, spirochaetal jaundice, and intestinal distomiasis. The discovery of trichinosis on Hawaii (April 1936) led to a survey of animals that might serve as carriers to ascertain the prevalence of this disease. Following the survey on Hawaii, reported to the Academy last year, the work was extended to Maui, Oahu, and Kauai. A summary is given below.

Animals examined	Number of animals examined Hawaii	Maui	Oahu	Kauai
Rats	2,130	1,094	352	601
Mice	306	33	2	2
Mongooses	70	22	1	
Hogs (wild)	41	2		2
Hogs (domesticated)	61	92	130	30

Infection with trichinae was found in the animals examined on Hawaii as follows: rats, 2.6 percent; mice, none; mongooses, 24.2 percent; wild hogs, 14.6 percent; domesticated hogs, 1.6 percent. On Maui, the infection was found in only one rat and two mongooses; no infection was found on Oahu or Kauai.

The spirochaetal jaundice organism, *Leptospira icterohemorrhagiae,* was noted in the urine of a patient at Pepeekeo Hospital, Hawaii, in October 1936. A guinea pig, inoculated with this urine, became infected, and died of jaundice after 9 days. In addition, of 30 rats trapped near Pepeekeo, 5 were found infected with *Leptospira.* This organism was also found in rats caught on Kauai.

In June 1937, an infection with intestinal flukes (*Stellantchasmus falcatus*) was found in a young Japanese, born and reared in Hawaii, who reported having eaten raw fish, including mullet. Out of 25 mullet (*Mugil cephalus*) caught in ponds and salt water around Oahu, 23 showed infective cysts (*metacercariae*) of this fluke in the musculatures. Infestation was also found in 2 mullet caught in waters near Hilo, Hawaii. It may be emphasized that there is no danger of human infection from mullet that have been properly cooked.

More detailed reports of these studies are being published elsewhere.

LIFE-FORMS OF THE FLOWERING PLANTS OF KIPAPA GULCH, OAHU

By

EDWARD Y. HOSAKA

[B. P. Bishop Mus., Occ. Papers, 13(17), 1937]

In recent years the life-forms study of vegetation has become popular. The life-forms of a region are the result of the total effect of environmental factors; thus they manifest climate. There are several systems as postulated by Humboldt, Kermer, Warming, and Raunkiaer. That of Raunkiaer has been most widely used because of its simplicity and applicability.

Raunkiaer bases his classification on a single structure, resting organ, which he interprets as the adjustment to unfavorable climate. On this basis, he distinguishes five main classes: phanerophytes, with their perennating buds over ten inches above the ground; chamaephytes, with buds below ten inches above ground; hemicryptophytes, with buds in the soil surface; chryptophytes, with buds buried in the soil or submerged in water; therophytes, perennating by seed.

Raunkiaer's system is useful in temperate regions but in the tropics it cannot be strictly applied. In the tropics, temperature conditions are favorable continuously throughout the year with moisture conditions locally and seasonally unfavorable. Hence most of the plants lack well-insulated buds or other resting organs that are found on plants in colder regions. Actually most of the plants grow throughout the year, or with but brief interruptions. In the study of the life-forms of Kipapa Gulch plants, the position of the growing points has been used in the attempt to apply the Raunkiaer system.

The life-forms of the plants in this region change with elevation. The life-form below 1,000 feet elevation is dominantly nanophanerophytes (herbs and shrubs), 1,000 feet to 2,000 feet elevation, micro- and meso-phanerophytes (tall trees), and 2,000 to 2,800 feet elevation, nano- and micro-phanerophytes (shrubs and dwarfed trees). The spectrum of Kipapa Gulch plants indicates a tropical region in possessing a relatively high percentage of phanerophytes indicating a warm, moist region, as compared to Raunkiaer's normal spectrum.

COLLECTING WILD SUGAR CANE IN NEW GUINEA

By

C. E. Pemberton

In view of the promising results already obtained by geneticists in the crossing of wild with cultivated canes and the limited number of the former so far utilized in such work, the Hawaiian Sugar Planters' Association sent C. G. Lennox and C. E. Pemberton, in January 1937, to New Guinea and some adjacent islands to study and collect seed of as many forms of wild cane as possible.

Using as headquarters, Rabaul, New Britain, the seat of government for the Mandated Territory of New Guinea, a survey was made of wild canes in coastal, river and mountain areas of New Britain, New Hanover, New Ireland, and New Guinea. Transportation was obtained on steamers, small motor boats, canoes, airplanes and much country was traversed on foot.

New Britain and especially New Guinea present high mountain areas and elevated grassy plateaus, offering a fitting environment for the evolutionary development of grasses. Wild canes were found to occupy an important place in the grass flora. Wide variations within certain definite types were found, supplying ample evidence of endemism. The paucity of wild canes on New Ireland and New Hanover can be explained by the heavy forest cover from coast to coast.

A large quantity of seed, consisting of over forty separate lots, was collected on New Britain and New Guinea. This was brought to Hawaii in June 1937, disinfected, and planted in flats within a special quarantine house maintained by the Hawaiian Sugar Planters' Association on Molokai. Several thousand vigorous seedlings, from eight to twelve feet in height and of numerous types, resulted after five months of growth. These will be released from quarantine some time during 1938, if disease free, and be ready for crossbreeding with commercial canes as soon as they flower.

CERAMIC CLAY IN HAWAII

By

C. K. Wentworth, R. C. Wells[3] and V. T. Allen[4]

In the central Polynesian area, northeast of Fiji and Tonga, where there are no continental types of rocks, ceramic clay is generally absent. Weathering of basic volcanic rocks under tropical conditions does not ordinarily produce clays of ceramic quality. However, since 1935, small amounts of medium or light gray residual clay have been found in restricted upland areas on Oahu, Maui, Molokai, and Kauai. The deposits take the form of thin underclays, always overlain by a well-marked humus or peat layer at the modern surface, and usually underlain by thin but more or less continuous masses of iron pan followed by weathered, buff or brown residuum.

In every instance the clay occurs in sloping areas of little relief, remnants of original constructional surfaces of volcanic domes, which receive rainfall of 150 to 400 inches annually but have long remained free from significant disturbance by erosion or deposition. In elevations ranging from 2,500 to 5,500 feet, patches of more or less distinctive bog vegetation have developed and are apparently the basis of reducing conditions under which a clay fairly low in iron has been produced.

[3] Chief Chemist, U. S. Geological Survey, Washington, D. C.
[4] Professor of Geology, St. Louis University, St. Louis, Mo.

Three complete chemical analyses show a rather variable composition, silica 34 to 57 percent, alumina 22 to 26 percent, iron oxides 3 to 9 per cent. Most surprising is approximately 14 percent of titanium oxide in two of the samples. Preliminary petrographic studies show derivation of the clay by alteration of feldspars to kaolinite, and ferromagnesian minerals to a brown clay mineral not yet positively identified. On certain islands the clays may have been derived from trachyte, but the presence of rocks less basic than basalt on the Koolau Range of Oahu, near the clay deposits, has not yet been demonstrated nor considered essential to the production of the clay by weathering.

SUGAR TRANSFORMATIONS IN THE CANE PLANT

By

CONSTANCE E. HARTT

(Haw. Planters' Record, **41**: 33-46, 1937)

Both leaves and stems of the sugar cane plant readily carry on interconversion of glucose and fructose as well as synthesis of sucrose, according to experiments in which excised blades, sheaths, and cut stalks of sugar cane were supplied with glucose or fructose in absolute darkness. Entire stalks of *Saccharum robustum,* a wild variety of sugar cane with naturally low sucrose content, were placed in a ten percent solution of glucose and fructose for 48 hours. The percentage of sucrose increased in the blades, the sheaths, and the stems. In the stems, the sucrose increased from 8.1 to 14.3 percent. Therefore cut stalks of sugar cane can absorb glucose through their cut ends, the glucose can go up to the leaves and be turned into sucrose, and some of the sucrose can return to the stem for storage.

Neither light nor chlorophyll is necessary for the interconversion of glucose and fructose or their transformation into sucrose. The gain in sucrose in blades supplied with glucose increased with temperature from about 10°C. to 40°C. and decreased at 50°C. Time and the concentration of glucose materially affect these processes. Sugar cane blades supplied with mannose made no sucrose. It is therefore unlikely that the interconversion of glucose and fructose in the sugar cane plant takes place by enolization, since mannose has the same enol form as glucose or fructose.

These findings demonstrate the importance of glucose as a forerunner of sucrose and indicate that part of the sucrose stored in the stem is made there from glucose transported to the stem from the leaf.

A STUDY OF THE MAGNETIC PROPERTIES OF KILAUEA ROCK

By

ARTHUR R. BEACH AND WILLARD H. ELLER

With a modified magnetometer of the type used in measuring earth's fields and two single turn coils reducing the control field at the magnet, it was possible to measure fields of about 1/1000 the strength of the earth's field.

The magnetic moment of the sample placed in EW axis was determined by the deflection of the magnet from the relation

$$M/H = d\ 3/2 \tan \theta$$

Magnetic poles were indicated by maximum deflection in either direction as the sample was rotated.

The results so far obtained indicate the following facts:

(1) That Kilauea lava is definitely magnetic;
(2) That the lava has a definite polarization;
(3) That lava, when heated to some temperature between about 800 degrees F. and 1,100 degrees F., can be magnetized by an applied field and its polarization is the same as that of the applied field (the determination of this critical temperature at which these phenomena occur is not yet completed);
(4) That most types of lava approach magnetic saturation when subjected to a field of about 30 times the strength of the earth's field, but up to this value the degree of magnetization is proportional to the applied field;
(5) That after lava has cooled there is no apparent change in its magnetic strength or polarization, even though subjected to very strong magnetizing forces.

It should be possible therefore to date lava flows by checking the polarization of the lava and comparing this with known magnetic declinations of past years.

STRAIN VARIATION AND HOST SPECIFICITY OF RHIZOBIA WITHIN THE COWPEA CROSS-INOCULATION GROUP

By

O. N. Allen and Ethel K. Allen

A study has been made of the infective and effective abilities of 54 strains of *Rhizobia* isolated from 28 species of leguminous plants when used as inocula for 20 plant members now included in the cowpea cross-inoculation group. Results have been based upon three replicative greenhouse experiments conducted under approximately the same meteorological conditions.

Marked differences were noted in the plant response to the various inocula in the greenhouse tests. Approximately 25 percent of the strains produced nodules upon all of the test plants, whereas the remaining strains were non-infective upon one to six different species. In regard to benefits derived from the inocula, 41 or 76 percent of the strains were non-effective upon five plants or less, while nine strains or 16 percent were non-beneficial upon six to nine of the test plants. Forty-eight or 89 percent of the strains were beneficial upon 19 of the 20 species. Only six or 11 percent of the strains benefited the growth of less than ten of the plants tested.

Ten of the 20 test plants were inoculated by each of the *Rhizobia* strains. The cowpea plant (*Vigna sinensis* L.) was the most susceptible to the various inocula inasmuch as each strain of *Rhizobia* not only produced nodules but benefited its growth; while the other extreme was represented by the lima bean (*Phaseolus lunatus*) upon which only 22 strains produced nodules, none of which were beneficial.

An analysis of the results suggests that variations in the infectiveness and effectiveness of *Rhizobia* from plants of the cowpea group may be of a greater magnitude than those previously recorded for the other cross-inoculation groups.

THE WEATHER ELEMENT IN THE HAWAIIAN CLIMATE

By

Stephen B. Jones

Climate is customarily described by averages. In this study some climatic averages have been broken down to show the relative importance of weather types. Hawaii has two basic weather types—trade wind and southerly (kona) —each of which has rainy and dry subtypes. Analysis of Honolulu rainfall for five years shows that trade wind rain is relatively constant, while rain due to extratropical cyclones (kona rain) is extremely variable. Kona rain is responsible for the winter maximum, trade wind rain showing no regular seasonal peak. It is estimated that the normal trade wind rainfall for Honolulu is about 250 millimeters. Mountain stations receiving more trade wind rain in proportion to the total, show no such marked summer minimum.

Trade wind rain is reemarkably constant in wet and dry years at all of five stations forming a profile across the Koolau Range, with the amount directly proportional to proximity to the mountain crest. Kona rain shows no such close relationship to topography, because much of the kona rain is frontal, not orographic. Stations on the northeast side of the range have more kona rain than stations on the southeast, due, probably, to the blowing over of convectively instable air. In an analogous way, the trade wind showers are blown southwestward.

Analysis of rainfall for the two wettest years (1887 and 1904) and two driest years (1878 and 1926) ever recorded at Honolulu shows that summer rain was approximately normal in all four, with the dry years showing rainier Junes than the wet years. In the dry years the customary rainfall curve was reversed, the minimum coming in winter.

Temperature variability is greatest at high altitudes and inland, and shows a slight winter maximum. Temperature fluctuations are usually caused by frontal passages or by vertical currents in instable air masses. Therefore, a rough correlation exists between temperature variability, the number of kona days, and the number of days with rainfall in excess of 2.5 millimeters.

SCIENCE IN TUBERCULOSIS CONTROL

By

C. ALVIN DOUGAN

Tuberculosis in its epidemiological aspects has its source in a specific pathological phenomenon, the softening of the caseous tubercle.

The tubercle is the body's primary cellular defense against acid-fast invaders which apparently cannot be destroyed by the simple expedient of phagocytosis. The strategy of the tubercle is devitalization of the maurauding pathogens by imprisonment and starvation. Walls of epithelioid or monocytic cells, reinforced by heavy fiber, are proliferated about the invading acid resistant microörganisms, while biochemical processes literally bury the imprisoned invaders in caseous, then calcified deposits to render them completely innocuous through starvation. Ultimately capillaries penetrate the derelict tubercles and remove the inert calcified remnants.

Under normal conditions of living, therefore, tuberculosis infection and pathological response is self-limiting.

Breakdown of the body's cellular defense, however, induced so characteristically and so commonly by the stress and strain of early adult life, gives rise and release to phenomenal numbers of virulent bacilli which disseminate and perpetuate disease. This softening of the caseous tubercle, associated as it is to the enormous multiplication, escape, and discharge of tubercle bacilli through blood and bronchial channels makes the breakdown of the tubercle the key problem confronting clinicians and epidemiologists concerned with the prevention of the spread of tuberculosis.

Failure of the individual and of society to make the tubercle invulnerable by the application of the simple rules for healthful living gives rise to the spread of tuberculosis in all its protean forms, necessitating an increasingly costly program of education, diagnosis, treatment, and rehabilitation.

Too wide a gap exists between our scientific knowledge of prevention and its application. Known and proven preventive and diagnostic safeguards are not applied to even contacts eminently endangered by known hazards of age, sex, race, occupation, or environment. Thus, national and local statistics show that year after year some 75 percent of tuberculous cases do not come to diagnosis until in the advanced stages of the disease, and that some 25 percent of the fatal cases are not reported to the Board of Health until after death. Drolet and Whitney have pointed out that no favorable shift has been observed in case rate ratio, over the past ten years.

In a recent high school survey, some 12 of the 13 active cases of tuberculosis disclosed by X-ray, were known household contacts of cases diagnosed in the Honolulu chest clinic since May 1929, but were not under the protection of modern medical techniques. Against the individual indifference to tuberculosis, society has not elaborated the safeguards as about a thousand lesser hazards.

Surveillance of all infected contacts, with application of the simple protective and modern diagnostic technique until their special danger has passed, offers not only control but eventual eradication of tuberculosis.

The logical plan to eradicate tuberculosis, is to disclose and terminate this age old death in the body's primary defense strategy, the tubercle.

ANALYSIS OF CERTAIN FACTORS ENTERING INTO THE MATERIAL WELFARE OF FAMILIES

By

NILS P. LARSEN

The paper was based on two charts worked out in The Queen's Hospital Research Department. Chart one was the analysis of various local diets in comparison with the low cost adequate diet developed by the nutrition committee. On the basis of the cost of this diet a second chart was made out that consisted of the cost of food for families of from one to ten members, and on various incomes.

Using Zimmerman's measurement basis that the most important single criterion in evaluating the material status of families is the percentage of income used for food, the chart indicated at what level the families lived in a degree of "plenty" or in a degree of "poverty." "Plenty" applied if 30 percent or less was used for food, and "poverty" existed if 80 percent or more of the income went into food.

It was shown that families on the plantation salaries could have four children and be "passable," and when they had six or more children they had to live in "poverty," if they fed all the members at least a low-cost, adequate diet.

This study was part of a continued study on the health status of Hawaiian families.

THE PHYSIOLOGY OF OIL PRODUCTION IN THE MACADAMIA

By

WINSTON W. JONES

(Proc., Am. Soc. for Hort. Sci., **35**, 1938)

Results reported show that oil formation in the macadamia nut (*Macadamia integrifolia* Maiden et Betche) can be divided into three phases. The first is a period of about 90 days following flowering in which very little oil is formed. The second is a period of about 70 days in which 85 percent of the oil is formed. Following this is a third period of about 70 days before the nuts are ready to harvest and during which very little oil is formed. The beginning of rapid oil formation seems to be associated with the hardening of the shell. Data for the nitrogen and carbohydrate fractions are given.

QUALITATIVE SPECTROCHEMICAL ANALYSIS IN AGRICULTURE

By

STANLEY S. BALLARD

The materials usually encountered in agricultural analytical studies are soils, fertilizers, and plant specimens. Ordinarily one wishes to determine the presence in these materials of the elements essential to plant growth, or those known to be toxic. Also it is necessary at times to analyze substances of heterogeneous composition and frequently those having widely divergent physical characteristics. Any or all of the 92 chemical elements may be sought. Using the methods developed in the spectroscopic laboratory of the Experiment Station of the Hawaiian Sugar Planters' Association, a sample may be analyzed rapidly to determine the presence or absence of some 50 of the elements. This list includes the major plant nutrients phosphorus, potassium, calcium, magnesium, and iron; the minor elements manganese, boron, copper, zinc and aluminum, and some twenty more metals and metalloids occasionally present in agricultural materials. Results of analyses are presented in semi-quantitative form, the five designations representing decreasing amounts of an element present in a sample being: "lots, some, less, trace, not detected." Variations in the amounts of minor elements present in various samples of similar major composition can readily be detected, as illustrated by research projects bearing on the occurrence of the less common plant nutrients in commercial fertilizers, and the distribution of the mineral elements throughout a single stalk of sugar cane. A sample can ordinarily be analyzed semi-quantitatively for the 50-odd arc sensitive elements in one working day. Spectroscopic analysis does not pretend to compete with chemical methods in the quantitative determination of the major constituents of a sample. It has great advantages in speed, ultimate sensitivity and breadth of application, however, when the minor or trace constituents are concerned. Or the spectrograph may be used to advantage in determining the general metallic constitution of a sample whose composition is totally unknown. Again, with the spectrograph comparisons between standardized substances of known composition and unknowns may be carried out easily and rapidly, giving quasi-quantitative results.

SEGREGATION OF SEX TYPES IN THE PAPAYA

By

William B. Storey

Papaya trees may be grouped into three broad classes on the basis of sex type: female, hermaphrodite, and male. Female and hermaphrodite types are fruitful and, therefore, are useful from the grower's point of view; the male type is non-fruiting and its presence in a commercial planting is not desired. Many practices have been devised for the purpose of eliminating male trees in populations intended for field planting, but not one of these has any foundation in fact for its existence and not one has been foolproof in operation.

A system of controlled pollination has been established which makes it possible for the grower to produce seed none of which will produce a male tree. Under controlled pollination the following results are obtained in the progenies:

1. A female crossed with a male yields females and males in the ratio of 1.0 to 1.0.
2. A female crossed with a hermaphrodite yields females and hermaphrodites in the ratio of 1.0 to 1.0.
3. A hermaphrodite crossed with a male yields females, hermaphrodites, and males in the ratio of 1.0 to 1.0 to 1.0.
4. A hermaphrodite when self-fertilized yields females and hermaphrodites in the ratio of 1.0 to 2.0.

By the simple expedient of hand pollination and bagging the flower, using either pollination number 2 or number 4 above, the grower need no longer resort to unproven methods to eliminate male trees from his planting.

GRASSES OF HAWAIIAN RANGES

By

E. Y. Hosaka and J. C. Ripperton

Agricultural leaders throughout the world are placing more emphasis on grass than ever before. Grass as an agent for holding soil from washing or blowing away, adding organic matter and enriching the soil, and grass as feed for cattle and other livestock is now the object of much research. A. S. Hitchcock in 1922 was the first to make a comprehensive study of the Hawaiian grasses. He reported 130 species, 47 native and 83 foreign. Since then several new endemic species have been discovered and many foreign species accidentally or purposely introduced from different parts of the world have been added. Hawaii is said to be the crossroad where grasses of the whole world congregate. There are now about 240 grass species in the islands, 54 native and 186 foreign.

Most grasses, contrary to common accepted conception, have a definite habitat. There are species restricted to the wet windward areas, the dry leeward slopes, and the cold dry uplands. In these zones two types of species are found, the sod or carpet and the tuft or bunch formers. Most of the grasses fall in the latter group.

In 1936, Leo D. Whitney*, E. Y. Hosaka, and J. C. Ripperton made a study of the grasses in Hawaii, paying particular attention to the range species. Several months were spent by Hosaka in the field, collecting and making a vegetational survey. In a bulletin to be published by the Hawaii Agricultural Experiment Station, 105 of the more economic species of the Hawaiian ranges are discussed; also, a synopsis of all the known grasses in the Territory is given.

POTENTIAL AGENTS OF BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

By

M. B. LINFORD

Plant-parasitic nematodes, in soil, are subject to the attack of a vast array of plant and animal enemies, most of which have but recently been recognized. Investigations in progress at the Pineapple Experiment Station since October 1935 have included a survey of parasites and predators occurring in Hawaiian soils and a partial analysis of their significance to agriculture. This paper describes representative types with their mode of attack, presents evidence that they are now helping to combat the destructive and cosmopolitan root-knot nematode, *Heterodera marioni*, and indicates possible means of increasing their beneficial action.

Thus far, 49 distinct species, as enumerated below, have been found locally. All but *Mononchus* and one mite have been new records for Hawaii, many of them new to science. Most attack various plant-parasitic and free-living nematodes with equal ease, but appear harmless to roots.

Thirteen nematode-trapping fungi (Hyphomycetes, Phycomycetes, Basidiomycetes, Actinomycetes), 1 egg parasite (*Penicillium*), 6 non-trapping

* Died November 7, 1937.

parasitic fungi (Chytridiales, Ancylistales, Hyphomycetes), 1 ecto-parasitic protozoan, 19 predacious nematodes (5 *Aphelenchoides,* 2 *Diplogaster,* 9 Dorylaimidae, and 3 *Monochus*), 6 mites (5 Parasitinae, 1 *Rhizoglyphus*), and 3 predacious tardigrades (*Macrobiotus*).

Some of these have been found in sand, volcanic ash, forest litter and soil, from sea level to 9,700 feet. In fields and gardens where *H. marioni* is established, several are widespread and abundant: 20 species have been found within a radius of 200 yards. In complex associations, these parasites and predators involve undesirable interactions, for they not only compete but also attack and destroy one another.

The biological control complex is now limiting nematode population but, unaided, is not effecting satisfactory control. Some benefits have accrued from experimental addition of a culture of an effective trapping fungus into soil in which it was not abundant. Other benefits, following decomposition of organic matter in soil, are attributable, at least in part, to increased activity of the biological control complex.

JUNGLES OF FIJI

By

HAROLD ST. JOHN

Fiji of the old cannibal days is no more. It is now a British crown colony, with pacified, Christianized natives living under a modern, efficient government. There are still 90,000 natives, mostly dwelling in grass huts in native villages, under their own chiefs.

My expedition during 1937 to Waya Island and to the headwaters of the Wainimala River and the high central plateau of Viti Levu was described and pictured.

NECROLOGY

John Minton Westgate, Director of the Hawaii Agricultural Experiment Station from 1915 to 1935 and Professor of Agriculture at the University of Hawaii from 1935 until the time of his death, died in Honolulu, September 25, 1937.

Professor Westgate was born on February 17, 1878, in Kingston, New York. He received the B. S. degree from Kansas State College in 1897, and the M. S. degree from the same institution two years later. From 1901 to 1903, he attended the University of Chicago for advanced study.

After twelve years of work in the United States Department of Agriculture, in the field of soil binding investigations and later with clover and alfalfa, he came to Honolulu as Agronomist in charge of the Hawaii Experiment Station which title was changed to Director in 1924.

Westgate was the author of numerous bulletins and papers on agronomical subjects. At the time of assuming his position at the University as Professor of Agriculture, he took a trip around the world spending much time in tropical regions gathering material for courses in tropical agriculture which he gave on his return.

Professor Westgate, to an unusual degree, had a broad sympathy for all classes and races, and contributed greatly to the Americanization of the young people of Hawaii with whom he came in contact.

Upendra Kumar Das, research associate in charge of the biochemical laboratory at the Experiment Station of the Hawaiian Sugar Planters' Association, was instantly killed by an explosion of apparatus in his laboratory on October 22, 1937. His death, equipped as he was for still finer research, has deprived us of a thorough scientist who was always motivated by the practical viewpoint.

Born in India on July 23, 1902, he received his early education at Tagore's School. He came here in 1924 and enrolled at the University of Hawaii. He majored in sugar technology and completed the work for the B. A. degree in three years, graduating with honors in June 1927. After graduation, he found time to secure additional experience in the laboratory of biological chemistry at the University of Hawaii, and in 1930 was awarded a master's degree. During a leave of absence in 1934, he spent a year at the University of Minnesota and received his doctor's degree there. While at Minnesota, he was elected to Sigma Xi.

His associates have lost a sympathetic, constructive counselor, and his friends miss a personality that is not replaceable.

Leo D. Whitney, Assistant Agronomist at the Hawaii Agricultural Experiment Station, died after a week's illness on November 7, 1937. Mr. Whitney was born at Santa Rosa, California, on May 11, 1908. He received his B. S. degree from the University of California in 1933. This was followed by two years of graduate study at the same institution.

During his two years of work in Hawaii, he concentrated on the study of taro, gathering and classifying some eighty varieties. In addition, he did outstanding work on native and introduced grasses of Hawaii. His researches are being completed by his colleagues. He was a faithful and cheerful friend to all his associates, and industrious and sincere in his search for truth in his chosen field. His early passing is a great loss to science. Surviving are his wife, mother, two sisters, and a brother.

Wilbur James MacNeil, retired member of the faculty of Punahou School, died December 22, 1937.

Mr. MacNeil was a graduate of Cornell University and received an M. S. from that institution. He also did advanced work at Harvard and the University of California.

For thirty-three years, from 1903 to 1936, an instructor in science and mathematics at Punahou Academy, Mr. MacNeil was responsible for the early training of a large number of men and women, many of whom have been prominent in scientific and professional work in Hawaii.

Mr. MacNeil was a member of several national scientific societies and active in local organizations, particularly in the Botanical Society. His work in plant selection and breeding is well known.

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Nieman, Helen E.
Nelson, Frances
Nikaido, Raymond
Nightingale, G. T.
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Okubo, Shigeo
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Ostergaard, Jens

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Jackson, Dean C.

Kerns, Kenneth R.

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OTHER ISLANDS

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Dickey, Lyle A.

Elbert, Samuel H.

Giacometti, G.

Jaggar, T. A.

Lamb, Sam

Moomaw, Ben F., Jr.

Stearns, Harold T.

Waesche, Hugh H.
Webster, James N. P.
Wingate, E. G.

MAINLAND

Davis, Watson

Handy, E. S.C.

Jones, Austin E.

Louttit, C. M.

Usinger, Robert L.

Wilder, Stuart G. (Mrs.)

PROCEEDINGS
HAWAIIAN ACADEMY
OF SCIENCE

FOURTEENTH ANNUAL MEETING
1938-1939

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HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Fourteenth Annual Meeting were held in Social Science Hall, University of Hawaii, November 17 and 18, 1938, and April 27 and 28, 1939, ending with a banquet at the Pacific Club on April 29.

OFFICERS

1938-1939

President, Walter Carter
Vice-President, Harry L. Arnold
Secretary-Treasurer, Mabel Slattery
Councilor (2 years), Cyril E. Pemberton
Councilor (1 year), Willard H. Eller
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1939-1940

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Councilor (1 year), Walter Carter (ex officio)

PROGRAM OF THE FOURTEENTH ANNUAL MEETING

THURSDAY, NOVEMBER 17, 1938, 7:30 P. M.

Preliminary announcements.

Election of members.

Appointment of committees.

Presentation of papers:

E. H. Bryan, Jr.: The natural history of the Phoenix Islands.

Kenneth P. Emory: The archaeology of the Phoenix Islands.

Stanley S. Ballard, Paul L. Gow, Martin Nelson: Apparatus for the production of absorption spectra.

Chester K. Wentworth: Specific gravity of sea water near Hawaii.

Joseph F. Kunesh: Planning in Hawaii.

Gordon T. Bowles: The Determination of genetic variables in man.

FRIDAY, NOVEMBER 18, 1938, 7:30 P. M.

Lyman A. Dean: Rainfall and coffee production in the Kona district.

John H. Beaumont: An analysis of growth and yield relationships of coffee trees in the Kona district, Hawaii.

Marie C. Neal: A List of mosses and vascular plants collected on Mauna Kea, August 1935. (By title only.)

Joseph Alicata: Life cycle and control of parasites of man in Hawaii.

George C. Munro: Protection for Hawaiian birds.

Bryce M. Stewart: Evolution of social legislation in modern democracies.

THURSDAY, APRIL 27, 1939, 7:30 P. M.

Charles L. Wilbar, Jr.: Sugar cane as a source of minerals in infant feeding.

Joseph E. Alicata: The relation of diet to parasitic infection.

Christopher Hamre: Survey of hemoglobin and blood cell levels of pre-school children.

Nils P. Larsen, George Pritchard, Charles L. Wilbar, Jr., A. L. Y. Ward: Ten-year study on tooth decay among children in Hawaii.

Edwin H. Bryan, Jr.: Polynesian natural history catalogs at Bishop Museum. (By title only.)

Edwin E. McNiel: Psychopathology in Hawaii.

FRIDAY, APRIL 28, 1939, 7:30 P. M.

Harold T. Stearns: Geology of the island of Kahoolawe, Hawaii.

C. H. Edmondson: Resistance of various woods to the action of Teredo.

Howard A. Powers: Hawaiian adz materials in the Haleakala section of Hawaii National Park.

G. K. Parris: A new disease of papaya.

D. M. Weller: Some effects of colchicine on sugar cane.

Stanley S. Ballard and L. A. Dean: The characteristics of radioactive phosphorus in solutions and soils.

N. E. Winters: The program of the U. S. Soil Conservation Service.

SATURDAY, MAY 7, 1939, 6:45 P. M.

Pacific Club Banquet.

Constitutional order of business.

Installation of new officers.

Presidential address: Some observations on Tropical Agriculture and their Significance to agriculture in Hawaii.

Adjournment.

ABSTRACTS OF PAPERS

SOME OBSERVATIONS ON TROPICAL AGRICULTURE AND THEIR SIGNIFICANCE TO AGRICULTURE IN HAWAII

By

WALTER CARTER
(Presidential Address)

A brief survey of the most important crops observed during a tour of tropical areas indicates that, so far as production of tropical crops is concerned, Hawaii is neglecting agricultural possibilities. Suggestions for the inclusion of tropical crops in the Hawaiian economy are made in the following paragraphs.

Cashew nuts, cloves, black wattle, and quinine are examples of tree crops which could be incorporated into the forestation program in Hawaii. Each of these commercial products requires processing. Operations requiring labor in the production of cloves could be largely mechanized. Prospects for quinine are particularly significant. As a strategic material on which the United States is dependent from outside sources, it is becoming more and more important. Suitable forest areas could be planted to serve the purposes of forestation and at the same time create an important reserve supply of quinine within United States territory.

With the aid of central cooperatives, the growth of coconuts on many of our coastal areas might be encouraged as an additional small farmer's crop as well as an item in the reserve fruit supply of the islands. Apart from processed coconut products, the export of nuts is a neglected item.

The importations of ginger into the United States are sufficiently high to call attention to the possibilities of increasing the planting of this crop profitably.

Silk production on a mechanized basis seems to offer an ideal opportunity for Hawaii. The possibilities in silk industry have been demonstrated in California, and Hawaii has certain climatic advantages which would materially reduce costs.

There is need for a drug and chemical manufactory in the islands, which could process and market many materials which could be grown, though not in sufficient quantities at first to justify separate processing units. A unit of the Hawaii Agricultural Experiment Station devoted to the possibilities of economic agricultural chemistry might well become an important factor in the diversification program.

It has been pointed out that, with the exception of the production of island food, any material increase in small holdings at the expense of corporate agricultural lands would ultimately lead to a lower standard of living in the islands. New crop development should be planned to fit in with our highly organized technical system of agriculture which is ideally suited to the needs of the island population because of the high grade of labor available and the opportunity it affords for the development of technical and semi-technical occupations.

(Illustrated with slides and motion pictures.)

NATURAL HISTORY OF THE PHOENIX ISLANDS

By

E. H. BRYAN, JR.

The Phoenix group, eight low, coral islands in the mid-Pacific, between 2 and 5 degrees south of the equator, are scattered over an area which measures 210 miles (E. to W.) by 120 miles (N. to S.). There is much variation in size and form, from atoll with spacious lagoon with numerous entrances to small sand flat with lagoon reduced to a shallow pool. In the order of their size the islands are:

Island	Latitude South	Longitude West	Length miles	Width miles	Lagoon type	Lagoon entrances
Canton	2° 49′	171° 43′	9.5	4.5	A*	3
Hull	4 30	172 12	6	3	A	20
Gardner	4 41	174 34	4	1.4	A	1
Enderbury	3 07	171 03	2.5	1	C	0
Sydney	4 27	171 16	2	2	B	0
Phoenix	3 42	170 42	0.8	0.6	C	0
McKean	3 37	174 07	0.6	0.6	C	0
Birnie	3 35	171 31	0.8	0.4	C	0

*A. Lagoon large and moderately deep; land a narrow rim.
B. Lagoon of moderate size and depth; wider ring of land.
C. Lagoon a shallow pond, which may nearly dry up.

None of the islands reaches a height of more than 40 feet, the average height of the rim being less than 20 feet, with lower elevations within.

The vegetation indicates that rainfall is heaviest on the three southern islands (Gardner, Hull, Sydney), on which grow trees and shrubs. The three smallest islands support only scattered herbs and low shrubs. On Canton and Enderbury there are a few patches of trees (*Cordia, Tournefortia, Morinda*), shrubs (*Scaevola, Pemphis, Sida*), and a few planted coconut palms, in addition to the low growth. Groves of coconut palms do well on Sydney and Hull, and some have been planted on Gardner. The trees and other plants on these islands are species widespread in the Pacific.

Sea birds, such as frigates, boobys, terns, tropic birds, petrels, and shearwaters, are numerous; and at times there are flocks of such migratory birds as plover, turnstones, and curlew. Rats are common on some of the islands; one species, probably of aboriginal introduction. Rabbits, abandoned by guano diggers, still survived in 1924 on Phoenix. Lizards and hermit crabs abound. Turtles come out of the sea to lay eggs. Fish and other marine life are abundant about the reefs. Insects, which are few in number of species but abundant in individuals, include roaches, silverfish, leafhoppers, plant bugs, small beetles, small moths, ants, and flies. On the wooded islands there are also large moths, butterflies, grasshoppers, crickets, and dragonflies. No mosquitoes were noted. Ground spiders are abundant, but no venomous arthropods.

"Discovered" during the first half of the 19th century, but previously known by Polynesians, these islands have been visited in turn by whalers, guano diggers, and (the southern ones) copra producers. They have been claimed by the United States and Great Britain. Canton and Hull have most value as stopping places for land and sea planes.

ARCHAEOLOGY OF THE PHOENIX ISLANDS

By

KENNETH P. EMORY

On a map of Sydney Island in the Phoenix group, made from a British Survey in 1889, ancient stone ruins are located at two places. E. H. Bryan, Jr., of Bishop Museum, photographed several of these in 1924, and several similar structures on Hull. He brought back a shell adz from Hull. The yacht *Zaca* stopped at Hull and Sydney in 1933 to enable Gordon Macgregor, returning from a Bishop Museum expedition to Rennel, to make a survey of archaeological remains. They discovered on Sydney Island a marae similar to the inland maraes of Tahiti and the Tuamotuan maraes. But the other structures, with the exception of one other marae of this kind, have not been found in Tahiti or the Tuamotus. As these maraes do not appear on Hull, though some of the other Sydney structures do appear there, it would seem that the maraes were built by the people of some visiting canoe, from the Tahitian region, which had sailed before the prevailing Trades, but that the other structures were left by a different group which settled for a time on both Hull and Sydney. The platforms, gravelike and shrinelike structures which they left, are strongly reminiscent of Caroline Islands structures and suggest that the people who left them came from that region. From the situation and condition of the eastern Polynesian maraes on Sydney, there is a hint that they were erected after the other structures. If this be so, the other, older structures may have been left by Polynesians on their way from Micronesia into eastern Polynesia, in which case they show that the early Polynesians have greatly modified the original structures with which they were familiar, while the peoples inhabiting Micronesia have kept to the old forms.

APPARATUS FOR THE PRODUCTION OF ABSORPTION SPECTRA

By

STANLEY S. BALLARD, PAUL L. GOW, AND MARTIN E. NELSON

Apparatus has been designed and constructed for producing and photographing absorption spectra, particularly the selective absorption spectra of liquids. The apparatus consists of a light source giving a continuous spectrum, absorption tubes for holding the liquid being tested, and a spectrograph to record the spectra. For a strong continuum in the ultra violet a hydrogen discharge tube capable of standing rather high current density is recommended. Tubes of this type have been constructed and have been found to operate satisfactorily. The tubes are energized by a portable voltage unit capable of giving up to 400 milliamperes at 4,000 volts. This unit was built with funds furnished by the Hawaii Agricultural Experiment Station.

We have designed and constructed three kinds of absorption cells—simple glass tubes with quartz windows cemented on the ends and with side tubes for introducing the liquid, cells of the same sort but modified so that the length can be varied from 1 mm. to 150 mm., and glass tubes arranged so that the quartz windows are held on mechanically by caps which screw over the ends of the tube. These last cells have the advantage that no cement is used, and hence there is no danger of the liquid attacking the cement and the windows falling off. These are quite similar to the saccharimeter tubes so common in Hawaii. In fact standard saccharimeter tubes can be used, when fitted with quartz windows.

The spectrograph was constructed in the Physics Department of the University of Hawaii. Since the optical parts are of fused quartz the instrument has low resolving power, which, however, is adequate for this type of work. The spectral range from 7,000 to 2,400 angstrom units is photographed on a single ten-inch plate.

The equipment is at present being used in the determination of the vitamin A and carotene contents of Hawaiian animal and vegetable products. Many other uses for the equipment are foreseen.

SPECIFIC GRAVITY OF SEA WATER NEAR HAWAII

By

CHESTER K. WENTWORTH

Sea water generally is from 20 to 30 parts per thousand heavier than fresh water. Figures for the vicinity of Hawaii available from oceanographic studies show an average value for 27 degrees Centigrade of 1.0230, referred to fresh water at 4 degrees, in accordance with common laboratory and oceanographic practice. In order to determine the important Ghyben-Herzberg ratio which applies to basal and artesian water supplies, fresh and sea water should be compared at the mean groundwater temperature in the artesian aquifer, which is about 22 degrees. Full correction involves the thermal contraction of sea water from 27 to 22 degrees at 0.00030 per degree (+ 150), and the thermal expansion of fresh water from 4 to 22 degrees (+ 220), as well as a slight correction for the greater density of artesian water than distilled water (— 23). Result is about 1.02647.

Recently somewhat over 100 samples have been collected, mostly from rocky shores around Oahu, but 27 from ships of the Inter-Island Steam Navigation Company and other agencies. Variation between the specific gravities, corrected to 22°/22°, of shore agencies, and ship averages, is less than 0.00001. Variations from time to time, at the same points, are nearly twice as great as the variations from place to place at the same time, this apparently being due to variable mixing of shallower and deeper layers of ocean water in connection with changing wave and current conditions. Final value for the specific gravity of sea water at 22 degrees, referred to artesian water at 22 degrees, is 1.02610, with a probable error of the mean of 0.000012. This reduces the Ghyben-Herzberg ratio to 1:38.3, as compared to 1:40, or 42, or 41 2/3, used by others.

PLANNING IN HAWAII

By

JOSEPH F. KUNESH, DIRECTOR

(TERRITORIAL PLANNING BOARD)

Planning in Hawaii began as early as the year 1906 when Charles Robinson wrote "The Beautifying of Honolulu." The excellent work of the Outdoor Circle began in 1911, and in 1915 the Honolulu City Planning Commission came into existence. The Shade Tree Commission, organized in 1923, has been an important factor in Honolulu's esthetic planning. The Outdoor Circle's eradication of the billboard nuisance in Honolulu constitutes one of the major accomplishments of civic planning in Hawaii.

In the City of Hilo a planning commission, organized in 1929, continued to function advisorily until 1937.

The effective work of the Highway Planning Survey of the Territorial Department of Public Works was begun in 1935.

Lewis Mumford, author of "The Culture of Cities" recently proclaimed that while Honolulu is fraught with the usual "growing pains" of a community, it is still a "malleable" city—amenable to effective long-range planning.

The Territorial Planning Board was created by legislative act in 1937. Nine members were named by the Governor, and the appointment of a planning staff of five members followed. Based on the technique developed by the National Resources Committee and 46 State Planning Boards, the methods and fields of planning in the Territory have been developed. Meetings are held monthly, including outside counties; and programs are presented and discussed. The reception of the plans by public-spirited citizens has been cordial, enthusiastic, and profitable.

Under preparation is the Board's first biennial report to the Legislature: "A Historic Inventory of the Physical, Social and Economic and Industrial Resources of the Territory of Hawaii." Acknowledgments are made to some 30 collaborators whose spontaneous and enthusiastic response has furnished a stimulus to initial stages of planning in Hawaii. A Land Planning Committee of fourteen members has been named. Implementation of other advisory committees is contemplated. The Works Progress Administration has kindly offered assistance in a 50-man project now under way.

The Territorial Planning Board is charged with duties of scheduling public works with respect to employment, and approval of major public improvements.

A much criticized source of cost of government lies in the fact that there are some 175,000 separate governments in the United States. Up to the present 1,700 town and city planning bodies have been set up, largely to consolidate efforts frequently duplicated. Hawaii now has two planning bodies and is keeping abreast of trends on the Mainland of which it is, very much, an integral part.

THE DETERMINATION OF GENETIC VARIABLES IN MAN

By

GORDON T. BOWLES

Studies in the problems of heredity in man have thus far dealt primarily with anatomical and secondarily with physiological factors. More especially they have been concerned with physical characters which are traceable to mutant variations which have been grouped together as "abnormalities."

These mutant variations are extremely varied as regards their importance to the organism as a whole. Some, such as color blindness, are comparatively trivial and are not generally ascertainable by casual external observation. The appearance of others, for example haemophilia and allergies, may be induced; while still others are continuously observable but are of minor significance. Among these may be listed dental and digital peculiarities, the occasional occurrence of "tails", partial or complete albinism, and irregularities of the ears, eyes, and hair. Finally, there are abnormalities which profoundly affect the anatomy and which are either definitely or tentatively attributed to physiological maladjustments. These include disturbances of the primary and secondary sex characters, giantism and dwarfism in its various manifestations, and many other gross abnormalities in which the entire organism undergoes continued or intermittent change.

The number of such abnormalities now totals several hundred but they are concerned with a relatively small proportion of any population and while extremely important in demonstrating the applicability of Mendelian laws to the problems of inheritance in man are otherwise of little use in dealing with inheritance in the vast majority of individuals who exhibit no such extraordinary peculiarities. To be sure, any "normal" population will individually exhibit varying degrees of metabolic and other physiological differentiation in which genetic as well as environmental factors are undoubtedly operative. The assignment of relative values to either set of factors is, however, so difficult as to render the importance of their measurement highly questionable.

It would seem more reliable to depend upon those physical characters which are affected primarily by age changes and sexual differences rather than by disturbances of a more or less pathological nature or which can be attributed even in part to environment.

These characters appear most prominently in the appendages and external organs of the head, primarily, and especially the face. They include the ears, nose, mouth, chin, and eyes in the soft parts and the bony supporting structures associated with them.

If each of these and other easily observable regions of the anatomy were to be studied in very close detail on several hundred or several thousand individuals genetically related it might be possible to determine what particular features could be determined as individual genetic variables.

Criticism of present methods lies primarily in the inadequacy of observations thus far attempted and the lack of a careful genetic approach.

RAINFALL AND COFFEE PRODUCTION IN THE KONA DISTRICT, HAWAII

By

L. A. Dean

1. There were two distinct periods of heavy rainfall and one period of markedly light precipitation during the period 1901 to 1936.
2. The dry season occurs during the winter months and these months having low means are the ones which have uncertain rainfall.
3. Much of the variability in annual coffee production may be ascribed to fluctuations in February to June rainfall occurring during the years in which the fruiting wood was produced.

AN ANALYSIS OF GROWTH AND YIELD RELATIONSHIPS OF COFFEE TREES (COFFEA ARABICA L.) IN THE KONA DISTRICT, HAWAII

By

J. H. Beaumont

This study of the yield and growth measurements of two groups of coffee trees—the Akamatsu trees which are 7 years of age and relatively low in vigor and production, and the Fukuda trees which are 13 years of age and high in vigor and production—shows that, with minor exceptions, the same relationships exist in both groups. Thus it may be concluded:

1. That certain growth responses of the tree are largely dependent upon or conditioned by the size or volume of the developing crop.
2. That the volume of the crop is largely determined by the growth made in the preceding growing and crop season.
3. That a dominant weather factor, such as spring rains, may disturb these relationships as Dean (4) shows but the tree will resume its normal,

overlapping, 2-year growth-and-bearing cycle in succeeding average years.

4. That by judicious pruning and fertilization—the first of which would tend to reduce the current or immediate year's crop and both of which would tend to increase the production of vigorous fruiting wood—and perhaps by other cultural practices, such as mulching which would tend to conserve moisture, the extreme fluctuations in annual yields may be reduced and the average yield as well as the general size and vigor of the tree may be considerably increased.

A LIST OF MOSSES AND VASCULAR PLANTS COLLECTED ON MAUNA KEA, AUGUST 1935

By

MARIE C. NEAL

Plants collected August 6-20, 1935, by the Mauna Kea Expedition, which was under the auspices of the Hawaiian Academy of Science, include bacteria, algae, fungi, lichens, mosses, liverworts, ferns, and spermatophytes. The altitudinal range covered from 5,800 feet to the summit of Mauna Kea, at 13,784 feet, chiefly parts of the alpine and subalpine zones on the southern and southeastern slopes of the mountain. The mosses, ferns, and spermatophytes total 146 species and varieties. Other groups have not been studied. The altitudinal range of many species was found to be greater than previously recorded. The mosses include 36 species and varieties (23 endemic, 9 cosmopolitan, 3 from Asia and islands of the Pacific, 1 from Europe) ; 3 species of mosses are new. The ferns include 20 species (10 endemic, 6 widespread, 2 from Asia or Fiji, 2 from America). The spermatophytes include 90 species and varieties (46 endemic, 9 widespread, 7 from Australia and islands of the Pacific). These figures show endemism to be high in all three groups and, which was unexpected, highest in the mosses. The large number of families and genera and the small number of species in each genus are also to be noted in an analysis of the plants. Aside from lichens found on rocks at the very summit, the highest plant, a cosmopolitan fern, *Asplenium adiantum nigrum,* was collected at an altitude of 13,500 feet on the Summit Cone. The same species of fern was also observed at many lower altitudes.

LIFE CYCLE AND CONTROL OF PARASITES OF MAN IN HAWAII

By

JOSEPH E. ALICATA

This paper included a discussion of the following parasites of man occuring in Hawaii:

Protozoa: *Endamoeba histolytica, Plasmodium* sp. (asexual stage);
Spirochaetes: *Trepanema pallidum, Leptospira icterohaemorrhagiae;*
Nematoda: *Ascaris lumbricoides, Trichuris trichiura, Necator americanus, Strongyloides stercoralis, Enterobius vermicularis, Trichinella spiralis;*
Cestoda: *Hymenolepis nana, Taenia saginata;*
Trematoda: *Fasciola gigantica, Stellantchasmus falcatus.*

(The paper was illustrated with charts.)

PROTECTION FOR HAWAIIAN BIRDS

By

GEORGE C. MUNRO

This year the subject of protection for Hawaiian birds is amplified and cogent reasons given for such protection.

Despite publicity and appeals last year and this, showing the necessity for protection, our vanishing shore and migratory birds are on next year's open shooting list. This is due to the fact that influential persons who desire to hold shooting privileges oppose protection and the fact that the public is apathetic. Our backwardness in adequate bird protection and wastefulness in shooting the plover is evident.

Dr. R. C. L. Perkins may be quoted from Fauna Hawaiiensis (vol. 1, pt. IV, "Vertebrata" under "Aves", p. 449, 1903) to show the value of the plover and the folly of shooting it. Dr. Arthur A. Allen may be quoted from the "Book of Birds" (Nat. Geogr. Soc., 1937) to show by present day interpretation that the plover should not be a game bird.

Sugar planters are going to expense to combat the army worm and neglecting the plover which costs nothing as a means of combating the worm.

Landowners whose efforts to protect the plover have failed, will stop all shooting on their lands. A strong appeal is made to the public—naming sections, societies, and groups—to bring pressure to bear on the Fish and Game Commission to have shooting of shore and migratory birds suspended pending legislation to give them permanent protection and sanctuary. Failure to have these birds protected can be blamed only on our neglect. We cannot blame the sportsmen or the Board of Agriculture and Forestry. It will reflect on us if the protection of Hawaii's migratory birds has to be taken up by the Federal Government.

THE EVOLUTION OF SOCIAL LEGISLATION IN MODERN DEMOCRACIES

By

BRYCE M. STEWART

Democracy has achieved a relatively high degree of freedom in expression, politics, religion and personal morality, but these liberties are conditioned by slow evolution of economic independence.

A conscious attack on this problem has been proceeding for more than a century, as is evidenced by a growing body of social legislation. Progress in the United States has been slow for stated reasons, and the present plethora of social legislation is in part a reaction to this condition.

Among the principal motivating factors is the political and economic inevitability of higher individual real incomes as population shifts from agriculture to industry, as its rate of growth declines, as mass production requires mass consumption, and depressions give rise to social discontent.

The term social legislation is restricted to labor legislation, and five classes of laws concerned with the following subjects are considered: (1) trade unions and collective bargaining; (2) working conditions and protection of wages; (3) organization of the labor market; (4) industrial and social hazards; (5) agencies for administration of labor laws.

The evolutionary pattern of each group is traced, and a tendency toward centralization in the national government is indicated. Finally, labor legislation moves into the international sphere; witness the work of the International Labor Organization.

The sporadic growth should be replaced by planned orderly progress, gauged to industry's capacity to assume the burden, with which no doubt wage earners would rest content. The alternative is violent change that will shake the social foundations.

Is the task within the powers of political and industrial leaders? Keynes finds substantial progress since the sixteenth century and asserts that, assuming no important wars and no important increase in population, the economic problem may be solved within a hundred years.

The progressive realization of higher standards in industrial relations as expressed in the policies and practices of individual employers and in labor legislation is vital to the survival of democracy and its flowering in the freedom of the human spirit.

SUGAR CANE SYRUP AS A SOURCE OF MINERALS IN INFANT FEEDING

By

CHARLES L. WILBAR, JR.

Calcium, phosphorus, iodine, and iron are the minerals most apt to be ingested in insufficient quantities by an infant. The intake of iodine is not a problem in Hawaii, as iodine is comparatively abundant here. Milk is high in calcium and phosphorus, but after the age of seven or eight months it takes nearly a quart of milk a day to meet the calcium and phosphorus requirements.

Iron is the mineral most apt to be insufficiently supplied in an infant's diet. A normal milk intake supplies only half of the infant's iron requirement. Nutritional anemia, due to an insufficient iron intake, is widespread among infants, including those on the Hawaiian sugar plantations. In 1936 a study by the Ewa Health Project on 238 babies under three years of age at Ewa and Waialua plantations showed an average hemoglobin of 62 percent. The average for children under one year of age was 59 percent.

A sugar cane syrup made from first crusher juice has been used as a carbohydrate in the infant formula for the past three years at Ewa. Analyses of this syrup show it to be a good source of calcium and a fair source of phosphorus. Other body minerals are present in liberal amounts. The important thing about the syrup is that it has a high iron content, containing about two to three milligrams of iron per 100 grams of syrup. All of this iron is in solution and in the ferrous state and should be available to the body.

The addition of sugar cane syrup to an infant's formula theoretically supplies enough iron to prevent nutritional anemia. This was substantiated clinically at Ewa by an average rise in hemoglobin of 20 percent among children under three years old during a two year period in which they were given cane syrup. A control group of children at Waialua, who received no cane syrup, still showed a marked anemia in 1938 (57 percent hemoglobin).

The sugar cane syrup is approximately 50 percent glucose, 25 percent dextrose and 25 percent levulose. It has been well digested by infants at Ewa, where practically every infant receives it.

THE RELATION OF DIET TO PARASITIC INFECTION

By

J. E. ALICATA

In recent years nutritionists have demonstrated that a diet deficient in any of the essentials (amino-acids, fatty acids, vitamins, and minerals) reduces the general vitality of the individual and breaks down the natural or acquired resistance to infections. Parasitological studies have indicated that a proper diet decreases susceptibility to parasitic infections so that fewer parasites become established in the body of the host, and, in some instances, that those parasites which do become established are retarded in growth.

Studies on parasites of poultry by J. E. Ackert and his collaborators over a period of several years have shown that deficiency of vitamin A and, to some extent, of vitamin B lowered the resistance of chickens to roundworms (*Ascaridia galli*), so that more and larger worms were present in chickens on the deficient diet. In later work it was demonstrated that the type of amino-acid resulting from digestion in the host might influence the course of infection: the inclusion of animal protein supplements (liquid skim milk and meat meal) in a cereal ration increased the growth ratio and resistance of chickens to parasitism, whereas the inclusion of a plant protein supplement (peanut meal) in a cereal ration resulted in slower growth and greater susceptibility to infection. These results were attributed in part to the wider range of amino-acids made available in the diets containing animal protein as contrasted with the restricted range of amino-acids in the plant diet.

My recent studies confirm the above findings. Birds on a cereal diet plus animal-protein supplements develop fewer parasites than those on the same basal diet plus plant-protein supplements. Tests were conducted on the resistance of the birds to nematodes (*Ascaridia galli*) and also to tapeworm (*Hymenolepsis exigua*) infection. The results are indicated in the following tables.

Table 1.—Relation of diet to nematode (*Ascaridia galli*) infection in poultry. All birds (chicks) were fed about 1,000 infective eggs at the age of 1 month and were killed about 1 month later.

Ration		Number of birds used	Total parasites recovered	Average number of parasites per bird		Age and average weight of birds when killed Age	Weight
Basal	Supplement			Mature	Immature	Weeks	Grams
Cereal	None	30	1,482	44.40	4.93	9.5	244
Cereal	Fish meal	30	309	0.30	30.00	9.5	699
Cereal-mineral	Dried skim milk	25	424	0.32	16.60	9.5	498
Cereal	Soybean; sesame meal	35	587	12.70	3.70	10.3	762
Cereal	Fish meal; dry skim milk	35	146	2.10	2.00	10.3	900

Table 2.—Relation of diet to tapeworm (*Hymenolepis exigua*) infection in poultry. All birds (chicks) fed 100 infective tapeworm larvae (cysticercoid) at the age of 3 weeks, and were killed 3 weeks later.

Ration		Number of birds used	Total parasites recovered	Average number of parasites per bird	Weight of birds when killed Grams
Basal	Supplement				
Cereal	Fish meal; dried skim milk	25	353	14.12	465
Cereal	Yeast; sesame peanut, soy-bean meal	25	1,640	65.6	337

A SURVEY OF HEMOGLOBIN AND BLOOD CELL LEVELS OF PRE-SCHOOL CHILDREN

By

CHRISTOPHER J. HAMRE AND KAMEHAMEHA WONG

The present study[1] was undertaken as a part of an extensive survey of blood values for normal human subjects residing in the Hawaiian islands. Since there are age differences for blood values, the results of the present study are characteristic only for children of the pre-school age. One hundred and seventy-eight children, 90 boys and 88 girls, of different races attending Castle Kindergarten and ranging in age from three to six years were examined for their blood values for hemoglobin, red blood cells, leucocytes, platelets, volume of packed red blood cells and differential leucocyte counts. The values for the corpuscular constants, mean corpuscular volume, mean corpuscular hemoglobin content and mean corpuscular hemoglobin concentrations were calculated from the values obtained for hemoglobin, red blood cells, and volume of packed cells. The extensive data so collected were submitted to statistical analysis wherever possible. The observations and conclusions derived from this study may be summarized as follows:

1. Racial differences did not occur for any of the blood values studied.
2. Age differences for the blood values of this group did not occur.
3. Sex differences for the blood values did not occur.
4. Infestations with pinworms did not influence blood values.

[1] Aided by grants from the Hawaiian Academy of Science and the Honolulu County Medical Association.

5. Significant differences for the blood picture of children above or below normal weight did not occur.
6. Social and economic status of the parents of this group of children was not reflected in the blood values for these children.
7. The mean values for the various blood elements for this group agree closely with those given for children of this age of other geographic localities.
8. The mean values for the hematological elements of this group are as follows:
   Hemoglobin, 13.6 ($\pm$ 0.090) grams per 100 c.c. blood.
   Erythrocytes, 4,810,000 ($\pm 0.03 \times 10^6$) per cu. mm. blood.
   Leucocytes, 7,900 ($\pm 0.152 \times 10^3$) per cu. mm. blood.
   Platelets, 295,000 ($\pm 0.759 \times 10^4$) per cu. mm. blood.
   Volume of packed red blood cells, 40.5 ($\pm$ 0.347) percent.
   Mean corpuscular volume, 84.7 ($\pm$ 0.720) cubic micra.
   Mean corpscular hemoglobin, 28.5 ($\pm$ 0.231) micromicrograms.
   Mean corpuscular hemoglobin concentration, 33.8 ($\pm$ 0.271) percent.

   Differential leucocyte count:

Polymorphonuclear leucocytes,	38.2 ($\pm$ 0.683) percent.
Eosinophile leucocytes,	4.9 ($\pm$ 0.255) percent.
Basophile leucocytes,	0.3 ($\pm$ 0.028) percent.
Lymphocytes,	48.4 ($\pm$ 0.777) percent.
Monocytes,	4.5 ($\pm$ 0.131) percent.
"Stab" Cells,	3.7 ($\pm$ 0.321) percent.

TEN YEAR STUDY ON TOOTH DECAY AMONG CHILDREN IN HAWAII

By

Nils P. Larsen, George Pritchard, Charles L. Wilbar, Jr.,
A. L. Y. Ward

Review of many theories regarding the relationship of the factors "per se" in diet and tooth decay. The authors, after summarizing the literature and their own ten year observation, lean toward Bodecker's recently expressed view that there may be a group of variables of which a number of different combinations can produce caries. For correction, therefore, the defect or deficiency of the diet or environment of the place in question should be analyzed and corrections of whatever element or elements that might be missing or decreased, should be made.

A study of the children on one plantation made in 1939 after ten years of diet education, shows that 50 percent fewer teeth are decayed than ten years ago, that the size of the lesion present is very much smaller, and that rampant decay which was common ten years ago has become a rarity. A very careful family diet study was then conducted. It showed that in the "good" diet families only 19 percent of 2,258 teeth showed decay; in the "fair" diet families 27.5 percent of 3,008 teeth showed decay; and in the "poor" diet families 47 percent of 626 teeth showed decay. These diets were analyzed in relation to the amount of fruits, vegetables, and milk to cereals, and called "good" or "poor", depending on the amount of protective foods consumed. To quote from Bodecker,

> The evidence is clearcut that dental decay is related to diet. The accumulating evidence also suggests that there is not a factor "per se" but that dental decay is the end result of various combinations of factors, several different sets of which may bring on the same end result—tooth decay.

POLYNESIAN NATURAL HISTORY CATALOGS AT BISHOP MUSEUM

By

E. H. BRYAN, JR.

As aids to taxonomic research on the plant and animal life of the oceanic Pacific region (Polynesia, Micronesia, and Melanesia) check lists with bibliographic references are available at Bernice P. Bishop Museum as follows:

Botany: A set of the bibliographic slips giving reference to species, compiled by E. D. Merrill in the course of preparing his Polynesian botanical bibliography (B. P. Bishop Mus., Bull. 144, 1937). A card catalog of all specimens in the Museum's herbarium. A card catalog of Hawaiian names of plants with their scientific equivalents.

Entomology: A card catalog of insects recorded from the whole area, one set arranged alphabetically by genus and species, a duplicate set arranged systematically by insect groups, and the same data arranged systematically by Pacific island groups. Check lists of 16 insect groups have been revised by specialists and published by the Museum.

Malacology: A card catalog of the land shells of Polynesia, Micronesia, Fiji, and the New Hebrides, giving bibliographic references, synonymy, geographical distribution, and notes concerning type specimens where these have been studied.

Ichthyology: Fishes of Oceania and its two supplements, by Henry W. Fowler, have been published (B. P. Bishop Mus., Mems. 10, 1928; 11 (5, 6), 1931, 1935).

Ornithology: A manuscript check list, with bibliography and distribution, of the birds recorded from the whole region.

Other zoology: A partial card catalog of bats, and the commencement of a manuscript list of land reptiles.

Ethnology: A file of photographs of important Polynesian specimens in other collections, together with notes regarding these, is being assembled.

The cooperation of persons working on any phase of natural history in the oceanic Pacific is sought.

PSYCHOPATHOLOGY IN HAWAII

By

EDWIN E. MCNIEL

Psychopathology is concerned with unusual thinking and feeling processes. In this paper an attempt is made to discuss psychopathology as the author has found it in the Territory of Hawaii.

The unusual geographical situation and subtropical setting of Hawaii have contributed to a series of conflicts which many newcomers and some old timers experience. The pioneering situation of the islands has enticed residents who may have been dissatisfied in their previous locale or who enjoy pioneering. The author feels that many of the so-called "bugaboos of the tropics" are overestimated and that many of the difficulties are primarily based on suggestion.

While Hawaiian folklore and religious practices have given much to the culture of the islands, they also have contributed a good deal to the psychopathological patterns found in mental patients, even formed a basis for strong suggestion, and occasionally have added to the emotional discomfort of some island residents.

Many of the interesting psychopathological problems in Hawaii arise on the basis of the various racial groups. Inter-racial marriages occasionally evidence some instability in one of the marital partners, and they may add to some of the emotional insecurity in the children. In the second and third generation of Japanese children in Hawaii we see a breaking up of old Japanese family customs and patterns. There is a tendency on the part of the children to emancipate themselves from parental authority. While some of these trends are in a healthy direction, others contribute to psychopathology and the development of definite emotional and mental disabilities.

From the standpoint of the sex life in the general community, probably the most unhealthy condition that exists is the large number of unmarried males in comparison with the small number of unmarried females.

GEOLOGIC HISTORY OF THE ISLAND OF KAHOOLAWE, HAWAII[2]

By

HAROLD T. STEARNS

Kahoolawe Island is an eroded volcano 1,491 feet high 94 miles southeast of Honolulu. The important stages in the geologic history follow.

LATE TERTIARY (?) AND EARLY PLEISTOCENE (?) TIME

1. Building of a shield-shaped volcano consisting of basalt flows and a few thin beds of vitric tuff about 1,500 feet high in relation to present sea level over rifts trending east, north, and southwest. Typical olivine, olivine-feldspar, and olivine-free basalts of the Kilauean type were poured out as thin pahoehoe and aa flows chiefly from the southwest rift.

2. A caldera about 3 miles in diameter and more than 800 feet deep formed by collapse at the summit. The southwest rift likewise collapsed, forming a graben about 1 mile wide bounded by échelon fault scarps. Outpouring of lava continued during this stage.

3. Progressive decrease in the rate of collapse with the result that lavas pouring out from the central crater and from the rifts finally buried completely the caldera and the southwest rift-zone graben. These lavas gradually differentiated into a slightly more silicious type containing olivine and pyroxene phenocrysts.

4. Cessation of volcanism, followed by a long period of weathering and erosion. A drainage pattern was established but erosion proceeded slowly because the island is sheltered by Maui from prevailing winds and has a relatively light rainfall. Cliffs formed along the east and south shores, which are exposed to strong wave action.

PLEISTOCENE TIME

5. Submergence of an unknown but large amount, drowning the mouths of the valleys and causing their floors to be alluviated. It culminated at a shore line at least 800 feet above present sea level, as is shown by the stripping of the soil from slopes below that level.

6. Gradual emergence of at least 800 feet. It is likely that during this time the island was subjected to a complicated series of submergence and emergence similar to those on the islands of Maui and Lanai, but here no marine deposits record these changes. Waves cut into the east side of the lava-filled caldera.

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[2] Published by permission of the Director, Geological Survey, United States Department of the Interior.

Recent Time

7. Five eruptions on the face of the cliff in Kanapou Bay, mostly along ancient faults of the old caldera. In places the cinders and thin sheets of lava rest upon gravel and talus. One of these eruptions was unique in that pumice was intruded into gravel. The eruptions were probably concurrent with the Recent eruptions on Haleakala.

8. Live stock introduced about 150 years ago destroyed the vegetation, so that the wind has stripped off practically all the soil down to bedrock over the entire summit of the island. Loess is still being deposited on the west slope of the island.

THE RESISTANCE OF WOODS TO THE ACTION OF TEREDO

By

C. H. Edmondson

In the course of my work on the shipworms of Hawaii, six stations have been established about Oahu—one in Hanauma Bay, one on Waikiki reef, one in the Ala Wai Canal, one in Pearl Harbor, and two in Kaneohe Bay. Seven species of shipworms have been recognized: *Teredo bartschi,* prevailing in Kaneohe Bay and in Pearl Harbor; *T. affinis,* in Hanauma Bay, on Waikiki reef, in Ala Wai Canal, and also observed in Kaneohe Bay; *T. parksi,* widely distributed about the island; *T. diegensis,* occasionally seen at several stations; *T. trulliformis,* seen but once, in Ala Wai Canal; *T. gregoryi,* observed in Kaneohe Bay and on Waikiki reef, and an undetermined species of *Bankia* frequently seen on Waikiki reef. The two most destructive shipworms at the stations under observation are *T. bartschi* and *T. affinis.*

Test blocks of more than 20 woods were employed and their resistance to *Teredo* noted. Results separate the woods into two groups; first, those offering little resistance to the shipworm and second, those offering a fair degree of resistance. In the first group are fir, cedar, maple, koa, kou, milo, guava, monkeypod, mokihana, silk oak, red lauan and white lauan. In the second group are redwood, kamani, ohia, eucalyptus, kauila, hau, ulei, primavera, Wolmanized wood, and Masonite composition.

Woods of the first group are usually heavily attacked in 60 to 90 days. Four of the second group, kauila, hau, ulei, and primavera have shown a high degree of resistance.

Narrow copper bands placed one half inch apart are very effective in stopping *Teredo,* for periods of a few months. Zinc bands placed in a similar manner possess no such merit. Antifouling paints repel *Teredo* in highly infested waters for periods of at least 8 months.

An untreated fir pile employed in construction at Midway Island by the United States Army was heavily infested in 9 months by *Teredo diegensis* and was also attacked by a large form, probably *Teredo gregoryi* Bartsch.

HAWAIIAN ADZ MATERIALS IN THE HALEAKALA SECTION OF HAWAII NATIONAL PARK

By

Howard A. Powers
(Acting District Ranger)

The quarries and workshops of Hawaiian adz makers found on Haleakala are located along a small section of the northwest rim of the crater-rift between the old Rest House and Kilohana. The quarries are all on the inner cliff slope of the rim which exposes the numerous flows of lava which make up the upper part of the volcano. The workshops are more numerous and more scattered—some are on the inner slope near the quarries, others are on the outer slope of the volcano located in or near sheltered spots or caves which offered some protection from the elements.

The rock used for adz-making is compact, fine-grained lava which chips very readily under a sharp blow. It is very brittle, and many partly-shaped adz blanks are found discarded because they broke in the wrong place. In contrast, the stones used for hammers in shaping the adzes are always of tough, porous rock which shatters less readily. Most of the hammer stones were carried in by the workmen; some from deposits of stream gravel lower on the mountain; and some even from the sea beaches, as many of the hammers show remnants of the smooth rounded surface typical only of wave-rounded cobble stones.

Microscopic study of thin sections of the adz rocks shows that all of the Haleakala material is from the same lava formation, an unusual rock which contains mica. This material is easily distinguished from the rock of the Mauna Kea adz quarries.

A NEW DISEASE OF PAPAYA

By

G. K. Parris

A disease of papaya (*Carica papaya*) new to the Territory of Hawaii was first seen in July 1937. It apparently is confined to Oahu and has caused losses of 6 to 30 percent at Lualualei, Waialua, and Poamoho.

Affected plants are badly stunted, and the foliage is yellowed with leaves crinkled and distorted. There is little necrosis except of the edges of very young leaves and of the interveinal regions of older leaves. The petioles of diseased leaves are characteristically bent downward at the point of attachment, whereas healthy leaves are borne on petioles which leave the stem at an angle at or above the horizontal. Usually only the upper two thirds of a tree shows symptoms. Diseased leaves abscise rapidly, and finally only a few small distorted leaves remain at the top of the plant; leaves formed prior to symptom development persist as a fringe around the lower third of the plant. In severe infections the plant may die.

On the petioles and main trunk of a diseased tree are linear, darker green than normal, slightly raised, hydrotic-like streaks. Streaks are 1/8 to 1 inch long by 1/32 to 3/8 inch wide. Streaking may or may not proceed other symptoms.

Fruits formed on diseased trees are distorted and occasionally "bleed" profusely; their taste is insipid and undesirable.

Juice inoculations from diseased plants to healthy plants, using carborundum as an abrasive, have given better than 75 percent transmission. The disease would, therefore, appear to be of the nature of a virus, though in some respects the disease does not show the reactions expected of a virus. When a diseased plant is decapitated, or when death of the growing point occurs naturally, new growth develops from lower portions of the stem. This new growth (one to eight shoots per tree) has in almost all instances remained healthy. The virus cannot be obtained from these symptomless shoots.

SOME EFFECTS OF COLCHICINE ON SUGAR CANE

By

D. M. Weller

A new method of inducing polypoidy in plants, now successfully used with many varieties, promises to become a useful tool in the hands of the geneticist. This method consists of the simple expedient of applying the alkaloid drug colchicine[3] to growing points, buds, ends of stumps of cut-off branches or shoots, or to seeds of plants under treatment with the result that plants developing after such treatment may be vegetatively larger in size and more vigorous than the parent plants, just as are (and for the same reason) polypoid hybrids produced by Mendelian crossing. Flowers (and fruit) of such plants may be larger than normal and, in addition to the normal pollen grains, produce others of considerably larger size. Increase in size of pollen grains and of stomata may be taken as indications of an increase in the number of chromosomes in the nuclei of such plants, which may be used to advantage in crosses with other plants by the usual Mendelian method. Also colchicine may induce fertility in sterile hybrids produced by the classical method. Plants produced by this non-Mendelian method of plant breeding may be propagated by cuttings, their improved characteristics and increased chromosome numbers remaining constant throughout succeeding generations.

Several thousand sugar-cane seedlings developing from colchicine-treated seeds of some 50 hybrids within the genus *Saccharum* showed various effects. Below the lethal treatment, which differed for different varieties, stimulation or depression of growth resulted according to concentration of solutions and duration of treatment. Shoots developing after treatments with high concentrations were short, broad, globose, or differed little in external appearance from the normal. Cytological studies of such seedlings showed the cells of their coleoptiles and growing points to contain lobed nuclei or multi-nuclei. Division figures exhibited abnormal spindles and increased numbers of chromosomes staining more deeply than normally.

Very young buds near the growing points of stalks of mature cane developed into shoots differing vegetatively (thickness and hairiness of leaf) from the parent plant. Flowers of such shoots produced pollen grains six to eight times the size of the normal pollen grains. Such referred effects may be quite as practicable and valuable to the plant breeders as direct effects. (Illustrated with demonstration material and projected photomicrographs.)

[3] According to R. A. Gortner colchicine ($C_{22}H_{25}NO_6$) is not an alkaloid drug. It is obtained from the autumn crocus, *Colchicum autumnale* and was once used as medicine for gout.

THE CHARACTERISTICS OF RADIOACTIVE PHOSPHORUS IN SOLUTIONS AND SOILS

By

STANLEY S. BALLARD AND L. A. DEAN

Phosphate fertilizer problems are being studied by the use of "tracer" phosphorus atoms rendered radioactive by bombardment with high speed deuterons in the cyclotron of E. O. Lawrence. Since these atoms are chemically identical with ordinary phosphorus atoms, they undergo the usual reactions in soils and plant materials. However, their unusual physical property of ejecting high speed electrons allows their progress through the soil and into the plant to be followed by sensitive electrical instruments.

Preliminary experiments have dealt chiefly with the development of a technique for measuring with a Lauritsen electroscope the radioactivity of the "labelled" phosphorus when in soils, solutions, and plant material ash. With constant concentration of phosphorus and depth of material, the measured radioactivity was found to vary linearly with the free surface area of the soil or solution being tested, so long as this area was smaller than that of the electroscope chamber. With constant concentration and area but varying amount of material, the measured radioactivity did not increase for depths greater than 15 mm., due to the absorption of the electrons emanating from the lower levels. With constant dimensions but varying dilution, the measured radioactivity of solutions was linearly proportional to the concentration of radio phosphorus. The approximate average error of such measurements was 1 percent for solutions and 3 percent for soils.

A relation between phosphorus sorption and soil particle size was indicated, the phosphorus appearing to go preferentially to the smaller particles of a heterogeneous soil. The rate of sorption and the total phosphate-fixing power of a soil could be tested readily, and they were determined for several soils.

A series of 26 observations, extending over a period of six weeks, was made on the strength of a certain test sample of phosphorus. As a result, the half-life period of the radioactive phosphorus was computed to be 14.3 days. This value is in good agreement with values quoted in the literature.

This work was made possible only through the generous gift by the Radiation Laboratory of the University of California of a sample of radio phosphorus. This gift and the encouragement and cooperation of Dr. John H. Lawrence are gratefully acknowledged.

THE PROGRAM OF THE UNITED STATES SOIL CONSERVATION SERVICE

By

N. E. WINTERS

The total land area of the continental United States is about 1,903,000,000 acres. About 415,000,000 acres have been placed under cultivation for the production of crops. About 161,000,000 acres of the plowed area, or 39 percent, is suitable for cultivation under present practices. About 254,000,000 acres or 61 percent is not suitable to be continued in cultivation under present practices. It is estimated that an additional area of land suitable for cultivation under present practices could be utilized, including something over 21,000,000 acres of plowable pasture land; about 20,000,000 acres now in brush and timber; 6,500,000 acres of wet land that can be drained; 3,000,000 acres that can be irrigated; or a total of something over 50,000,000 acres, making a grand total area suitable for cultivation under present practices of nearly 212,000,000 acres.

About 18 percent of the crop land or approximately 76,000,000 acres is not suitable to continue under cultivation under prevailing economic conditions, even with the best conservation practices known.

LAND SUITABLE FOR CULTIVATION UNDER BEST SOIL CONSERVATION PRACTICES

Now in cultivation	339,079,482
Plowable pasture	52,722,676
In brush and timber	42,151,544
In need of drainage	7,663,821
In need of irrigation	5,848,729
Total	447,466,252

EROSION PROBLEM FOR THE CONTINENTAL UNITED STATES

Of the 339,079,482 acres now classified as good crop land, 178,000,000 acres, or 52 percent is eroded very seriously, while only 161,000,000 acres, or less than one half, can be continued in cultivation indefinitely under present practices without serious erosion injury.

In 1934, a nation wide erosion survey showed that 100,000,000 acres of our cultivated fields have now lost practically all of their top soil, and a large percentage of the top soil is gone from another 125,000,000 acres, or in other words, over 75 percent of the rich top soil is gone from 225,000,000 acres. Fifty-seven million acres of our cultivated fields have been practically destroyed by erosion from either wind or water or both; many of them in frequent gullies, with much of the sub-soil washed away. This does not count the 145,000,000 acres in mesas, canyons and bad lands on which man cannot do much about the problem.

In the continental United States, including cultivated land, pasture, wood lots, brush, and timber, we have a total of about 1,000,000 acres in farms, and with the installation of the best conservation practices known, we have a total of over 447,000,000 acres suitable for cultivation after retiring permanently from cultivation, the 76,000,000 acres that is absolutely unsuited for the production of cultivated crops. We have about 750,000,000 acres in all kinds of pastures and of this area 165,000,000 acres of grass lands have been devastated by erosion. The serious erosion that is now occuring on 176,000,000 acres of our cultivated areas can be controlled by practices that have been demonstrated to be economical and feasible by owners and operators.

Practical Methods of Procedure in Erosion Control

Some of the field practices that will help in the conservation of soil and water are:

1, adaptable crop rotations
2, contour farming
3, erosion resistant strip crops
4, terracing
5, protection of lands, grass lands, and crop residues from fire
6, use of cover crops for erosion control, pasture, and soil organic matter
7, improvement of our pastures by controlled grazing and other methods
8, retirement of undesirable crop land from cultivation and rededication of the same to less intensive but profitable uses
9, economic control of gullies in our fields and pastures by means of water diversion, vegetative plantings and mechanical methods
10, installation of farm ponds to provide water facilities for live stock, supplemental irrigation and other useful purposes

The Enlarged Functions of the Service

In addition to these practical methods of conserving the basic soil and water resources, the Department of Agriculture has placed upon the Soil Conservation Service the responsibility for the improvement of physical land use programs to involve the participation in the operation of agricultural lands, including not only erosion control, but also the following: Sub-marginal land purchases and the development of the same, formerly administered by the Bureau of Agricultural Economics, under Title 3 of the Bankhead-Jones

Farm Tenancy Act of 1937; the agricultural phase of flood control under the Flood Control Act of 1936, to plan and carry out further protection measures with a view to reducing hazards of flood to human life and property, and damage to stream channels, reservoirs, harbors and ditches by deposits of eroded material. Also under the Water Facilities Act of 1937, assistance is given to farmers and ranchers in the improvement and development of farm and range and water supplies in the arid and semi-arid areas, with a view to promoting the better use of land and advancing human welfare (for the present, this program is limited to 17 western States); the farm forestry program of the Cooperative Farm Forestry Act of 1937, in which it is our duty to further the program of farm forestry in agriculture with a view to conserving soil and water resources, improving farm income and aiding in the establishment of sound and economical land-use methods; drainage and irrigation, under the Agricultural Appropriations Act of 1932, and subsequent appropriation acts, formerly administered by the Bureau of Agricultural Engineering. In this phase of the program, the objective is to develop efficient and economical methods of draining and irrigating agricultural lands with a view to promoting better land use.

The basic problem of the Soil Conservation Service is to aid in bringing about better physical adjustments in land use with a view to bettering human welfare, conserving natural resources, establishing a permanent and balanced agriculture, and reducing the hazards of flood and siltation. While the program covers several lines of action, they all have a common ultimate goal of better land use, better life for the people living on the land, and the protection of public welfare through the conservation of our soil, the control of rainfall, flood control, and prevention of the destruction of expensive reservoirs and navigable streams through siltation and sedimentation.

(The above lecture was illustrated by lantern slides showing actual erosion conditions and methods of control.)

NECROLOGY

Reverend William D. Westervelt, author of historical papers and leader in the civic life of Honolulu, died March 9, 1939, at the age of 89.

He was born in Oberlin, Ohio, December 26, 1849; studied for the ministry, and was graduated from Oberlin College, B.A. 1871, B.D. 1874.

He was the pastor of churches in Cleveland, Ohio, Morristown, N. Y., Denver, Colorado, and Chicago, Illinois. He came to Hawaii in 1889 to devote two years to missionary work, and returned ten years later to make the islands his home.

In addition to taking an active interest in civic welfare in Hawaii, he devoted much time to historical research, and was the author of several books and numerous articles on the history and legends of Hawaii. He was one of the world's great stamp collectors. During the World War he engaged in draft and relief work.

He was a member of numerous scientific, historical, civic, and fraternal organizations, in all of which he took an active part. He held charter membership in the Hawaiian Academy of Science.

Bruce Cartwright, Jr., Honolulu business executive, whose avocations included Polynesian history and ethnology, died in Honolulu, March 11, 1939.

He was born in Honolulu, January 22, 1882, the third generation of Cartwrights prominent in the business life of Hawaii. His grandfather, Alexander Joy Cartwright, came to Hawaii from Nantucket, by way of California, during the period of the gold rush; he became a close friend of royalty, built up a business, and helped to found many public institutions.

Bruce Cartwright was educated at Punahou and military academies in California, and received the degree of Ph.B. from Sheffield Scientific School, Yale University, in 1905.

His work in Honolulu included engineering activities for the U. S. Navy at Pearl Harbor, and estate and insurance business. During the World War he served as a captain in the motor transport corps, U. S. Army; and later he held reserve commissions in both the army and navy.

Mr. Cartwright had many interests and devoted much time to civic enterprise. He was a commissioner of the Hawaii Board of Agriculture and Forestry, a trustee of the Library of Hawaii and the Queen Emma Estate, Associate in Ethnology with Bernice P. Bishop Museum, a leader in the Hawaiian Historical Society and Hawaii Volcano Research Association, and a member of many civic and fraternal organizations. He was an authority on postage stamps and coins, was a member of scientific expeditions to the main and outlying Hawaiian islands and Samoa, and wrote several papers on scientific subjects.

Charles Sheldon Judd, for many years chief forester of the Territory, died June 29, 1939, at the age of 58. Born in Honolulu on July 11, 1881, he was the grandson of Dr. G. P. Judd, one of the first American physicians in Hawaii, a noted statesman of the old monarchy.

After graduating from Punahou Mr. Judd attended Yale University, taking his Bachelor of Arts degree in 1905 and becoming Master of Forestry in 1907. After four years in the United States forest service, principally in Washington and Oregon, in which he rose to the position of assistant district forester, he returned to Honolulu to become land commissioner for the territory. In January 1915 he was appointed territorial forester, the position he held until his death.

In addition to his governmental duties, Mr. Judd taught forestry at the University of Hawaii, and wrote extensively on Hawaiian forestry and forest problems. He was a member of the Bishop Museum expeditions to the Hawaiian Islands Bird Reservation in 1923, and was a member of the Academy of Science since the year of its organization.

David LeRoy Topping, a charter member of the Hawaiian Academy of Science, was born in the village of North Harpersfield, N. Y., on November 2, 1861, and died in Honolulu on July 29, 1939. A life long natural history enthusiast, he was particularly devoted to hiking and botany and had collected extensively in various parts of the world. He specialized in ferns and fern allies but by no means limited his collecting to these groups, as is evidenced by his varied contributions to many scientific institutions. He came to Hawaii to live in 1922 after twenty years of Government service in the Philippines, and most of his work was done in these two regions. Other places where he made noteworthy collections were the environs of Washington, D.C., upper New York State, North Borneo, Siberia, Japan, China, and India. He is survived by two brothers, both residents of New York State.

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Egler, Frank E.
Eguchi, George
Ehrhorn, E. M.
Elbert, Samuel H.
Eller, Willard H.
Ely, Charles
Emory, Kenneth P.
Engard, Charles J.
Enright, James R.
Erwin, Ada B.

Farden, Carl A.
Faus, R. B.
Feldwisch, W. F.
Fennel, E. A.
Field, Harry P.
Ford, A. H.
Foster, Z. C.
Fronk, C. E.
Fujimoto, Giichi
Fukunaga, Edward T.
Fullaway, D. T.
Furer, W. C.

Gantt, Paul A.
Giacometti, G.
Gilbert, James
Gordon, Alta
Goto, Y. B.
Gotschalk, H. C.
Gow, Paul
Gregory, H. E.

Hadden, F. C.
Hammond, W. H.
Hamre, Christopher J.
Hance, F. B.
Handy, E. S. C.
Harker, E. L.
Harne, de Maurice A.
Harry, John V.
Hartt, Constance E.
Hartung, Marguerite
Hashimoto, I.
Henke, Louis A.
Hirashima, Bert
Holdaway, F. G.
Holmes, Henry
Holmes, W. G.
Hosaka, Edward Y.
Howe, Jane G.
Hoy, Elvin A.
Hoy, Ruth
Hutchinson, A. E.

Illingworth, J. F.
Ito, Kiyoshi

Jackson, Dean C.
Jaggar, T. A., Jr.
Jensen, Jorgen P.
Johnson, Horace
Johnson, June
Jones, Winston W.
Jordan, A. E.
Joy, A. B.
Judd, Albert F.

Katsuki, I.
Keck, C. B.
Keesing, Felix
Keller, Arthur R.
Kerns, Kenneth R.
Kikuta, Kazuo
King, Norman
Koehler, Lucy J.
Krauss, Beatrice H.
Krauss, F. G.

Krauss, W. W.
Kunesh, Joseph

Lam, Margaret
Lam, Robert L.
Lamb, Alvin R.
Larrabee, L. M.
Larsen, N. P.
Lee, Richard K. C.
Lee, Robert
Lennox, Colin G.
Ley, Gaston J.
Libbey, Valentine B.
Linford, Maurice B.
Livesay, T. M.
Loomis, Chas. F.
Louis, James L.
Louis, Lucille
Love, Russell
Lyon, H. L.
Lyon, H. L., Mrs.

Manglesdorf, A. J.
Martin, Joseph P.
Mason, Arthur C.
Mau, Kong Tong
McAllep, Will R.
McBride, O. C.
McCalla, Mary D.
McGuire, Thos. R. L.
McHenry, Jack
McKay, William
McNiel, Edwin E.
McPhail, M.
McVeagh, Thomas C.
Meinecke, Joseph B.
Meinecke, William H.
Meyer, H. A.
Michener, H. D.
Millard, Robert
Miller, C. D.
Miller, Milton A.
Mitchell, Donald
Moltzau, Ralph H.
Moomaw, Ben F., Jr.
Morgan, Edward
Moss, L. C.
Munro, George C.

Nakamoto, G.
Neal, Marie C.
Nelson, Frances
Nelson, Martin
Nieman, Helen E.
Nikaido, Raymond
Nightingale, G. T.
Northwood, J. d'A.

Okimoto, Marion C.
Okubo, Shigeo
Oliveira, Juliette M.
Olson, Gustaf W.
Ostergaard, Jens

Palmer, H. S.
Parker, H. P.
Parris, G. Keith
Patton, E. K.
Payne, H.
Pemberton, C. E.
Penn, Ray E.
Phillips, L. G.
Phillips, Vance
Pinkerton, F. J.
Potgieter, Martha
Potter, Colin
Powers, Howard A.
Pritchard, George P. J.

Ripperton, J. C.
Runyan, Mabel
Ryerson, Martha S.

Sakimura, Kay
Satterthwaite, Ann Y.
Schmidt, Carl T.
Schmidt, Helen D.
Shellhorn, Katherine
Sideris, C. P.
Simmons, W. L.
Sinclair, Gregg M.
Slattery, Mabel
Smith, Leslie R.
Smith, Madorah E.
Smith, Ronald Q.
Spalding, P. E.
Spiegelberg, Carl H.
Stearns, Harold T.
St. John, Harold
Stokes, J. F. G.
Storey, W. B.
Street, Alison Watt
Suehiro, Amy
Suzuki, Francis T.
Swezey, O. H.
Takahashi, Tokue
Tam, Richard K.
Tilden, Irvin L.
Tinker, Spencer
Titcomb, Margaret
Tower, B. A.

Vaksvik, Knute N.
Van Zwaluwenburg, R. H.
Vernon, Mabel D.
Voorhees, George

Wadsworth, Harold A.
Waesche, Hugh H.
Wakabayashi, S.
Wall, Garton E.
Ward, Andrew Lee Yates
Warner, H. H.
Webster, James N. P.
Weidman, Arah
Weinrich, William
Welch, J. E.
Weller, D. M.
Welty, E.
Wentworth, Chester K.
Wentworth, Edna C.
West, R. T.
Wicke, Henry
Wilbar, Chas.
Wilder, Stuart G.
Willard, H. F.
Williams, F. X.
Williams, John N. S.
Wilson, Walter J. L.
Wingate, E. G.
Winchell, Horace
Winstedt, Ruth M.
Winter, William
Winters, Mary E.
Winters, N. E.
Withington, Paul
Work, Samuel H.

Yang, Y. C.
Yap, Francis T. C.
Yee, Phillip K. H.
Yoshida, Ruth K.
Young, H. Y.

Zimmerman, E. C.

PROCEEDINGS HAWAIIAN ACADEMY OF SCIENCE

FIFTEENTH ANNUAL MEETING
1939-1940

BERNICE P. BISHOP MUSEUM
SPECIAL PUBLICATION 35

HONOLULU, HAWAII
PUBLISHED BY THE MUSEUM
1940

HAWAIIAN ACADEMY OF SCIENCE

The Hawaiian Academy of Science was organized July 23, 1925, for "the promotion of research and the diffusion of knowledge."

The sessions of the Fifteenth Annual Meeting were held in Social Science Hall, University of Hawaii, November 16 and 17, 1939, and April 11 and 12, 1940, ending with a banquet at the Pacific Club on April 13.

OFFICERS

1939-1940

President, Harry L. Arnold
Vice-President, Cyril E. Pemberton
Secretary-Treasurer, Mabel Slattery
Councilor (2 years), Carey D. Miller
Councilor (1 year), Harry F. Clements
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Councilor (1 year), Harry L. Arnold (ex-officio)

PROGRAM OF THE FIFTEENTH ANNUAL MEETING

THURSDAY, NOVEMBER 16, 1939, 7:30 P. M.

Preliminary announcements.

Presentation of papers:

Winston W. Jones: The influence of relative humidity on the thermal death point of the papaya.

C. P. Sideris, H. Y. Young, and B. H. Krauss: Conditions favoring the accumulation of ascorbic acid in pineapple plant tissues.

Joseph E. Alicata: Life history and control of the liver fluke of cattle in Hawaii.

Martha Potgieter: Utilization of the calcium and phosphorus of taro.

Peter H. Buck: Anthropology and religion.

FRIDAY, NOVEMBER 17, 1939, 7:30 P. M.

Martin E. Nelson and Stanley S. Ballard: A spectrographic method for the determination of vitamin A in oils.

W. H. Hammond, W. Y. Young, and F. Fong: Metallurgical analysis of nickel in steel by spectrograph.

Horace Winchell: Mineralogy: Augite crystals from the Koko region, from Puu Pa, and from Haleakala.

Thomas A. Jaggar: Gases of primary volcanism.

Richard H. P. Sia: Epidemiological studies of scarlet fever and diphtheria in North China.

THURSDAY, APRIL 11, 1940, 7:30 P. M.

Harold S. Palmer: Altitude and azimuth chart for photography in Hawaii.

O. N. Allen and Ethel K. Allen: False nodulation on certain leguminous species.

Edward Y. Hosaka: A revision of the Hawaiian species of Myrsine (Suttonia, Rapanea). (By title only.)

H. A. Wadsworth: The cost of sugar as related to the irrigation interval.

Hugh H. Waesche: Tilting of the ground at Kilauea.

Stephen B. Jones: Lags and ranges of temperature in Hawaii.

FRIDAY, APRIL 12, 1940, 7:30 P. M.

J. Ripperton and E. Y. Hosaka: The ecological approach as a basis for agricultural development in Hawaii.

John W. Coulter: Land utilization in the Territory of Hawaii, 1940.

H. David Michener: Control of dormancy in seed potatoes.

George C. Munro: Decrease of Hawaiian passerine birds.

Harold T. Stearns: The occurrence of ground water in the Hawaiian islands.

SATURDAY, APRIL 13, 1940, 6:30 P. M.

Pacific Club banquet.

Constitutional order of business.

Installation of new officers.

Election of members.

Address by Dr. M. F. Haralson: Syphilis from the public health standpoint.

Adjournment.

ABSTRACTS OF PAPERS

SYPHILIS FROM THE PUBLIC HEALTH STANDPOINT

By

M. F. HARALSON

(Special Address)

Syphilis was probably introduced into Europe by Columbus' sailors. There it spread rapidly, but for 400 years mercury was the only method of treatment used, and little else was learned of its cure. Not until the twentieth century were the organism which causes the disease, the Wassermann test, and treatment by special arsenical compounds discovered.

However, the application of this knowledge and widespread interest in the prevention and control of syphilis has been slow, probably due to the fact that two decades ago the American public knew nothing about the disease.

As early as 1876, Dr. J. Marion Sims, then President of the American Medical Association, recognized the need of disseminating information to the laity as well as the medical profession, and urged that syphilis be dealt with in the same manner as other communicable diseases; but it was not until 1912, with the organization of the American Social Hygiene Association, that much was done about it openly. The seriousness of the problem was revealed during the World War, resulting in an appropriation by Congress in 1918, but with the curtailment of federal subsidy after the war, much of the work lapsed.

The Social Security law enacted in 1935 granted funds for research and assistance to the states. Further expansion of the venereal disease control program resulted from passage of the LaFollette-Bulwinkle Bill, authorizing appropriations increasing each year over a three-year period, up to the amount of $7,000,000 for the fiscal year ending June 30, 1941.

The necessary points in a properly organized control program are:

1. Supervision by a full-time, well-trained physician, and assistance of competent personnel.
2. Free diagnostic services.
3. Reporting of all cases to the health department.
4. Free treatment for indigents.
5. Location and treatment of sources and contacts of infection.
6. Education and cooperation of the public and medical profession.

THE INFLUENCE OF RELATIVE HUMIDITY ON THE THERMAL DEATH POINT OF PAPAYA AS INDICATED BY RESPIRATORY CURVES

By

WINSTON W. JONES

The temperature tolerance of most plant material is relatively narrow. Little metabolic activity occurs below 0 degrees C., and the thermal death point lies between 45 and 55 degrees C. for most plants. Three factors which greatly influence the thermal death point are (1) the water content of the plant material, (2) the relative humidity of the surrounding air, and (3) the length of time the high temperature is maintained. The present paper deals with relative humidity as it influences papaya fruits subjected to the vapor-heat treatment. The vapor-heat treatment, as prescribed by the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture consists in holding the temperature of the fruits at 43.3 degrees (110 degrees F.) for 8 hours during which time the air must be fully saturated with water vapor. The purpose of this treatment is to eliminate the Mediterranean fruit fly and melon fly so that Hawaiian fruits and vegetables may be safely shipped to the mainland United States.

From the experiments reported it is shown that papaya fruits are severely injured when subjected to a temperature of 43.3 degrees C. under saturated conditions for a period of 16 hours or longer. It is further shown that with a relative humidity of 60 percent, other conditions remaining the same, visible injury does not occur. The rate of carbon dioxide production reaches a higher peak after a longer period of treatment and then falls more rapidly under a condition of saturation than under a condition of 60 percent relative humidity. The factor or factors that cause injury under the saturated condition and not under the condition of lower humidity are not clear. It is thought that the lower water content of the fruit treated at low humidity, brought about by the increased rate of transpiration, is the important factor in preventing injury.

(This report has been published in full in Proc. Am. Soc. Hort. Sci. **37**: 119-124, 1939.)

CONDITIONS FAVORING THE ACCUMULATION OF ASCORBIC ACID IN PINEAPPLE PLANT TISSUES

By

C. P. Sideris, H. Y. Young, and B. H. Krauss

Studies conducted on the distribution of ascorbic acid, as determined by sodium 2, 6 dichlorobenzenone indophenol, in different sections of the stem and leaves of pineapple plants have demonstrated its presence only in the chlorophyllous sections of the leaves. The non-chlorophyllous sections contain either mere traces of ascorbic acid or none. By comparing the amounts of ascorbic acid in comparable sections of the old, mature, active, and young groups of leaves, we find that the highly differentiated and physiologically very active tissues of the leaves contain more ascorbic acid than either the less differentiated meristematic or the less active and old tissues.

The data indicate that ascorbic acid reaches its peak only in the fully expanded and mature leaves. In the old leaves, where protoplasmic vigor and activity have been considerably reduced, the amounts of ascorbic acid are appreciably lower. The titratable acidity values of the leaves due, possibly, to such organic acids as malic or citric, are greater in the highly differentiated tissues of the young than of the more advanced groups of leaves.

Pineapple fruits have considerably higher values of ascorbic acid during the flowering than the subsequent periods of growth. After the flowering period, the values drop quite appreciably but after their initial drop they remain fairly constant during the growth and maturation periods of the fruits. During the ripening period ascorbic acid values become slightly lower and with overripe fruits they are still lower.

The data suggest that ascorbic acid is produced in highly differentiated tissues possessing very great protoplasmic functional activity. In specialized tissues lacking such activity, such as the water conducting vessels or storage cells, ascorbic acid values are nil.

The data show clearly that tissues from very young fruits, although lacking complete development, contain more ascorbic acid than tissues from the meristematic regions of either the leaves or the stem. Fruit tissues have highly specialized functions very early in their development, whereas very young leaf or stem tissues lack this functional specialization.

(This complete report will be published in Jour. Biol. Chem.)

LIFE HISTORY AND CONTROL OF THE LIVER FLUKE OF CATTLE IN HAWAII

By

JOSEPH E. ALICATA

The life history of *Fasciola gigantica* resembles that of other fascioloid flukes. Eggs eliminated with the feces of cattle, in the presence of water, develop into miracidia and in about 2 weeks hatch. The miracidium bores into fresh-water snails (*Fossaria*) and during a period of 6 weeks develops into a series of stages known as sporocyst, redia, daughter redia, and cercaria. Mature cercariae leave the body of the snail and encyst on surrounding vegetation. Whenever infected vegetation is eaten by cattle, the flukes eventually reach the liver and in about 3 months reach maturity.

Fluke control depends largely on three factors, namely:

1. Treatment of infected animals: with (a) "distol", (b) kamala, or (c) hexachloroethane. The last two are still under experimentation.
2. Prevention of animals from becoming infected: by (a) fencing off swampy areas, and (b) feeding grass cut from non-swampy districts.
3. Destruction of fresh-water snails: by use of (a) drainage, (b) copper sulphate, (c) biological control.

Method 3 has received comparatively little attention. After a careful study of known predators on aquatic snails, the writer suggested the possible use of aquatic fireflies of the genus *Luciola*, common in the Orient. These insects are reported as being absolutely harmless and, according to personal communications with Y. K. Okada and Hachiro Yuasa, Japanese entomologists, the larvae are exclusively carnivorous and consume a large number of snails. The writer offered this suggestion to D. T. Fullaway, Territorial entomologist of the Board of Agriculture and Forestry, and, as a result, species of fireflies have been imported by him from Japan and the Philippines. Observations are now in progress to determine the possible establishment of these insects locally and to determine to what extent they may control the fresh-water snail carriers of liver flukes.

THE UTILIZATION OF THE CALCIUM AND PHOSPHORUS OF TARO

By

MARTHA POTGIETER

Digestion experiments with young rats and with adult women, on diets high in taro, show that the calcium and phosphorus of taro are readily digested and absorbed by the animal digestive system.

Compared, in rats, with the availability of the calcium and phosphorus of soluble inorganic salts (which are known to be readily digested and absorbed), the availability of the calcium and phosphorus in taro was found to be 80 percent.

The two human subjects were placed on a diet high in poi, in which poi furnished 80 percent of the calcium present, maintained calcium equilibrium on a daily calcium intake equal to the average daily minimum requirement of 6.4 mg. per kilogram of body weight. This shows that the calcium of poi is readily utilized by the human digestive tract and that poi, though not so rich in calcium as milk, is capable of supplying an adult's daily requirement for this mineral in a form which is readily utilized.

On the basis of these results the increased production and use of taro are being strongly urged in Hawaii today.

(This report will be published in full in Am. Dietetics Assoc. Jour.)

ANTHROPOLOGY AND RELIGION

By

PETER H. BUCK

Polynesian religion may be dealt with in three stages. Firstly, the creation of gods by man through the deification of ancestors. Secondly, the creation of man by the gods when an organized priesthood in central Polynesia institutionalized a pattern of theology. Thirdly, the death of the gods when the Polynesians accepted Christianity and renounced their own gods. Polynesian religion was so interwoven with the social structure of the people that the renouncement of the gods led to the abandonment of many customs and observances that formed an integral part of Polynesian culture. Hence, the death of the gods led to the decay of the culture with which they were associated. The Christian religion is an integral part of western civilization and its abandonment by European nations may lead to the wreck of western civilization.

A SPECTROGRAPHIC METHOD FOR THE DETERMINATION OF VITAMIN A IN OILS

By

MARTIN E. NELSON AND STANLEY S. BALLARD

A modified spectrographic method has been developed for the determination of vitamin A in oils by the measurement of the absorption of light at 3,280 angströms. The extinction coefficient, $E = \log (I_0/I)$, for a 1 percent solution (in ethyl alcohol) in a 1 cm. cell, is used as a measure of the vitamin A content of that solution. In practice, I_0 and I are the intensities of the light transmitted by 1 cm. of pure solvent and of solution, respectively. These intensities are evaluated from the measured densities of the photographic plate at the maximum of the vitamin A absorption band. The densities may be obtained from the characteristic curve of the photographic plate, in which case the plate must be calibrated. Or, since the blackening or density (D) of the exposed plate is linearly proportional to log I, within limits, the intensity ratio can be found directly from the difference (D_0—D), where D_0 and D are densities of the solvent and solution strips respectively. Using these two methods of determination, E values were calculated for the non-saponifiable fraction of the Reference Cod Liver Oil of the United States Pharmacopoeia, which is standardized to contain 3,000 International Units of vitamin A per gram. The mean values obtained were respectively 1.441 ± 0.019 (21 determinations), and 1.434 ± 0.020 (19 determinations), with standard deviations of 0.084 ± 0.013 and 0.087 ± 0.014. These means agree well with the value 1.44 reported by E. M. Hume (Nature **143**:22, 1939).

Three commercial cod liver oils were assayed by comparison with the standard United States Pharmacopoeia Reference Oil. The mean potencies obtained were 6,170, 2,600, and 1,700 International Units per gram. These oils were advertised to contain not less than 6,000, 2,000 and 1,800 International Units per gram, respectively. Absorption spectrograms were taken of extracts of the hepatopancreas of *opihi,* the Hawaiian limpet. They failed to show the vitamin A band, but showed the characteristic absorption bands of β—carotene.

METALLURGICAL ANALYSIS OF NICKEL IN STEEL BY SPECTROGRAPH

By

W. H. HAMMOND, W. Y. YOUNG, AND F. FONG

We have been working on the details of a quantitative determination of nickel in steel by arc spectroscopy, using a Hasler and Lindhurst Grating Spectroscope. No particular claim is made to originality of the method used. We worked out the details, however, so that alloy steels could be picked out from plain carbon steels with a saving in time over ordinary wet methods. The calibration curve, which we set up, was based on Bureau of Standards analyzed steels, and determined nickel in the range 0.1-2.5 percent with an accuracy, at worst, of about 10 percent. From the same spectra in which we determined nickel quantitatively, we could make a qualitative analysis for chromium, molybdenum, vanadium, and others, with an approximation of the amounts present sufficiently close to grade the steels. We hope to increase the accuracy and reproductibility of our results by substituting spark for arc technique, using apparatus designed by S. S Ballard of the University of Hawaii.

MINERALOGY: AUGITE CRYSTALS FROM THE KOKO REGION, FROM PUU PA AND FROM HALEAKALA

By

HORACE WINCHELL

Augite crystal lapilli are well known from various parts of the world, including the summit of Haleakala, Maui, Hawaiian islands. A study of crystals from several localities in the Territory seems to indicate that they should be classified in two major types, one of which comprises two subtypes.

The first major type is that of Haleakala. Its composition as determined analytically by Washington and Merwin (Am. Jour. Sci., V, 3:117-122, 1922) indicates that it contains about 70 percent diopside, 15 percent hedenbergite, 5 percent acmite, and nearly 9 percent alumina and ferric oxide. This type of material is widespread in the basaltic lavas of Hawaii, and isolated crystals of it sometimes occur as lapilli in tuff (and cinder) formations, and sometimes as phenocrysts weathered out of lava flows. Such augite crystals occur at Red Hill on the rim of Haleakala Crater, and at no less than four localities in the crater, as well as at Puu Olai, on the southwest shore of the mountain. These crystals are optically very similar to most pyroxene phenocrysts encountered in all other parts of the Hawaiian islands, associated with basaltic or near-basaltic lavas.

In addition to the Haleakala type, there is a subtype which has similar optical properties and therefore similar composition, but which displays the zoning phenomenon known as "hourglass structure." This subtype occurs as crystal lapilli in the vicinity of Koko Crater, Oahu, having weathered out of a reddish tuff bed that caps several hills in that area. These crystals with hourglass structure appear to be confined to the lavas and pyroclastics of the Honolulu series of southeastern Oahu, occurring as phenocrysts in several of the nepheline- and melilite-bearing lavas of this group as well as in more normal basalts at Koko Crater and vicinity.

The second major type of pyroxene crystal lapilli in the Territory occurs at Puu Pa, near Waimea, Hawaii, and on the Waianae-Makaha ridge in the Waianae Mountains, Oahu. Optical properties show that this material is composed mainly of diopside, with probably less than 12 percent of all other pyroxene constituents. The extinction angle of the diopsidic material is 37 degrees as compared with 45 to 51 degrees for the augitic, and the birefringence is 0.030 instead of 0.024 to 0.025. The optic axial angle is slightly smaller. Little can be said of the associations of the diopsidic crystals. Mauna Kea and the Waianae Mountains appear to be capped by considerable thicknesses of lavas containing andesine or anemousite, but Haleakala also has a capping formation of this type. It is hoped that future studies will determine the paragenetic relations of these three kinds of pyroxene in Hawaii.

GASES OF PRIMARY VOLCANISM

By

THOMAS A. JAGGAR

By arranging analyses of gaseous constituents of Hawaiian active lava in the order of each gas, guided by progress from poor to good collections, it was found that increasing amounts of H_2O, SO_3, and Cl_2 moved from good to poor. Of those that went from poor to good CO_2, SO_2, and N_2 were the leaders, and in much smaller volume H_2, CO, and S_2. Argon is in excess of its air ratio in good collections.

Conclusions were tested by curves of analyses in sequence following respectively the order of hydrogen, carbon dioxide and the inverse of water-vapor. These three constituents vary together, and in the poor collections the volcanic gases start from zero values. Summarized in a single diagram the curve shows water-vapor vanishing in excellent collections along with chlorine and sulphur trioxide, while the volcanic gases and the argon group increase to a mixture making perfect normal summation without water-vapor.

Comparing the proportions of the inflammables and the oxide gases in the interpretation of the several curves, it is obvious that the principal chemical process in volcanism is the water-gas reactions $H_2 + CO_2$, and secondary ones are exhaustion of atmospheric oxygen from air with inflammables to yield excessive nitrogen, and the reaction of SO_2 with hydrogen.

The fact that vacuum heating of plutonic rocks yields little nitrogen and sulphur, and increased hydrogen, led to comparison of volcanic gas collections of Hawaii, Iceland, Martinique, and Santorin. Analyses computed water-free show hydrogen increasing to 77 percent, and this agrees with vacuum-heating of granite. Carbon dioxide and hydrogen are the dominant gases of primary volcanism, and their reaction is non-explosive. Sulphur, owing to low volatility, is a crateral concentrate.

Curves are studied of 26 analyses of 10 gases from vacuum tubes collected 1917-1919 at flaming vents of molten lava. Absence of steam, except as non-explosive reaction product of effervescence, from solution of hydrogen and carbonic acid in magma, is a new conception. Steam-blast eruption becomes a secondary ground-water geyser effect of lava lowering.

EPIDEMIOLOGICAL STUDIES OF SCARLET FEVER AND DIPHTHERIA IN NORTH CHINA

By

RICHARD H. P. SIA

In North China, scarlet fever has been a very serious and dreaded disease. The mortality rate from this infection has been high, varying from 15 to 30 percent. Deaths were chiefly due to septic complications—evidences of the highly invasive nature of the scarlatinal streptococci. The introduction of scarlatinal antitoxin for the treatment of scarlet fever has helped in controlling the toxemic phase of the disease but has not been effective in checking the spread of the local streptococcal infection. Recently, sulfanilamide has been found to be highly effective in combating these septic processes.

In connection with the study on the epidemiology of scarlet fever, the hemolytic streptococci isolated from the nose and throat of scarlet fever patients and their contacts were serologically typed according to the method recently introduced by Griffith. In carrying out this work, many technical difficulties were encountered. We were successful in overcoming most of these difficulties. As a rule, several cultures were made from each individual case at various intervals, and almost without exception, the various cultures of streptococci from the same individual fell into the same serological type.

This study shows that scarlet fever is caused by multiple types of hemolytic streptococci; that the same type of organism is as a rule found in a family where several cases occur together, and, that as high as 82.5 percent of contacts harbor the same types of organisms as those from patients. This latter finding frequently enables one to trace the source and spread of the infection. That scarlatinal infection may manifest itself in various clinical forms is also demonstrated.

After the results were obtained through the serological typing of scarlatinal streptococci, a similar study was carried out with organisms isolated from patients suffering from diphtheria and their contacts. In studying 95 strains of virulent *C. diphtheriae* obtained from active cases of diphtheria, the organisms were found to fall into 10 serological types. The result of this study again shows that whenever two or more cases of diphtheria occurred in the same family and at about the same time, the organisms invariably fell into the same type, indicating that either one infected the other or that each contracted the infection from the same source. In some instances, the sources of infection have actually been traced to carriers harboring the same serological type of *C. diphtheriae* as those from patients.

ALTITUDE AND AZIMUTH CHART FOR PHOTOGRAPHY IN HAWAII

By

HAROLD S. PALMER

Many photographs are best taken with the sunlight from a particular direction. The chart shows the altitude, or angular height, of the sun above the horizon, and its azimuth, or degrees east or west of south, for any hour of any date. Dates from the winter to the summer solstice are given at the top and dates for the rest of the year at the bottom of the chart. Morning hours are on the left and afternoon hours on the right. Vertical date lines and horizontal hour lines form a rectangular network on which two sets of curves are superposed.

The desired altitude and azimuth are first determined. The intersection of the corresponding curves is next found. Going horizontally from this point we find the hour of the day, remembering that the sun is east of south in the morning, and west in the afternoon. As there are two dates in the year when the sun follows the same path, we have our choice of two dates which are found by going vertically up or down from the intersection.

The time shown is local apparent time. Its difference from standard time (involving the equation of time and differences in longitude) introduce maximum errors of about 5 degrees in altitude and 8 degrees in azimuth, except around noon in midsummer when errors of azimuth become excessive. Therefore, azimuths are not plotted for these times. This omission is not serious as the sun is then nearly overhead. Differences in latitude within the Territory of Hawaii introduce maximum errors of about 2 degrees in both altitude and azimuth.

The data on which the chart is based are given in U. S. Hydrographic Office Publication 201, "Simultaneous Altitudes and Azimuths of Celestial Bodies."

FALSE NODULATION ON CERTAIN LEGUMINOUS SPECIES

By

O. N. Allen and Ethel K. Allen

It is well known that ordinarily when a leguminous plant is infected with appropriate rhizobia typical nodules are formed on the root systems and as a result of the symbiosis the plant benefits from the fixation of atmospheric nitrogen. Although normal nodules show considerable variation in size and shape depending upon the plant species as well as the rhizobium concerned, they may be characterized as hypertrophied plant tissue having (a) a periphery of loosely packed cortical cells, the majority of which are devoid of prominent cellular contents; (b) an innermost region, or the bacteroid area, consisting of plant cells packed with the nitrogen-fixing bacteria; and (c) a conspicuously branched vascular system which connects the nodule with the vascular system of the root.

The present study concerns an atypical type of swelling found frequently at the bases of secondary roots and in the root axils of soybean, peanut, and sesbania plants grown under controlled greenhouse conditions. These bulbous swellings were found to encircle some roots forming a collar at the base. The name "false nodules" has been given to these structures inasmuch as they may readily be mistaken for true nodules if only casually examined. Because of their occurrence on the roots of control plants and plants treated with incompatible inocula, isolations of rhizobia were attempted for the purpose of confirming them as nodules. The failure to demonstrate rhizobia by a variety of cultural methods prompted a histological study in order to ascertain their anatomical nature. The following conclusions are warranted at this time:

1. The outgrowths termed false nodules are merely hypertrophied cortical parenchyma completely lacking in a differentiation of tissues.

2. All sections of false nodules fixed in modified Flemming's solution and stained with Heidenhain's iron-alum haematoxylin, using alkaline crystal violet as the counterstain followed by an iodine mordant, showed heavy deposits of starch grains in the innermost cells. This technique, believed to be new to stain technology, is hereby recommended in the examination of true nodule tissues because of its ability to demonstrate bacteria, infection threads, nuclear structures, and starch grains with equal clarity in the same section.

3. None of the false nodules examined showed evidence of infection, nor were bacteria demonstrated during any stage of their development.

From a practical standpoint false nodules demand a certain amount of attention since there is a possibility of their being interpreted as true nodules by agriculturists. Similarly might false nodules be the explanation of many irregularities current in cross-inoculation data. Accordingly, it is suggested that in doubtful cases such formations should be sliced with a knife; whereupon, to the unaided eye true nodules will show an inner zone (bacteroid area) of pink or grayish color in contrast to false nodules which will be totally lacking in differentiation.

A REVISION OF THE HAWAIIAN SPECIES OF MYRSINE (SUTTONIA, RAPANEA)

By

EDWARD Y. HOSAKA

The genus *Myrsine* is found in the tropical and subtropical regions with the highest development in the Malaysian area. The relationship of the species in the genus indicates a Malaysian affinity of the Hawaiian species (*kolea*).

The species in Hawaii are either trees or shrubs with variable leaves. The flowers are clustered on raised bracteate gemmules in the axils of the leaves or on naked stems below the leaves. The fruits are less than 0.25 inch across and depressed-globose or round; their color at maturity is dark purple.

The genus in Hawaii is represented by two groups of plants; those that have more or less distinct and definite characters, and those that have fluctuating characters. The least variable plants are found on Kauai, the most variable ones on Hawaii.

The variation in the habit of the species in relation to environment is rather striking. The large tree species are found in the lower forests where the rainfall is moderate and the sunshine abundant. With an increase in elevation above certain levels, especially in the rain forest, the species become smaller until under bog conditions they are dwarfed and usually have small leaves.

Willis' age and area theory, when applied to this group of plants, seems to work nicely. Some of the species have a wide distribution while others are confined to a small area. The greatest development of the genus in Hawaii is at present in the high, wet mountains of Kauai. Kauai is considered an old island, hence the fauna and flora are more highly developed than those of the other islands. There are 16 species and 1 variety found on Kauai, and of this number 13 are peculiar to the island. Oahu has the next largest total number, 8 species and 3 varieties. Molokai has 6, Maui 5, and Lanai 4 species. Hawaii, the largest but the youngest island, has only 3 species and all of them are common on the other islands.

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THE COST OF SUGAR AS RELATED TO THE IRRIGATION INTERVAL

By

H. A. Wadsworth

The water requirements of the sugar-cane plant have long been the subject of experimentation. Recent work under the authority of the Experiment Station of the Hawaiian Sugar Planters' Association demonstrated that maximum yields of cane, and presumably of sugar, would be produced if the plants were continuously kept in full vegetative vigor, insofar as this condition might be affected by irrigation manipulation. This end can be gained by irrigating at such intervals that the soil moisture never falls below the permanent wilting percentage.

Another aspect is presented if the aim of irrigating is to produce a ton of sugar for the smallest cash outlay for water and for the labor of applying that water. An experiment to test the economic values associated with irrigation has recently been completed at the Waialua Agricultural Company.

Three irrigation practices were established in a well replicated experiment.

One of these involved irrigating at such intervals that the soil moisture never fell below the permanent wilting percentage. In another, four days of soil moisture deficiency were suffered by the plants after the exhaustion of readily available soil moisture from each irrigation. In the third treatment, the period of soil moisture deficiency was increased to eight days. For convenience, the variables are called the "zero idle day," "four idle day" and "eight idle day" treatments. Results are summarized in the following table:

TREATMENT	YIELD PER ACRE		IRRIGATION COSTS PER TON OF SUGAR		NUMBER OF IRRIGATIONS
	CANE (TONS)	SUGAR (TONS)	WATER M. G.	LABOR MAN DAYS	
0—idle days	75.6±0.71	9.2±0.23	0.859	1.786	41.1
4—idle days	72.8±1.53	9.1±0.21	0.579	1.217	27.2
8—idle days	69.0±0.91	8.8±0.11	0.517	1.025	22.6

It is apparent that the manipulation of the irrigation schedule was effective in modifying the yield of cane; there are no significant differences between the yields of sugar.

Although the availability of nitrogen and the light intensities involved undoubtedly contribute to the results obtained it is thought that these factors were equally effective on all plots. The interrelation between the effects of soil moisture, available nitrogen, and environment factors in the production of sugar at the lowest possible cost, deserves further study.

The following table gives comparative cost data for a plantation operating under two different policies with regard to irrigation interval.

	Policy A	Policy C
Differential irrigation treatment, per irrigation	10.9 idle days	0.2 idle days
Total man-days per ton of sugar, for irrigating	1.03	1.79
Million gallons of water, per ton of sugar	0.52	0.86
Cost of labor per ton of sugar at $2.00 per man-day	$2.06	$3.58
Cost of water per ton of sugar at $12.00 per million gallons	$6.24	$10.32
Total cost of irrigating, dollars per ton of sugar	$8.30	$13.90
Annual crop, tons of sugar	35,000	35,000
Total irrigation cost, per year	$290,500	$486,500
Difference, in favor of Policy A	$196,000	

TILTING OF THE GROUND AT KILAUEA

By

HUGH H. WAESCHE

Tilt has been defined by T. A. Jaggar and R. H. Finch as "a change in angular relation between a portion of the earth's surface and the plumb line." It is measured by some type of horizontal pendulum such as a seismograph or by special instruments of several types known as clinoscopes. At Kilauea the Bosch-Omori seismograph located on the northeast rim of the crater is extremely sensitive to tilt and is the key station for tilt studies. Clinoscopes are located in cellars on the southeast, west, and northeast rims of Halemaumau. Daily readings are made at all of these stations.

Results of the readings are plotted on coordinate paper and values are measured in degrees of arc departure of the ground from horizontal. At the observatory, tilt has been measured for 27 years. Over this period it has been found that tilt at the northeast rim of Kilauea crater considered as the path of the top of a vertical rod describes an annual loop of from 5 to 20 seconds of rotational arc with the loop elongated in a NNE. to SSW. direction, the greater axis usually being about twice the length of the shorter one. In the course of producing the large loop, many smaller loops occur. Both progress clockwise. The series of charts here discussed are those from 1932 to 1940 inclusive. The plotted points are a smoothed curve of seven-day overlapping mean, for each day of the year. In addition is shown one chart illustrating a curve of unsmoothed daily tilt and another graph showing monthly tilt for N. to S. component and E. to W. component independently as well as an average curve plotted with these. One chart, illustrating tilt at a Halemaumau clinoscope, completes the group. Most of the Halemaumau tilt appears to have been roughly to the WNW.

Tilt and seasonal temperature change at Kilauea seem correlated: northeast tilts with colder weather in late winter and spring and southwest tilts with warmer weather in summer and fall. There appears to be no relation between tilt and rainfall. In the past there has been direct relationship between lava movement and amount and direction of tilt at the observatory. The 1932 Halemaumau inflow was preceded by increased northeast tilt and then recession to the southwest. On October 6, 1935 before the Mauna Loa northeast rift eruption, tilt at the observatory began an abnormal southeast movement continuing until the third week in November when the direction changed to northeast and then gradually receded to the northwest where on January 5, 1936 it was at its normal position to start the new annual circuit. Mauna Loa outflow began November 21, 1935 and ended January 2, 1936.

The approximate center of each annual loop migrated southwest between 1936 and 1939 inclusive. Accumulated tilt had however recovered two seconds of arc to the north at the end of 1939 over either the preceding year or 1937. In March 1940 the relative position was the same; this may be significant of volcanic change.

LAGS AND RANGES OF TEMPERATURES IN HAWAII

By

STEPHEN B. JONES

Leighly's study of the lag of seasons (The extremes of the annual temperature march with particular reference to California: Univ. Cal. Pub. Geog. **6**:191-234, 1938) shows that the effect of relatively close proximity to the sea may be nullified if topography or wind prevents ingress of maritime air to the "climatological air" in which measurements are made. The low amplitudes of Hawaiian temperature curves do not permit the use of Leighly's device for determining extremes, but the lags of the midpoints of the 120 warmest and 120 coolest days agree in a general way with his theories, cloudiness and rain being also important. Lags were determined for the 43 Hawaiian stations having temperature records of 20 or more years. Summer lags are equal to or greater than winter lags at all stations. The greatest and least summer lags (of 120-day midpoints) are 84 and 45 days. For winter, the corresponding figures are 62 and 44 days. Except for a few peculiar stations, the greatest lags are found in rainy localities on northeast (windward) coasts. The lags differ by as much as two weeks on windward and leeward coasts of a mountainous island only 600 square miles in area.

The theoretical insolation curve for 20 degrees north latitude shows a broad maximum and sharp minimum. However, most Hawaiian stations, and also the sea and air temperatures of the ocean about the islands, show curves more or less sinusoidal. Two common deviations from the sinusoid are warm Februaries, due probably to low rainfalls frequent in that month in the present century, and cool early summers, due probably to the steadiness of the trade winds then. Summer truncation due to convectional cloud cover is notable at two stations in the lee of high mountains: Kula Sanitorium on Maui, and Kealakekua in the Kona coffee belt on Hawaii. At Kealakekua (10-year record) the lags of the mean daily maxima and minima are three or four months out of phase. The curve of minima has small lags, but the curve of maxima reaches its lowest in April and its highest in November.

Annual range of temperature varies nearly 100 percent in the islands (from 4.4 to 8.5 degrees F.) and more than 50 percent on different coasts of a single small island, lee coasts usually having the larger ranges. Low annual ranges usually are accompanied by low means and low mean maxima and usually are found in windward locations of heavy rainfall. At low altitudes (400 feet and less) on rainy coasts, the lapse rate is almost isothermal.

A difference of 50 percent or more in daily range between coasts of a small island may be noted, lee slopes usually having the greater ranges. Windward stations usually have greater daily ranges in winter than summer, by three degrees or more in some cases, while leeward stations usually have greater ranges in summer than winter. Greater uniformity on all coasts is characteristic of winter, with its more variable winds. Greater contrast is found in the summer months of steady trades.

THE ECOLOGICAL APPROACH AS A BASIS FOR AGRICULTURAL DEVELOPMENT IN HAWAII

By

J. Ripperton and E. Y. Hosaka

A scheme was proposed of classifying the lands of the Territory into a series of zones, which it is believed will be useful in the further development of diversified agriculture in Hawaii. The division into zones is based on a combination of climatic factors and the natural or wild vegetation. Division into zones on the basis of existing climatic data is not satisfactory because of the lack of adequate rainfall data in many areas and the lack of information as to differences in solar radiation, wind velocity, relative humidity, etc. Full use of wild vegetation is hampered by the destruction or changing of the native flora and by the introduction of many exotic species so that it is often a matter of speculation as to what the plant association has been in any particular area or what the future one will be. A combination of the two approaches furnishes, it is believed, a fairly satisfactory division as a tentative basis until more exact information is available.

These zones have been set up primarily as a basis for classification of ranges and pastures. As a result of rather extensive field survey, a total of about 350 species existing on the range have been listed and set up in a table showing their distribution by zones and by islands, and their general habits of growth and forage value.

LAND UTILIZATION IN THE TERRITORY OF HAWAII, 1940

By

JOHN W. COULTER

In 1933 I published a research bulletin under the title, "Land Utilization in the Hawaiian Islands" (University of Hawaii Research Publication, no. 8). A demand has arisen for a second edition of the bulletin, which will be published by the Agricultural Extension Service of the University probably under the title, "Agricultural land use planning in the Territory of Hawaii." The same maps and graphs will be used as they appeared in the first edition, for there has been no change in land utilization since 1930 sufficently important to make changes on small maps. Factors of weather and climate which affect small farming and diversified agriculture in general have become more fully understood since the first bulletin was published.

Setting up a technology for farming in the tropics is difficult for people accustomed to farming in the temperate zone. Important phases of scientifically directed agriculture for the Territory lie in the field of the social sciences. An agricultural program will go hand in hand with Americanization. An important phase of the problem is that of land ownership and farm security.

The sugar industry in the islands had an experimental period of 50 years. The experimental period for the pineapple industry was shorter, for scientific resources and capital were more adequate at the time this enterprise was started. When other proper adjustments to the environment of the Territory appear they can be developed more quickly with the employment of government or private capital than did the two major crops, for we now have accessible more scientific and business knowledge.

CONTROL OF DORMANCY IN SEED POTATOES

By

H. DAVID MICHENER

Seed potatoes have a natural dormant period lasting 2 or 3 months after harvesting. This fact is of considerable importance in Hawaii, as seed is harvested in September on the mainland and is still dormant when it reaches Hawaii for fall plantings. Some method for shortening this dormant period is desirable.

Ethylene-chlorohydrin vapor (at the rate of about 0.65 gram chlorohydrin per kilogram of potato tubers) has given the best result of any treatment used so far. It causes germination of the tubers within a short time (usually 15 or

20 days) after treatment. It also causes all the seed to germinate at once, whereas individual tubers from untreated seed may differ by several weeks in their time of germination, and some of the plants are ready to harvest while others have not yet had time to form mature potatoes. This results in considerable loss in yield.

The ethylene-chlorohydrin treatment increases the yield even from seed that is beginning to germinate at the time of treatment. In an experiment with such seed, the untreated lot came up slightly later and died slightly later than the treated seed, but both groups had about the same growing period. The treated seed gave a significantly greater yield, the result of an increase in the number of tubers formed rather than of an increase in tuber size. The best treatment produced a 21 percent increase in total yield, but it is probable that larger increases can be obtained with improved methods of treatment.

The average number of stems per hill was increased by the ethylene-chlorohydrin treatment. It has been shown by other workers that an increase in the number of stems (when there are less than four stems) produces an increase in yield.

DECREASE OF HAWAIIAN PASSERINE BIRDS

By

George C. Munro

In the late eighties and early nineties there was fairly complete investigation of the Hawaiian avifauna. This showed that five species on Oahu, two on Hawaii, and one on Lanai were nearly or quite extinct. Decrease after that continued intermittently. A survey made in 1935-37 seemed to show that 21 species would possibly survive and that 31 species were doomed to extinction, and some of them already irrevocably gone. The fact that the Hawaii National Park Service in recent years has instituted research into the causes of the decrease of the Hawaiian passerine or perching birds gives hope that something may be accomplished in saving some of these birds that seemed hopelessly doomed to extinction a few years ago.

In the writer's opinion the evidence is conclusive that introduced bird diseases are mainly responsible for the reduction in numbers in some and the complete extinction of other species of the native perching birds, which are susceptible to these diseases. Investigation alone can show whether this is true and perhaps point some way to combat it. The genus *Chasiempis,* a flycatcher, the *elepaio* of the Hawaiians, is the only genus that seems immune and the three species are still thriving even at the lower levels where all the other native birds have disappeared.

Already steps are being taken at the Hawaii National Park to prevent infection being carried from poultry yards into the forest. It seems advisable to do this at human settlements at other high levels on other islands. In the high and isolated forests of several islands there are representatives of some of the interesting Hawaiian forms still existing in fair numbers where they are remote from human habitation. If they are made safe from infection they will likely spread back to places where they were numerous in the nineties and again furnish spectacular scenes such as those described by R. C. L. Perkins and other writers who saw them before they were reduced in numbers.

(This report was published in full in the Honolulu Star-Bulletin, June 8, 1940.)

THE OCCURRENCE OF GROUND WATER IN THE HAWAIIAN ISLANDS

By

HAROLD T. STEARNS

Ground water in Hawaii occurs chiefly in three ways—basal, perched, and confined. Basal water occurs as follows: (1) shallow water in the limestone, volcanics, gravel, and other permeable rocks that form the coastal plains, usually without restraining beds; and (2) water in the basalts, with or without restraining beds. It is artesian if restrained by buried soils or clays of the coastal plains. Basal water generally floats on salt water according to the Ghyben-Herzberg principle and is usually recovered by means of Maui-type wells (shaft and infiltration tunnel) or drilled wells.

Six types of structures perch water or hold it above the basal water table in a basaltic island. They are (1) sills, (2) ash or tuff beds, (3) soil, (4) alluvium, (5) ice, and (6) dense flow rock. Ash and alluvium perch the most water. It is generally recovered by tunnels contouring the surface of the perching formation.

Confined water occurs in compartments of porous lava between dikes. Such water extends to considerable depth below sea level in most places and is usually resting on impermeable intrusive rock and not floating on sea water. It is obtained by means of horizontal tunnels driven at right angles to the trend of the dikes, or by the Lanai-type well (shaft and infiltration tunnel in the dike complex). Saturated dike complexes capped by impermeable alluvium may yield small quantities of artesian water.

NECROLOGY

Dr. Royal Norton Chapman, educator and scientist, died on December 2, 1939, in Minneapolis. He was born in Morristown, Minnesota, on September 17, 1889. He received college degrees from the University of Minnesota (B.A., 1914; M.A., 1915) and Cornell University (Ph.D., 1917). As teacher and professor at Minnesota, Dr. Chapman developed a new method of experimental animal ecology, 1917-1930. In 1930 he came to Hawaii to become director of the Pineapple Experiment Station. In addition to helping to solve pineapple problems, he made splendid contributions to the development at the University of Hawaii of a Graduate School of Tropical Agriculture, to the Institute of Pacific Relations, the Y.M.C.A., and many other civic and scientific activities. In the summer of 1939 he returned to the University of Minnesota to become dean of the Graduate School. His was a life filled with many and diverse accomplishments. How regrettable that it should have been cut off upon the threshold of a new and chosen field.

Albert Francis Judd, president of the board of trustees of Bernice P. Bishop Museum, died December 18, 1939. He was born in Honolulu December 20, 1874, the eldest son of a distinguished adviser of Hawaiian royalty. He was educated at Oahu College and Yale University, B.A. 1897, and LL.B. 1900. He practiced law in Honolulu from 1899 to 1914 and occupied many public positions including that of senator to the Hawaiian Legislature, 1911 and 1913. In 1908 he became a trustee of the Bernice P. Bishop Estate and of the Bishop Museum, and devoted much of his time and energy to the welfare of the Kamehameha Schools and the work of the Museum. Several expeditions to Samoa gave him keen insight into the ethnology and natural history of that group. He was a logical choice as chairman of the committee of the Frederic Duclos Barstow Foundation, which established the Felete School on Tutuila, to help improve the educational adjustments of Samoans. A man of vision and tireless energy to accomplish what he thought was right, Mr. Judd made valuable contributions in many fields; and by kindly advice and sterling example helped many associates to valuable accomplishments.

William R. McAllep, consulting sugar technologist with the Experiment Station of the Hawaiian Sugar Planters' Association, died in Honolulu, October 21, 1939. He was born in San Francisco, September 28, 1880, and was a graduate of the University of Southern California. After working with several of the beet sugar factories of the west, he came to Hawaii in 1915 as assistant sugar technologist with the Hawaiian Sugar Planters' Association. He was appointed to head the department in 1920, and became consulting technologist in 1934. He was a member of the University of Hawaii faculty, as lecturer on sugar technology, beginning in 1919. He served as vice president and president of both the Hawaiian Chemists' Association and the Association of Hawaiian Sugar Technologists, and was a member of several American and foreign chemical societies.

Harold Francis Willard, entomologist, died in Honolulu, August 18, 1939. He was born in Neillsville, Wisconsin, February 21, 1884. After graduating from Massachusetts Agricultural College in 1911, he came to Honolulu and taught agriculture in Mills School, Mid-Pacific Institute, for about three years. He then became a homesteader at Haiku, Maui. In 1916 he began a study of fruit flies in Hawaii for the U. S. Bureau of Entomology, working with E. A. Back and C. E. Pemberton. He made valuable contributions to the knowledge of the interrelation of parasites of the fruit flies. He also worked on the parasites of the pink boll worm in Hawaii. From 1929 until the time of his death he had charge of the Hawaii field office of the United States Bureau of Entomology and Plant Quarantine. In his work as a regulatory official in the enforcement of provisions seeking to prevent the spread of insect pests to the mainland United States, he had the confidence of growers, shippers, and transportation officials. He took a large part in fraternal, religious, and civic activities.

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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

SIXTEENTH, SEVENTEENTH, AND EIGHTEENTH ANNUAL MEETINGS 1940-1943

Published by the University of Hawaii Honolulu, T. H., 1945

FOREWORD

Annual proceedings of the Hawaiian Academy of Science were published by the Bernice P. Bishop Museum during the period from 1925 to 1940. Termination of this arrangement, made necessary by increasing demands on Museum resources, was made known to the Academy Council in 1940. Temporary provision was made for placing the annual proceedings on file in several Honolulu libraries and inquiries were made in regard to possible channels of publication. The outbreak of the Pacific war came before any decision had been reached.

In the fall of 1943, a canvass of members showed that a majority desired to resume publication of the proceedings. Negotiations with the University of Hawaii followed, and an agreement was reached for publication of the present volume which covers proceedings of the Sixteenth, Seventeenth, and Eighteenth Annual Meetings. Meetings originally listed on programs as First (November 13 and 14, 1941), Second (October 15 and 16, 1942), and Final (May 6 and 7, 1943) Sessions of the Seventeenth Annual Meeting are here, by action of the Council, designated as constituting the Seventeenth and Eighteenth Annual Meetings in order to reconcile the numbering of meetings with the number of years elapsed since the date of founding. The original extension of the Seventeenth Annual Meeting was a response to war conditions.

The Academy is pleased that the present publication arrangement makes it possible to publish in full, "The Search for Truth in the Realm of Man," the address presented by Harry F. Clements upon retirement from office in 1943. The full text of C. E. Pemberton's 1941 presidential address, "The Contributions of the Entomologists to Hawaii's Welfare," appears in *Hawaiian Planters' Record,* 45 (2): 107-119 (1941).

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Secretary-Treasurer, Mabel Slattery
Councilor (2 years), Julius L. Collins
Councilor (1 year), Carey D. Miller
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THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE."

THE SEARCH for TRUTH in the REALM OF MAN

Presidential Address 1943

Harry F. Clements

From the time that man began to think at all, he attempted to evaluate himself in relation to the universe. His thoughts involved a search for truth which would give point to the living of his life. His earliest efforts resulted in the development of various forms of mysticism according to which he patterned his life. In other words, he was unable to find the essential truth in his immediate environment and searched for it in another world. For many centuries, his life was lived with the afterlife as the objective and nearly all his privations as well as good fortunes were divinely directed preparations for the next world. No one, I think, should underestimate the greatness of the force which this pattern of life exerted on him.

As man grew older, however, his thinking led to reason and logic. His concept of the hereafter changed and became more orderly as his powers of reason became more orderly. As abstract reasoning led to objective reasoning, it was inevitable that man's search for truth should become more and more associated with things of this life. Thus the brilliant Church scholar Abelard, shortly after A. D. 1100, expressed the ideas that doubt is the road to enquiry, that through enquiry the truth is perceived, and that it is necessary to understand in order to believe. The science of the western world thus had its inception in the monasteries of the Church. Roger Bacon, a Franciscan, became the link connecting the mathematics of Arabia and the scholarship of the Church, as enhanced by the logic and reason of Greece, with the science to come. Man at first used science on the material things about him, all the while excluding his spiritual self from the inquisitive, experimental methods. But science has been ruthless as well as revealing. It was inevitable that the wall of isolation with which man had excluded himself from the work of science should have begun to crumble not only because of the pressure of scientific enquiry but because of the introspective attacks of man himself. But those qualities by which he had distinguished himself from other forms of life, he discovered, were not suited to measurement and hence he was forced to one of two diverging thoughts: (1) Either the truth is that life has no point in being and that spiritual qualities do not in fact exist, or (2) that there is a fundamental immiscibility of the methods and concepts of science and the search for truth within the realm of man.

I suspect that many men have resigned themselves to the first alternative, especially in these recent years of depressions, wars, and political upheavals. But I think many more men deny it. Among these men, to be sure, are the amateurish philosophers who would have us return to the philosophy of early times. Some churchmen would have us return to the churches by shouting somewhat gleefully, I fear, that there are no atheists in fox holes. To me, neither group is making a twentieth century contribution. However, I too, think that man cannot succeed in his search for truth using the methods of science of the era known by Newtonian physics. I think this because two totally different aspects of matter and its organization are involved. In this paper I shall attempt to show (1) that the science of the eighteenth and nineteenth centuries is not applicable to the problem at hand and (2) that modern science based on a concept wholly strange to early science is well on its way toward a recognition of the spiritual qualities in man.

To accomplish my first objective, I have chosen to trace very briefly the development of science up to the time of Darwin. Prior to 1600 for about seven hundred years, man was undergoing a transition from a period dominated by Christian dogma and Greek philosophy to one which was to be dominated by experiment. Leonardo da Vinci is reported to have said, "Who cares what Aristotle thought? Let's go see it and experiment with it." Those early pioneers of science, although for the most part important members of the Church, were beginning to suspect that observation and experimentation were the only certain bases of truth, and hence they were sooner or later to be regarded as rebels not only by the Church but also by the followers of Aristotle and Plato as well. When Galileo in the sixteenth century adopted the Copernican concept of the planetary system, he encountered a great deal of opposition from both these groups. How strange it seems that what Galileo had seen through his telescope was denied by Church authorities and not until 1822—two hundred and fifty years later—was the sun, by papal decree, allowed its central place in our planetary system.

Toward the end of the seventeenth century, Isaac Newton developed what are now some of the simple experiments in high school physics. These simple observations could be expressed mathematically. They could be repeated time and again. And hence, two important things occurred. First, the standing of mathematics as providing the necessary symbolism for expressing the cause and effect relationships of science was greatly enhanced and second, the teachings of the Church and of the Greek philosophers were scheduled for a loss of prestige in the affairs of men.

Man's achievements in science through the next two hundred years you well know. He proceeded to probe into the unknown. Properties of materials yielded readily to the cause-and-effect method. The list of elements grew very rapidly. As more elements were discovered, they formed an orderly pattern. So precise were man's accomplishments in science, that predictions not only of hitherto unknown elements but even of their properties were made, to be fully realized when the elements were finally found. Until early in the last century, chemists confined themselves to what was called the inorganic world. But in 1829, Wöhler further shook the religious and Aristotelian worlds when from an inorganic compound he synthesized urea, a compound which previously had been produced only by living things. Such compounds found only in living organisms prior to this time were regarded as "vital" and beyond the realm of science. But here was an organic compound built in a test tube through the use of an inorganic compound and a little heat.

Other syntheses followed. Toward the end of the last century, Emil Fisher built sugar from coal and lime. Later he synthesized the very stuff which is always associated with life—protein. In recent years, the multitude of regulatory compounds found in plants and animals and many others hitherto unknown even in living organisms have similarly been built from inorganic materials. It is no wonder that chemists began to predict that life itself would soon be synthesized.

In the meantime, physicists were making similar strides. As new elements were added, their properties were established. Constants of various types were obtained to fit the new discoveries into the mathematical pattern. Electricity was brought out of the clouds and put to work not only for the physicist but for commerce. Along with these developments came reorientations in astronomy. So beautifully developed were the mathematical formulations, and so confident were the mathematicians who formulated them, that when certain planets deviated from the predicted course, it was clear that something was wrong with the planets. When it was calculated that there must be another planet which so far had not been seen, not only was that fact announced, but the time when it could be seen, as well as the place from which it could be seen, were stated. Further support for the cause of science was obtained when the astronomer turned his telescope to the designated spot—and there was Neptune. The small, distant planet of Pluto was similarly discovered more recently. The achievements in physics were so precise, so predictable, that the end of research in the physical world was anticipated.

Thus, mathematics achieved its place at the head of the list as the mother of all sciences. Physics being nearest to mathematics had become the most precise, definitive of all sciences, a standing it shared somewhat, though reluctantly, with chemistry. The biological sciences were regarded at best as quasi sciences incapable of precision, while the social sciences were not regarded as sciences at all. It does seem a far cry to place physics and chemistry in the same category with—let us say—political science, in which the principle of uncertainty has long been recognized. Texts on psychology usually include in their prefaces a frightened claim for recognition as one of the sciences.

Science has become a dominant fact in the life of man. Even his cigarettes have to be scientifically prepared. His drinks are subjected to scientific taste tests. His mattresses are scientifically built to fit his every curve. And with what reverence he regards the words "Scientific Research!"

And it is no cause for wonder that science began to invade the realm of individual man. Because such qualities as man's spirit, his aspirations, his hopes—or if you please—his soul, could not be measured or weighed, some scientists became cynical and denied their existence. And many men otherwise impressed with science became cynical too.

But let us take inventory of the progress which has been made and attempt to determine whether the methods of science are compatible with the search for truth within individual man. It is true that science has eliminated the likelihood of famine. It is true that science has brought disease under control. It is true that science has made the material aspects of man's existence pleasanter. Though its positive contributions have been large, the advantages of which no one should question, the significance of these achievements should not be exaggerated. But isn't this what has happened? Science through its objectivity vanquished the mysticism of the early periods, but in so doing made that a goal. Science produced machines which were to make life for man easier; but the machine became the master. Science applied genetics to the improvement of animals and plants for man's needs, and then proceeded to apply genetics to man himself as though criteria for developing man suited to society were definable or as simple as those for producing a faster race horse, or a better laying hen, or a redder apple. How small the step between this attempt and the concept of a super race! Mathematics, because of its assumed superior position, has projected a halo about the magnitude of numbers, and so sacred are large numbers that they have become the goal, not only in our political life, but in the educational world as well. Man is becoming more interested in a poll of public opinion than he is in an understanding of current problems.

Here, I think, we become aware of the essential nature of the immiscibility of the methods of science and the search for truth within the realm of man. Science bases its studies on numbers or masses, whereas the truth for man is an aspect of the individual which never can exist as an average. The science of Newton, in undertaking a search for truth within a man, is as likely to succeed as is a committee of people which sets out to compose a Shostakovitch symphony or which might try to arrive at any of those things which are that inseparable mixture of objective purposing and the inspired soul of the creator.

And now, I shall turn to the new science, the science which we might think of as having begun with Darwin's evolution, but which did not become an important factor in man's progress until the beginning of this century.

You will remember how the physicist had seen the end of his researches and how the chemist had classified his elements into their proper categories, and how systematic and orderly everything was. When new facts are observed, minor adjustments in the philosophy of the subject are usually necessary to accommodate the new find. But once in a very great while, a new concept or fact shakes the very foundations of that philosophy. The X-ray discovery did just this. From X-rays, to electrons, to radioactivity, and finally to radium, required only about five short years. And with radium came a wholly new concept of the nature of elements. Uranium, as it gave up its radiation, changed successively to other elements and finally to lead. As the nature of the radiation was studied, the findings led to the transmutation of other elements. Finally, Planck's quantum theory broke energy into units. Many new ideas developed. Perhaps the two most important are these: (1) Because of a lack of constancy within the atom, the behavior of any individual particle cannot be predicted, but the behavior of the whole mass of atoms can. Thus, we now have probability and perhaps evolution, not only in biology, but in the physical universe. (2) In 1927, Heisenberg, and also Bohr, found it impossible to ascertain accurately and simultaneously the position of an atomic particle and its velocity. The more accurately the one is determined, the less accurate is the other. Eddington calls this the "principle of indeterminacy," or the "principle of uncertainty." And here we have the physicist himself showing the weakness in the cause-and-effect principle which had been the very basis of his science. Then came relativity and Einstein who further shook science by showing that what had been considered absolute units of length and time were actually so only relative to the position of the observer in time-space.

On the basis of these achievements, let us reorient our viewpoint. You remember how earlier we placed mathematics at the top as the mother of science, and how physics and chemistry were next and how the biological and social sciences we hardly considered scientific at all? Let us now in the light of developments undertake a revision of that concept. Let's put mathematics at the bottom of our conceptual structure of truth and label it what it is, not a science, but a form of symbolic logic which has shown itself not to be infallible but nevertheless very useful. Next to it, let's place physics as not only the most elemental, but also the most elementary of sciences. Although it is the simplest of sciences, I don't mean that it is readily understood. But in the realm of physics, we deal with single atoms and talk in such terms as protons, electrons, positrons, neutrons. When we combine two or three of these single systems, we complicate the system many times and instead of talking of definable particles, we now talk in terms of molecules, chemical compounds, and chemical properties. We have seen the principle of uncertainty applied to single atoms. How much more complex and uncertain is a many-fold combination of such uncertainties! From lower chemistry we go higher to the realm of colloidal chemistry where substances cease to exist as atoms or even as molecules and where we speak of molecular aggregations whose *properties are totally different from those of the individual atoms making up the aggregate.* At this level, the uncertainties become greater and so pronounced that they are much more easily discerned. For example, one characteristic encountered in colloidal chemistry is a property known as "hysteresis." Those of you who have seen a hysterical person can guess at the nature of the property. Where Newton could perform the same experiment dozens of times and get the same precise results, in colloids this is not possible. If we take gelatin and allow it to swell in water and then dry it and cause it to swell a second time, it will not repeat the course it followed the first time. Here the system has a history, or memory, which modifies its subsequent behavior. Furthermore, age assumes an important role in colloids. Among the more complex colloidal systems we deal with rhythmic phenomena. Thus, at this level we drop much of the vocabulary of the physicist and begin to use words we find at higher levels.

At the next higher level, physiology, we have the protoplasms of lower plant and animal life which possess many of the properties of colloids, but in addition we now speak of age, life cycle, reproduction, growth, irritability, permeability. Quite obviously the complexities have increased enormously but understanding of these qualities is possible. For example, some rhythms or habits are rather easily induced among plants as well as among low animals. The opening and closing of certain flowers is a case in point. The stimulus required at first is, of course, light. If the flower is exposed for two or three days to normal sunrise, and then is put into a dark room on the fourth day, it opens when the time of sunrise comes. It will close at sunset, even though it has been in the dark all the time. Here we see a rhythm of events not unlike some we see in colloids and not unlike some we find in man.

In temperate and arctic regions, plants undergo deeply seated changes, mostly colloidal in nature, to withstand the winter temperature. This, I know, is teleology, but nevertheless it seems to be true. At the beginning of summer these plants are susceptible to injury at temperatures only slightly below freezing. Somewhat later, but still in summer, these plants undergo a hardening process which makes them resistant to the low temperatures to be experienced two or three months later. Here, then, is a hardening process accomplished in anticipation of expected events. In humans we call this discipline and habit.

Thus, at the physiological level of complexity, we approach problems with a totally different set of concepts and tools than at the chemical levels. Although measurement is still an important tool, we become more interested in an understanding of the organism.

From the physiological level we next rise to the psychological level where only a beginning has been achieved by science. Here we deal with a new set of qualities—thoughts, honesty, objectives. Some qualities are characteristically emotional such as fear, hate, resentment, love, jealousy, pride. Although these emotional reactions may result objectively from the highest levels of ethics and beauty, they commonly may be derived from the lower physiological stimuli such as hunger, disease, pain, abnormal functions, or they may result from social factors. But even though only a beginning has been made, it seems very clear to me that the qualities at this level are as real and distinctive as are the qualities of elements at the physicist's level. The degree of difference between the qualities at the psychological level and those at the physiological level is no greater than the degree of difference between the qualities at the physiological and colloidal levels. Furthermore, at any of the levels, we use methods peculiarly appropriate to the level. Just so, at the psychological level we cannot expect to use the tools of the physicist, or of the chemist, or even those of the physiologist to obtain an understanding of the individual. I am fairly confident that Gandhi, or Gauguin, or the Russian peasant have not done what they have because of a peculiar chemical composition, or a balanced diet, or an abnormal gland.

Now, at the highest of all levels—the social or culture level—we place that undefinable quality which Spengler calls the soul of a people or of a city. It is that something which has been associated with every culture or civilization the world has ever seen. Important at this level are such qualities as intellectual climate, not in the meteorological sense but certainly associated with it; tradition, as the accumulated achievement of individuals; social participation, as characterized by inspiration, or complacency, or resignation. I want to stress here the individual, for a culture is the result of ideas developed by individuals who together make up an intellectual climate or set the tone even though they in turn have derived their inspiration—or call it "soul"—from the traditions of that society bequeathed to them not only in books but in their very protoplasm.

With this review of the change which has come over scientific perspective, let me contrast the new science with the old: In simplest terms, the new science studies the individual in relation to the mass, whereas the old science dealt with averages and absolutes; the new science recognizes probability, whereas the old emphasized precise cause-and-effect relationships; the new science recognizes evolution, whereas the old science postulated immutability; the new science recognizes qualities as properties of levels of organizational complexities, whereas the old science thought of qualities only as properties of elements; the new science aims at understanding, whereas the old science was concerned with measurement and mathematical formulations.

With these thoughts, let us examine the progress which is being made right now. At the physiological level and below—that is, the chemical and physical—progress has been and continues to be tremendous. At the psychological and social levels, however, only a beginning has been achieved. I am certain that the big developments of the next century or two will come in these two fields, but workers in these fields will have to develop new tools for their work. The use of the old science in these fields will not lead anywhere. For example, in the educational world, so strong has been the concept of the average that the average person becomes the goal. And yet the principle of uncertainty or indeterminacy tells us that the concept of averages can be applied only to the mass but not to the individual.

It seems to me that the science which will reveal the truth in man is that directed toward an understanding of (1) those positive psychological elements which make men different from one another; (2) those qualities which properly cultivated make for initiative and enterprise, and which drive men on despite hardship; (3) those things which so far the poet, the painter, and the musical composer have come closer to revealing than any group of scientists. And how important is understanding at the psychological level! If Hitler can be said to have accomplished anything, his biggest achievement, it seems to me, was the demonstration that psychological weapons are stronger than tanks. How quickly seeds of distrust and suspicion defeated army after army! Is it unreasonable to expect that seeds of positive, strength-giving qualities can be cultivated in society once they are understood?

Finally, we are approaching a time calling for important undertakings at the social level where the problems are infinitely greater than at any of the other levels. For here we have masses of individuals. Today we seem to be moving toward a world society made up of a mass of masses, each mass with its own culture, and each culture with its own individuals. The goal, it seems to me, is clear. We need to construct a society that will protect the majority without destroying the minority; one that will punish offenders of a common code without directing the activities of all men; *one that will have some chance of reaching an equilibrium with those natural forces within a culture which are the culmination of the works of the individual people.* I hope we shall have the necessary objectivity and tolerance and strength to undertake these things, for here, I think, lies the truth for man, the truth that will give point to his life.

THE 16th ANNUAL MEETING 1940-41

Program

NOVEMBER 7, 1940

John Harris and O. N. Allen: Infectiveness of Rhizobia Isolated from Species of *Sesbania.*

E. H. Bryan, Jr.: Plant Life on Central Pacific Atolls.

Walter Carter: Notes on Milky Disease of Japanese Beetle Larvae.

W. H. Hammond: Research in Electrorecovery of Tin.

S. Okubo, Clarence Lyman, and L. A. Dean: Polarographic Studies.

N. E. Winters: Some Soil Conservation Observations in Hawaii.

Chester K. Wentworth and Horace Winchell: The Koolau Basalt Series.

T. A. Jaggar: Discovery in Volcanology.

NOVEMBER 8, 1940

Symposium: Food Resources in Hawaii.

A. L. Dean, Chairman: Introduction.

H. H. Warner: How Much Food Does Hawaii Produce?

Carey D. Miller and Martha Potgieter: Food Needs of the People of Hawaii under Normal and Emergency Conditions.

Louis A. Henke: Beef and Dairy Resources in Hawaii.

Samuel H. Work: Swine and Sheep Resources in Hawaii.

C. M. Bice: Poultry Resources in Hawaii.

Alvin R. Lamb: Potential Food Resources of Hawaii.

A. L. Dean: Summary and Discussion.

APRIL 17, 1941

J. W. Coulter: A Problem of Land Utilization in Fiji.

Stanley S. Ballard and Carroll B. Mills: The Quantitative Spectrographic Determination of Trace Quantities of Potassium. (By title only.)

J. L. Collins: Genetic Studies of Leaf Spines in *Ananas comosus.*

Lorin E. Harris: The Quantitative Utilization of Urea and Soybean Oil Meal Nitrogen by Steers.

Harry W. Palm: Model Technique in Stream Gaging. (By title only.)

Carey D. Miller: Growth of Rats on a Human Dietary.

Christopher J. Hamre and John T. McHenry: Blood Values for Hens Fed Yeast-fermented Mash. (By title only.)

Harold St. John: *Cyrtandra* as an Indicator of the Former Extent of Forests on Oahu.

Harry L. Arnold: The Symbiosis Between Medicine and Science.

APRIL 18, 1941

Symposium: Rats in their Relation to Health and Economics in Hawaii.

Harry L. Arnold, Chairman: Introduction.

C. E. Pemberton: The Species of Rodents and Fleas in Hawaii.

James R. Enright: Rat-borne Diseases in Hawaii.

Ralph E. Doty: Control of Rats in the Cane Fields of Hawaii.

APRIL 19, 1941

Annual Dinner

Business Meeting

Installation of Officers

Address by Retiring President

C. E. Pemberton: Contributions of the Entomologists to Hawaii's Welfare.

Abstracts

INFECTIVENESS OF RHIZOBIA ISOLATED FROM SPECIES OF *SESBANIA*

Greenhouse studies have been made with four strains of rhizobia isolated from *Sesbania sesban* and ten strains from *Sesbania grandiflora* to determine their ability to nodulate a variety of leguminous test plants. All the rhizobia gave satisfactory nodulation of *Sesbania grandiflora* and, with the exception of one strain, all produced nodules upon the lateral roots of cowpea (*Vigna sinensis*). Variations in infectiveness were obtained in the tests involving the other plant species: nine strains produced nodules upon *Cyamopsis tetragonolobus,* five upon *Arachis hypogaea* and *Alysicarpus vaginalis,* two upon *Crotalaria anagyroides,* and only one upon *Crotalaria saltiana.* None of the rhizobia from *Sesbania* was able to infect the roots of *Erythrina indica, Canavalia campylocarpa, Indigofera suffruticosa,* and *Phaseolus lathyroides.* Similarly, nodules were not produced when rhizobia from plants representative of the pea, soybean, lupine, cowpea, alfalfa, and clover cross-inoculation groups were used as inocula upon *Sesbania grandiflora.*

All the *Sesbania* rhizobia stained Gram negative, and produced a white or colorless, translucent to opaque type of growth upon agar media. Considerable variation in reaction of the strains was noted when they were grown upon asparagus-potato extract, mineral salt agar base with mannitol, sucrose, levulose, and maltose as sources of carbon. Only acid reactions resulted from growth on rhamnose, galactose, lactose, and glucose media. These data are in contrast to the alkaline condition characteristic of the cowpea, soybean, and lupine rhizobia upon all the above carbohydrates. Buff-colored or weakly positive tyrosinase tests were produced by twelve of the fourteen *Sesbania* strains upon an asparagus mannitol agar base with 0.15 per cent tyrosine added. Alkaline reactions, accompanied by the formation of distinct serum zones, were produced in litmus milk.

JOHN HARRIS and O. N. ALLEN

PLANT LIFE ON CENTRAL PACIFIC ATOLLS

A study of thirty atolls and coral islands in the central Pacific shows similarities of flora. The vegetation on an island seems to be closely correlated with climatic conditions.

Islands may be grouped from "very dry" to "very wet." (1) Very dry islands (no trees): Johnston, Birnie, McKean, Phoenix, Baker, Jarvis, Starbuck. Howland is transitional, a patch of *Cordia* trees being nearly dead. Malden, also transitional, has stunted trees, in part destroyed by goats. (2) Dry islands (scattered trees, but coconut palms do not grow well): Enderbury, Canton, and much of Christmas. (3) Special type: Vostok and Rose support a single kind of tree (*Pisonia*) in rather luxuriant stands. (4) Islands of medium rainfall (coconut palms and "dry forest"): Christmas (western part), Sydney, Hull, Gardner, Atafu, Nukunono, Fakaofu, Nassau, Pukapuka, Manihiki, Rakahanga, Tongareva (Penrhyn), Survarov, Palmerston, Flint, Caroline. (5) Moderately wet islands: Fanning, Swains. (6) Very wet islands: Washington, Palmyra.

Meager rainfall records indicate that type 1 islands average less than 25 inches a year; type 2, probably 25 to 40 inches; type 4, from 40 to 80 inches; type 5, between 80 and 120 inches; type 6, over 120 inches a year.

Species of plants from these islands have been identified as follows: 1 fungus, 1 lichen, 12 algae, 6 mosses, 11 ferns, 111 flowering plants. Some species occur only on one island. Others, such as *Lepturus repens, Boerhaavia tetrandra, Portulaca lutea, Fleurya ruderalis, Pisonia grandis, Suriana maritima, Triumfetta procumbens, Sida fallax, Ipomoea grandiflora, Cordia subcordata, Messerschmidia argentea,* and *Scaevola frutescens,* occur on many islands.

E. H. BRYAN, JR.

NOTES ON MILKY DISEASE OF JAPANESE BEETLE LARVAE

Two species of bacteria, pathogenic to the larvae of the Japanese beetle (*Popillia japonica* Newm.) in the eastern United States, have been tested on the larvae of *Anomala orientalis* Waterh. and *Adoretus sinicus* Burm. Both species of bacteria were found to be pathogenic to both beetle species.

The percentage of successful inoculations under laboratory conditions was low in all cases but distribution of both species of bacteria in beetle-infested fields is believed desirable.

WALTER CARTER

RESEARCH IN ELECTRORECOVERY OF TIN

Statistics demonstrate the need for the United States to recover tin from engineering scrap as a conservation measure. Babbitt-bearing discard, for instance, containing lead and other impurities over specification tolerances, usually contains about 85 per cent tin worth at present around 60 cents a pound.

With the cooperation of Professor E. M. Bilger of the University of Hawaii and of Professor F. C. Mathers of the University of Indiana, the author is studying methods for the electrorecovery of tin. A sulphate-fluoride process has been worked out which is successful under controlled operating conditions. Another process using a high hydrochloric acid bath is under systematic study and appears to offer economies in material and labor, if certain obstacles can be overcome.

W. H. HAMMOND

POLAROGRAPHIC STUDIES

The principles, apparatus, and operating technique of the polarographic method, based upon the authors' experiences in constructing and operating polarographs of several types, were discussed. The purpose of the presentation was to consider the possibilities and limitations of polarography with special reference to agricultural science. This method is especially useful for the rapid analysis of small quantities of solutions containing micro concentrations of electro-reducible and electro-oxidizable substances.

The characteristics and operation of the dropping mercury electrode were explained and the preparation and interpolation of current-voltage curves or polarograms discussed. A description was given of the polarograph built and now in operation in the laboratories of the Hawaii Agricultural Experiment Station. Polarograms secured while determining zinc in pineapple leaves and in samples of perchloric acid illustrated the practical application of the method.

S. OKUBO, CLARENCE LYMAN, and L. A. DEAN

SOME SOIL CONSERVATION OBSERVATIONS IN HAWAII

There are two principles to be considered in soil conservation and erosion control. One is the use of vegetation and the other is the use of mechanical measures.

Comparison of soil and water losses between clean tilled fields and those with a dense vegetative cover taken from many experiments on thirteen important soils representing 250 million acres, indicates the importance of the use of vegetation in erosion control.

Many observations in Hawaii during the past two years show that freshly plowed fields are subject to severe erosion when heavy rains come. On clean cultivated fields planted in row crops such as pineapples and vegetables, all conservation operations such as terraces, water disposal channels and other engineering structures must be installed to meet the conditions of the particular field. Soil type, slope of the field, amount of rainfall expected, and vegetative cover to be maintained on the field must be considered.

The terrace interval, the cross section of the terrace channel, and the grade of the terrace must be planned to control the excess runoff water and to keep velocity down to non-erosive values. It is important that cultivated crops be planted in rows parallel with the terrace channels in order to help protect the channels from sedimentation and limit inter-terrace soil movement. These same plans would apply to papaya and banana orchards.

Straight crop rows running across the slope of the field may result in more damage than benefit. The construction of terraces or of temporary field ditches with too great vertical interval or with low channel capacity may do considerable damage to the field and will not satisfactorily control erosion or conserve water.

N. E. WINTERS

THE KOOLAU BASALT SERIES

The Koolau Range forms the eastern and larger half of the Island of Oahu. It is composed of thin basaltic lava flows of remarkably uniform type, erupted from fissure vents along a rift zone thirty miles in length, which is now represented by the dike complex. Interest in the petrography and chemical composition of the Koolau lava flows centers in the fact that the Koolau Range is better known to geologists and visitors than any other part of Hawaii, and in its importance as a source of more than two thirds of all the ground water at present developed in the Hawaiian Islands. Despite this fact, until recently, its chemical composition has been indicated by a single complete analysis of a specimen labeled, "Koolau Mountains, Oahu."

A number of additional analyses of specimens from carefully described points are made available through a grant from the Geological Society of America. These analyses show a nearly uniform composition centered at about 50 per cent silica and closely comparable with the composition of Kilauea and Mauna Loa lavas. Indications are that the entire Koolau Range is composed of this primitive type of basalt. From this and related studies it is increasingly apparent that there is an important relationship between chemical composition of lava flows and the shapes, structures, modes of weathering, and water-bearing properties of lava domes.

CHESTER K. WENTWORTH and HORACE WINCHELL

DISCOVERY IN VOLCANOLOGY

Thirty years of experiment at the Hawaiian Volcano Observatory have resulted in the following deductions:

A lava column is made up of four substances: (1) deep magma from the centrosphere, unique and homogeneous; (2) gas foam, fluent and vesicular; (3) gases—hydrogen, carbon oxides, and nitrogen group; and (4) glowing residue, semisolidified.

Lava lowering is just as common as lava rising, and explosive eruptions are complications of such lowering with ground water.

A volcano is a contaminated external remnant of intensely living, buried intrusion along belts of profound rifting.

The contamination of deep magma is by crustal, marine, and atmospheric concentrates such as the thirteen light elements including iron which make up 99 per cent of the theoretical crust. A corollary is that abundance in the crust is no criterion of percentage composition of core, planets, boluses, or solar system. From 72 per cent of the crust area—the sea bottom—man has never collected rock specimens. The iron core doctrine is completely wrong, just as Kelvin's solar cooling was completely wrong. There are more than sixty elements heavier than iron. Crust elements are refuse of the core. An exploded core would not make hard pieces of metal like meteorites. Fragments of shallow shell would.

There is no distinction between magmatic and tectonic seismology with earthquakes 400 miles deep. Tilt and change of level are measurable anywhere. Surface effect of intrusive magma needs study everywhere. The most neglected field of science is that of the sea bottom. Physical geology cannot be made a science without knowledge of sea bottom thermal gradient, rock, lava flows, quakes, and magnetism. Money and labor can make this science just as they have made astrophysics and public health.

Ground tilt and level changes at volcanic ignisepta—earthcrust partitions built from core up by intrusion along volcano chains—have led to increased knowledge of engineering and public safety. Cycles and prediction are developing with knowledge of volcanoes and earthquakes.

T. A. JAGGAR

HOW MUCH FOOD DOES HAWAII PRODUCE?

Data used are based on recorded unloadings of food imports at Honolulu and other island ports, both from commercial shipping and Army and Navy transports, for the first six months of 1940. They are total imports for Hawaii; deficiencies in local production are for the group, and in many instances would be still more severe for Oahu alone.

On a whole milk basis, Hawaii produced 28 per cent of its combined consumption of milk, butter, and cheese, a gain of 4 per cent over an estimate made in 1935. Of grains and cereal preparations, Hawaii produced only about 1 per cent of consumption, chiefly rice from Kauai.

Of vegetables and vegetable preparations, 46 per cent of local consumption is produced in Hawaii, and for fruit and fruit preparations the amount is 34 per cent. If during an emergency period shipments of fresh vegetables and fresh fruit to the Mainland were stopped and the products consumed locally, the local production in each case would approximate 50 per cent of consumption. Meat and meat products are produced locally to about 41 per cent of the consumption, and for fish products the contribution of local production to local consumption is about 30 per cent. With shipping curtailed, the local catch would supply nearly 50 per cent. For eggs, the percentage is 40.

Of total human food consumed, the Territory both in 1935 and in 1940 was producing about 30 per cent, indicating that increases in production have just kept pace with increased consumption.

H. H. WARNER

FOOD NEEDS OF THE PEOPLE OF HAWAII UNDER NORMAL AND EMERGENCY CONDITIONS

Recent nutrition research has disclosed many facts regarding the specific food needs of man, and also that these needs are often not adequately met. Dietary requirements vary with age, sex, occupation, and climate. The food needs of man under emergency conditions are the same as at normal times, or possibly greater. Increased physical, mental, and emotional strain increase man's requirements for calories and vitamins, especially vitamin B. Man can subsist for a relatively long time on a restricted food intake but cannot function properly on such a diet. Vitamin B is perhaps the one dietary essential man can least afford to reduce in time of stress.

Locally grown foods of high nutritive value that could be produced easily and adequately are of four types: starchy vegetables, green leafy vegetables, legumes, and fruits. With wise distribution of available foods according to specific needs, the population of the Territory could be adequately fed throughout an isolation period of indefinite duration.

MARTHA POTGIETER and CAREY D. MILLER

BEEF AND DAIRY RESOURCES IN HAWAII

The hypothetical problem of providing beef and dairy products for the Territory during a period of shipping blockade can be approached from known facts on imports and local production, and from experimental evidence on values of local feeds.

Should such a blockade affect inter-island shipping, Oahu's beef resources would be woefully inadequate, while the other islands would have an ample supply.

Marketing 20 to 25 per cent of the total beef herds annually, Hawaii produces around fifteen million pounds of beef, or about 60 per cent of the local consumption of beef and beef products. By marketing around 40 per cent of the herd, present imports could be replaced by local beef for several years, but the price—destruction of the herds—would be too high for any except an extreme emergency. A more satisfactory solution is to increase herds by improving pastures and to pasture more breeding animals and calves while pen fattening steers on cane tops, bagasse, and molasses.

More serious is the outlook for supplementing dairy resources, because of inadequacy both of herds and of local feeds. In round figures, Hawaii produces less than sixty million pounds of fresh milk. Canned milk equivalent to about thirty-seven million pounds, and butter, cheese, and special milk products equivalent to over one hundred million pounds are imported annually.

Far from present consumption being maintained in case of blockade, even the present production would probably drop, due to inadequate feed supplies, chiefly protein feeds. Plans for emergency feeding include use of pineapple bran, cane molasses, pineapple syrup, yeast from molasses, urea, and soybean and pigeon pea fodder.

L. A. HENKE

SWINE AND SHEEP RESOURCES IN HAWAII

Hawaii has a sheep population of around thirty-two thousand head, located chiefly on Niihau and at the Humuula station of the Parker Ranch. About 8 per cent—roughly a hundred thousand pounds of carcass—goes to slaughter each year in addition to the more than 1,150,000 pounds of fresh and frozen mutton and lamb annually imported from mainland and foreign sources. Hawaii's yearly per capita consumption of this type of meat is 3.0 pounds of which only 0.3 pound is of local production. In eighteen years the total annual per capita consumption has increased from 1.1 pounds. It is interesting to know how long our sheep population would last with imports cut off. Hawaii's entire population would be supplied for ten months without taking account of natural increase and without decreasing consumption.

The territorial swine population is about forty-three thousand head. A great portion of this number is turned over each year as the hog is a most prolific animal. Nevertheless, the Territory imported nine and one-third million pounds of pork and various pork products in 1939. This is nearly double the territorial production of about five million pounds. Swine compete with dairy cows for many kinds of feeds. Thus, Hawaii's hog population would be the first to go. Without decreasing the normal rate of annual per capita consumption, the Territory's swine population can be expected to furnish food for about six months.

SAMUEL H. WORK

POULTRY RESOURCES IN HAWAII

At present poultry is raised on all the inhabited islands of the Territory of Hawaii. Poultry and eggs produced in 1939 had a value of approximately $900,000. Survey figures, obtained by the Agricultural Extension Service, University of Hawaii, indicate that the poultry population for 1939 was 325,000 birds over four months of age, and 300,000 birds under four months of age.

Feed consumed during 1939 amounted to 17,625 tons, of which practically 100 per cent was imported. At present an all-Hawaiian ration does not exist. Local sources of proteins are inadequate; consequently, feeds of this nature must be imported.

Local feedstuffs that have proven to be of nutritive value, and those now under investigation, would be used to formulate emergency rations. These include cane molasses, pineapple bran, pineapple syrup, algaroba bean meal, pigeon peas, kafir corn, cull taro, coral rock and coral sand, koa haole, sweet potato leaves, cane molasses yeast, meat and bonemeal, tuna fish meal, corn, and cull fruits and vegetables.

An emergency period would necessitate a reduction in the poultry population. A concentration of poultry near large cities or towns would of necessity bring about greater efficiency of production and distribution of poultry products. All hatching and brooding operations would cease for the period of the emergency. From the birds retained over the emergency period a new million-dollar, poultry industry would develop in Hawaii.

C. M. BICE

POTENTIAL FOOD RESOURCES IN HAWAII

The aim of this symposium is to find some correlation between nutritional needs and available foods. We must distinguish between the physiological necessity of supplying certain nutritional entities such as vitamins and a possible requirement for certain specific foods. We can get our ascorbic acid supply from imported oranges or from locally grown guavas. We can secure the bulk of our energy requirement from imported rice or from locally produced sweet potatoes and sugar. Many such illustrations could be cited.

A cooperative scheme for growing food crops suited to local soils and climate has been planned by representatives of the University of Hawaii, the Hawaiian Sugar Planters' Association, the Pineapple Producers' Cooperative Association, and by interested individuals. Some of the food crops included are sweet potatoes, string beans, lima beans, pigeon peas, peanuts, carrots, onions, and Chinese cabbage. These crops can be produced and they will be produced if necessary.

It is both practical and economical to feed waste products from the sugar and pineapple industries to our cattle, hogs, and poultry, using the valuable wastes from these animals to fertilize the crops. The animals and the main products of the crops are sold for cash, and the wastes or by-products from each are used to reduce the cost of production of the main products.

ALVIN R. LAMB

A PROBLEM OF LAND UTILIZATION IN FIJI

The East Indians in Fiji have created a grave problem for the Fijians. The problem is pressing because the Indian population is increasing more rapidly than that of the Fijians, and the Indians are aggressive in demanding more and more land. There are about 100,000 Fijians, some 4,500 people of mixed European and native descent, and 4,000 Europeans in the colony. The Fijian background of communal society is still strongly preserved. For example, arrangements are made in common by the men for the weeding of trails and of ground about villages, for building and repairing of dwelling houses, cook houses, and latrines, and by the women for fishing and other activities.

Leading Europeans in Fiji maintain that it is economically unsound to permit native Fijians to hold large areas of unused and untaxed land which Indian or other settlers would be prepared to open up and cultivate. The Indians also press this point strongly. The native chiefs passed a resolution in 1936 asking that the Government control all lands they did not require. These lands would be free for leasing to others and the rents would accrue to the Fijians.

Emigration from India to Fiji for the purpose of providing plantation labor dates from 1878. There are now some 100,000 East Indians in Fiji and of these 71 per cent were born in the colony. The great majority of the Indians are Hindoos. About 12 per cent are Mohammedans, and 1,000 are Christians. Commercial agriculture is almost entirely in Indian hands. Sugar cane farms are very popular and are keenly sought when new areas of land are opened for settlement. The Colonial Sugar Refining Company controls the sugar industry and the Indians work under the supervision of officers of that company.

It seems inevitable that the East Indians will exceed the Fijians in number. Their presence in Fiji has introduced a new and alien culture into the Pacific.

JOHN WESLEY COULTER

THE QUANTITATIVE SPECTROGRAPHIC DETERMINATION OF TRACE QUANTITIES OF POTASSIUM

In order to determine traces of potassium in sodium acetate soil extracts, some special analytical method is necessary. We have developed a spectrographic method of very great sensitivity and acceptable accuracy.

The instrument of dispersion is a Cenco spectrograph that employs a 12,000-line concave replica grating of 1-meter radius of curvature. Spectra are excited by a high-voltage condensed spark struck between a copper rod and a shallow copper pan in which the liquid sample has been taken to dryness. A large inductance in series with the spark serves to suppress undesirable air spark lines. An auxiliary spark gap in series with the source gap steadies the discharge and increases the consistency of the results.

The optical densities of the spectrum lines are measured by a densitometer consistent to 0.5 per cent. Several methods for reducing the data were investigated. The usual practice of drawing calibration curves was abandoned when it was found that results were invalidated by the variation in the amounts of calcium and magnesium present in the samples. A more successful method involves the addition of known amounts of potassium to the samples. A simple mathematical relationship connects the line density ratios of the sample and the sample with the potassium added, the mass of potassium added, and the amount present originally in the sample.

In order to reduce the errors resulting from variations in the electric circuit and the photographic process, actual computations are made using the ratios of the densities of the potassium doublet at 4046 angstroms to the 4102 line of indium, the internal standard element.

The technique gives results whose average error is approximately 5 per cent for absolute amounts of potassium greater than 5 micrograms. Amounts of potassium as small as 0.5 micrograms can be determined, but with considerable sacrifice of accuracy. Samples can be analysed in duplicate at the rate of eight to ten per man-day. The consumption of electricity, chemical reagents, and photographic supplies is very small.

STANLEY S. BALLARD and CARROLL B. MILLS

GENETIC STUDIES OF LEAF SPINES IN *ANANAS COMOSUS*

Pineapple varieties are characterized by three leaf types: spiny, no spines, and spines only near the tips of leaves. Genetic control is exerted by two independently inherited gene pairs, with an epistatic effect of the non-spiny character over both the spiny and spiny tip characters. The allel of the epistatic non-spiny character does not alter the development of either of the other characters.

These relationships, although truly Mendelian, give rise to a series of modified segregation ratios due to the epistatic nature of the non-spiny type. From crosses of these three leaf types the following series of ratios in segregating populations can be obtained:

NON-SPINY	SPINY TIP	SPINY
12	3	1
6	1	1
4	3	1
2	1	1
3	1	0
3	0	1
0	3	1
1	1	0
1	0	1
0	1	1
1	0	0
0	1	0
0	0	1

Of these thirteen possible ratios, eight were obtained in experimental cultures.

J. L. COLLINS

THE QUANTITATIVE UTILIZATION OF UREA AND SOYBEAN OIL MEAL NITROGEN BY STEERS

The Territory of Hawaii imports most of its protein concentrates. Urea contains 46.6 per cent nitrogen and is a possible economic substitute for organic proteins in polygastric animals. Experiments were undertaken to determine whether the rate of conversion of urea nitrogen to protein was sufficient to cover a part of the protein requirements of growing steers and to measure the efficiency by determining the biological value of urea in comparison with that of soybean oil meal. The experiments consisted of a series of nitrogen metabolism studies on four Holstein steers, using rations prepared by substituting urea and soybean oil meal in amounts of 11 to 12 per cent protein equivalent to a basal ration containing 1.44 per cent protein. The conclusions drawn from these studies are:

1. The endogenous nitrogen of 6- to 8-month old steers averaged 0.034 gm. per kilogram of body weight. The metabolic nitrogen in the feces averaged 4.89 gm. per kilogram of dry matter consumed.
2. The apparent digestion coefficient of urea nitrogen was 74 and that of soybean oil meal 78. When corrected for the metabolic nitrogen in the feces the values were 93 and 92, respectively.
3. The biological value of urea nitrogen is 24 and that of soybean oil meal nitrogen 54 when fed at an 11 and 12 per cent protein equivalent level.
4. When fed at a lower level of intake the biological value of urea would probably be much higher than when fed at these high levels.
5. In case of a blockade of the islands during a war, urea would be very valuable, because it is high in nitrogen, is cheap per pound of nitrogen, and could be shipped and stored in less space than other protein concentrates.

LORIN E. HARRIS

MODEL TECHNIQUE IN STREAM GAGING

Since 1910 the U. S. Geological Survey, in cooperation with the Territorial Division of Hydrography, has collected a large mass of data on flood flows of natural streams in Hawaii. These data are in the form of gage-height graphs only. High-water rating curves which, in general, have not been defined by actual measurements of flood flows, would make these data valuable to designing engineers.

The naturally steep channels and the extreme turbulence of flood flows which have hindered or prevented direct discharge measurements by conventional methods, allow us to build and test models of sections of stream channel at gaging stations without resort to geometric distortion of scale, and with assurance that viscous flow will be inhibited within our working range. Thus it is possible to get close dynamic similitude and this reasoning is supported by the results of twelve experiments thus far completed at the Geological Survey hydraulic laboratory at Waialua. The fit between model and prototype data within the range of field measurements is close enough to lend confidence in the entire model rating, in spite of the fact that normally the high end of the rating presents a wavy rather than smooth appearance. The reason for any change in curvature is always apparent from observation of the model stream in action.

The laboratory is equipped with an area for building models and with tools and gages especially designed for convenient and rapid model building. Three separate weirs of various sizes have been calibrated volumetrically and insure precision in flow measurements throughout the necessary and obtainable range of 0.003 to 5.0 cubic feet per second.

HARRY W. PALM

GROWTH OF RATS ON HUMAN DIETARY

The experiments here reported were started by Kiyo Nakatani, graduate student in nutrition at the University of Hawaii, and continued by Fujie Enomoto and Mabel Inada, Home Economics students, with the assistance of Kisako Yanazawa, technician at the Nutrition Laboratory, under the direction of the author.

The growth of young rats fed a diet composed of foods that make up a typical Japanese diet was compared with the growth of rats of the breeding colony fed a stock diet. This stock diet, which permits excellent growth and reproduction, consists of whole milk powder, whole wheat flour, dried soybeans (cooked, redried, and ground to fine meal), sodium chloride, and a small quantity of wheat germ.

The quantities of foods chosen for the experimental rat diet resulted in a diet relatively better than that eaten by many Japanese, but the diet was typical in that it contained a large amount of white rice and certain typical Japanese foods.

The diet composed of Japanese foods permitted good growth but was less satisfactory than the stock diet when fed to young rats. The records for reproduction and lactation, which in rats are sensitive measures of the nutritive value of the food, showed the Japanese diet to be inferior to the stock diet fed to the breeding colony.

CAREY D. MILLER

BLOOD VALUES FOR CHICKENS FED YEAST-FERMENTED MASH

Blood studies were made on a group of thirty-nine white Leghorn hens to determine the effect of the feeding of yeast-fermented mash on various blood elements. The blood elements observed are indicated in the following table and blood samples for these determinations were obtained by the usual methods and with the usual apparatus. Values for the corpuscular constants (mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration) of fowls have not previously been noted in the literature. Since differences of opinion as to the characteristics of monocytes of chickens exist, we have computed two values for monocytes, one for what we consider to be typical monocytes, and for the other we have combined those values with those for large lymphocytes because some authors have apparently identified the latter as monocytes. Each of the values so obtained agrees closely with normal values given by different groups of investigators. A statistical study was made of the values for the various blood elements for the control birds and the birds fed the yeast-fermented mash. No significant differences were found. The values for the two groups were combined and found to agree closely with normal values offered by other investigators. The following table summarizes the values for the various blood elements for the entire group of birds.

CHRISTOPHER J. HAMRE and JOHN MCHENRY

CYRTANDRA AS AN INDICATOR OF THE FORMER EXTENT OF FOREST ON OAHU

Cyrtandra, or "kanawao keokeo," the largest genus of Hawaiian flowering plants, occurs only in the moist native forests. Most of its numerous species are restricted to small areas—often to a single or a few adjacent valleys on one mountain range. Its seed dispersal is inefficient and it cannot live in dry, open, or sunny places. As animal or other agents do not now carry the seeds from the Waianae to the Koolau Mountains or reverse, it is deduced that they did not do so formerly, and that the species could only have migrated across if the Schofield-Wahiawa saddle was well forested.

HAROLD ST. JOHN

Blood Elements Observed in Samples from Chickens Fed Yeast-fermented Mash

ELEMENT	AVERAGE VALUES	STANDARD DEVIATION	STANDARD ERROR OF MEAN	RANGE
Hemoglobin, grams per 100 cc. of blood	11.90	1.02	0.16	9.50 to 14.00
Erythrocytes, millions per cu. mm. of blood	2.996	0.217	0.034	2.48 to 3.465
Volume of packed red blood cells, cc. per 100 cc. blood	29.70	4.15	0.66	21.00 to 42.00
Mean corpuscular hemoglobin, micromicrograms	39.81	3.18	0.51	35.10 to 51.40
Mean corpuscular hemoglobin concentration, per cent	40.60	4.60	0.73	29.98 to 48.60
Thrombocytes, ten thousands per cu. mm. of blood	27.14	8.13	1.30	11.50 to 46.00
Leucocytes, ten thousands per cu. mm. of blood	34.20	9.42	1.50	14.50 to 64.00
Differential leucocyte count percentage				
Heterophiles	30.85	11.52	1.84	12.33 to 58.50
Eosinophiles	4.67	2.65	0.42	0.66 to 13.66
Basophiles	2.59	1.41	0.22	0.33 to 5.33
Small lymphocytes	52.40	13.90	2.22	20.00 to 74.00
Large lymphocytes	8.34	3.58	0.57	2.33 to 15.00
Monocytes	0.60	0.92	0.14	0.00 to 3.00
Monocytes and large lymphocytes	9.24	3.47	0.55	2.99 to 16.00

THE SYMBIOSIS BETWEEN MEDICINE AND SCIENCE

Although medical men were probably among the first students of science and have constituted an extremely important factor throughout the years in the development and advancement of science, still in the conduct of their profession itself they cannot practice science in the strict sense. They use all of the sciences many times a day both in diagnosis and in treatment, and it is impossible for a man to be a good physician without a considerable amount of scientific training, knowledge, and equipment. Nevertheless, when it comes to the actual treatment of the patient, physicians cannot stand solidly on scientific ground but must resort to the art of the practice of medicine. Benefits which medicine has received from science are probably balanced by those benefits which medical men have contributed to the fund of scientific knowledge in general.

There has existed for many years, then, a mutually beneficial relationship between the practice of medicine and the practice of science; but the practice of medicine is an art and not a science.

H. L. ARNOLD

THE SPECIES OF RODENTS AND FLEAS IN HAWAII

Apart from a small rabbit found on Rabbit and Lehua Islets, the only other members of the mammalian order Rodentia occurring wild in Hawaii are five kinds of rats and the cosmopolitan mouse *Mus musculus.* The rats are as follows:

Rattus norvegicus. Characterized by its large size, blunt muzzle, small ears barely reaching the eyes when pressed forwards, heavy tail, which is shorter than the rest of the body, and small pads on the soles of the feet.

Rattus rattus rattus. This is the so-called black rat. It is smaller than *R. norvegicus,* slender, with sharp muzzle, large ears, slender tail longer than the rest of the body, and with rather large pads on the soles of the feet.

Rattus rattus (*alexandrinus* type) and *Rattus rattus* (*frugivorus* type) are considered forms or sub-species of the black rat. M. A. C. Hinton of the British Museum describes *alexandrinus* as brownish grey on the back with the belly more or less dingy, whereas *frugivorus* is yellowish or reddish brown on the back with the belly pure white or pale lemon.

Rattus hawaiiensis is native to the Hawaiian Islands. When full grown it is usually about five inches or less in length. The tail is slender and a little longer than the body. The species has only eight mammary glands. This is two to four less than on the other rats discussed. It is primarily a field rat.

All but the Hawaiian rat are cosmopolitan.

Fleas known in Hawaii are as follows:

Pulex irritans. On dogs, cats, man. Rare on rats.

Ctenocephalides felis. On cats, dogs, mongooses. Rare on rats and mice.

Xenopsylla cheopis. On rats. Rare on mice and mongooses. None as yet found on dogs or cats.

Xenopsylla hawaiiensis. On rats. Rare on mice and mongooses. None on dogs or cats.

Nosopsyllus fasciatus. On rats; mostly about 2,500 feet elevation on Maui and Hawaii. Rare on mice and mongooses.

Leptopsylla segnis. On mice; uncommon on rats and mongooses.

Echidnophaga gallinaceae. On poultry, rats, dogs, mongooses.

Fleas are most numerous on rats living in, under, or near buildings. Dry weather favors flea development. Rock salt spread under houses will stop flea epidemics about Honolulu.

C. E. PEMBERTON

RAT-BORNE DISEASES IN HAWAII

Rats are reservoirs of organisms causing plague, typhus, ratbite fever, and infectious jaundice. They harbor eleven species of internal parasites which also occur in man, the principal ones in Hawaii being trichinosis from infested wild pork and two species of tapeworm, *Hymenolepsis nana,* and *H. diminuta.* The Norway rat supposedly suffers from spontaneous amoebic dysentery, and is therefore a possible disseminator of this disease. Rats may be carriers of the Gartner group of bacilli which causes food infection.

Plague history goes back to biblical times. The disease is carried by the rat flea. The "Black Death" of the fourteenth century destroyed one-fourth of the population of Europe. Since 1921, there have been fifty-nine cases in the Territory, fifty-three of which were in Hamakua, Hawaii and six scattered over four districts on Maui. Honolulu had its last case in 1910 but relaxation of precautions could easily result in its spread from Hawaii to Honolulu.

Typhus was first recognized here in 1933 and has accounted for 298 cases in the Territory of Hawaii with 216 of these in Honolulu.

There have been recorded since 1921, sixty-seven cases of infectious jaundice which may be traced directly to contamination by rats.

JAMES R. ENRIGHT

CONTROL OF RATS IN THE CANE FIELDS OF HAWAII

Rats have caused great losses in cane fields, especially in moist windward areas. The prebaited feeding station method of control has been developed and used with marked success on all seriously affected plantations.

The best bait is rolled oats flavored slightly with corn oil, raw linseed oil, or coconut oil. Thallium sulphate at a concentration of one pound to two hundred pounds of oats is recommended as the lethal agent.

The equipment of each station consists of a small square baking pan placed under a curved cover of light galvanized iron costing about eighteen cents complete. Usually three or four stations are placed per acre, spacing them fifty to eighty feet apart, concentrating along the edges next to gulches or waste land. The treatment should be repeated once in every three months or even less in exposed fields during the fall and winter months.

The field procedure consists of four operations:

1. Placing stations in the field and filling them with unpoisoned oats.
2. After four days exposure, the stations should be visited and refilled with unpoisoned oats.
3. After two or three days more any remaining unpoisoned oats should be removed and poisoned oats substituted.
4. After at least three days exposure of the poisoned oats, the stations may be removed.

The success of this method is entirely dependent on the field operators, who must be intelligent, reliable, and able to work on their own.

The cost of successful plantation control under this system ranges from forty cents to one dollar per acre per year.

Some of the advantages of this system are:

1. Poison detection and subsequent bait shyness has been markedly reduced.
2. This method continues to be efficient as the rats cannot circumvent it.
3. There are no recoveries as the rats always eat an overdose.
4. The cost is very reasonable and its efficiency increases with length of time in operation.
5. It affords a means of measuring actual effectiveness promptly.

R. E. DOTY

CONTRIBUTIONS OF THE ENTOMOLOGISTS TO HAWAII'S WELFARE

Presidential address 1941.

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Hawaii's endemic insect fauna, though consisting of some three thousand species, is both inconspicuous and innocuous as compared with the large number of species which have arrived in the Islands since the advent of immigrant peoples. During centuries of evolution, the Hawaiian species have become balanced, controlled, and adjusted to each other and to their hosts in a fashion which has been aptly termed, "The Balance of Nature." No such balance operates among the many insects that have come in from the Mainland or foreign countries. It has been the lot of the entomologists to establish such an adjustment through the employment of biological control methods. Broadly considered, this involves a study of these insects in their home lands to determine all factors which naturally limit or check their populations. Then follows the introduction into the new lands of any or all of these factors which can be safely utilized. Usually these natural elements of control are other insects.

Beginning with Albert Koebele, succeeding entomologists in Hawaii have used to great advantage this biological method of insect control and large economic results have attended their efforts. A long list of individual accomplishments is on record. An important contributing aid to this work has been the extensive building of well-ordered collections, especially from tropical countries. Taxonomic work, without which the workers in biological control would have been heavily handicapped, has been given full attention.

Because of ecological conditions peculiar to Hawaii, the biological method of insect control can be used to greater advantage than probably anywhere else in the world. It is suggested that local institutions encourage and support the establishment of a permanent biological laboratory in some Malayan region especially rich in insect life where continuous research would reveal many species beneficial to Hawaii if introduced thereto. A large number of destructive insects in the Hawaiian Islands have had their origin in Indo-Malayan and Oriental regions and it is believed that a cultural center like Kuala Lumpur in the Malay Peninsula would offer good possibilities for such a laboratory.

Hawaiian entomologists have not neglected the field of artificial control of insect pests. Conspicuous in this work is the tremendous annual savings to the pineapple producers through the development and application of methods in the control of the pineapple mealy bug and the saving of crops which otherwise would be severely depleted by the wilt disease induced by this insect.

Finally, the unending service of plant inspectors, whose work is primarily entomological, has, without question, saved the Territory untold economic problems. Their work has gone on continuously and quietly for several decades.

C. E. PEMBERTON

THE 17th and 18th ANNUAL MEETINGS 1941-43

Program

NOVEMBER 13, 1941

C. M. Bice: The Nutritive Value of Certain Local Feedstuffs in Emergency Poultry Rations.

F. G. Holdaway: Blowfly Strike of Young Calves in Hawaii.

Joseph E. Alicata and Virginia Breaks: Canine Leptospirosis.

Stephen B. Jones: A Proposed Meteorological Expedition to Mauna Kea.

T. A. Jaggar: Steam in Volcanoes.

Richard B. Black: New Coasts in Antarctica.

NOVEMBER 14, 1941

Symposium: Water Resources.

Chester K. Wentworth, Chairman: Introduction.

Max H. Carson: Rainfall and Regional Aspects of Water Supply.

Harold S. Palmer: Geologic Structure and Ground Water Supplies.

Joel B. Cox: Water in Relation to Hawaiian Agriculture.

Walter H. Samson: Municipal Water Supply Problems in Hawaii.

OCTOBER 15, 1942

Arthur S. Ayres: Organic Matter and the Base-Exchange Relationships of Hawaiian Soils.

Harold E. Clark and Kenneth R. Kerns: Some Effects of Phytohormones on Pineapples.

David T. Fullaway: Food Storage Problems Under War Conditions.

W. A. Frazier, A. J. Mangelsdorf, and Colin G. Lennox: Adaptation and Behavior of Certain Food Crops in Hawaii.

OCTOBER 16, 1942

T. A. Jaggar: Abrasion Hardness.

Chester K. Wentworth: Correlation of Rainfall and Ground Water.

Walter Carter: Studies of the Oral Secretion of *Pseudococcus brevipes,* the Pineapple Mealy Bug.

Joseph E. Alicata: Epidemiology of Typhus and Leptospirosis in Hawaii.

Forrest J. Pinkerton: The Blood and Plasma Bank in Time of Peace and War.

Peter H. Buck: The Feather Capes of Hawaii.

MAY 6, 1943

Lawrence Boggs: A Chemical Identification of a Large Stock of Steels in One Week by Spark and Spot Tests.

Vernon E. Hargrave: A Chemical Method for Identifying Compounded Commercial Synthetic Rubbers.

Francis Fong: Speeding Up the Chemical Analysis of Miscellaneous Ferrous Alloys by Means of the Spectrograph.

W. H. Hammond: A Physicochemical Method of Analyzing Cadmium in the Presence of Zinc.

William B. Storey: A Concept of the Papaya Fruit as an Anomalous Structure.

F. G. Holdaway: Cryolite: An Important Insecticide for Some Vegetable Crops.

MAY 7, 1943

Kenneth P. Emory: Useful Methods of Obtaining and Preparing Food from Coconuts.

C. Alvin Dougan: The Development of the Fluorogram.

Peter H. Buck: Hawaiian Weapons.

Business Meeting

Address by Retiring President

Harry F. Clements: The Search for Truth in the Realm of Man.

Abstracts

THE NUTRITIVE VALUE OF CERTAIN LOCAL FEEDSTUFFS IN EMERGENCY POULTRY RATIONS

In the past, the poultrymen of the Territory of Hawaii have imported feeds from the Mainland and elsewhere. Such feeds may not be available during an emergency period. Therefore, the Poultry Department of the Hawaii Agricultural Experiment Station at the University of Hawaii initiated studies to determine the nutritive value of certain local feedstuffs. Experiments in which ground red milo maize was substituted for yellow corn meal indicated that chicks grew at the same rate on both diets. Red milo maize was equal to yellow corn meal in rations for layers. Egg production from the two lots of birds was practically the same.

When cane molasses yeast was substituted for meat scrap, fish meal, or soybean oil meal, chicks in the experimental and check lots were comparable in body size, rate of feathering, and sexual maturity. Pullets fed the yeast laid slightly better than those which received meat scrap, fish meal, or soybean meal.

Local flame-dried fish meal in poultry rations did not have any detrimental effect upon feather growth, body size, mortality, or egg production. No undesirable flavor was noted in either the eggs or meat from birds fed local fish meal.

From these and previous studies an "All Hawaiian" emergency ration was developed which contains local feedstuffs in the following proportions: red milo maize, 40; cane molasses yeast, 15; koa haole seed meal, 5; corn or finely ground pineapple bran, 15; pigeon pea meal, 5; algaroba bean meal, 15; local meat and bone meal, 5; salt, 1; and coral sand, 2. Honohono grass or other greens are fed at the rate of 1 pound per 100 hens daily.

C. M. BICE

BLOWFLY STRIKE OF YOUNG CALVES IN HAWAII

Technical paper No. 95, Hawaii Agricultural Experiment Station

During 1940 many young calves died on Kauai. Investigation revealed that attack by blowflies was the cause. Three species of flies were involved: the Oriental blowfly *Chrysomyia megacephala* (Fabricius), the greenbottle fly or European blowfly *Lucilia sericata* (Meigen) and the Australia green blowfly or "hairy maggot" fly *Chrysomyia rufifacies* (Macquaert).

Attack, known as "fly strike," consists of the development on the living calf, of fly larvae or maggots hatched from eggs deposited on the calf by the adult flies. The larvae live in the surface layers of the skin which become raw and odorous. The hair becomes matted and comes away from the body with the outer layers of the skin. The attacked calf becomes dejected and usually lies down. It is commonly ignored by the mother and, if not found and suitably treated, dies in a few days. Calves are most commonly attacked during the first week of life, less commonly during the second week, and only occasionally in the third week. Calves may be attacked on almost any part of the body—on the shoulder, back, rump or tail, in the nose, ears, rectum, on the navel, or between the legs and the body.

Of 29 ranches, 16 or 55.2 per cent reported strikes on young calves. On ranches where strikes occurred, 15.6 per cent of the calves born were struck and 57.5 per cent of those struck died. Strikes occurred most predominantly in the moderately warm and wet sections—Climate Zone D_1 of Ripperton and Hosaka—with one high record from a section bordering Zone D_2, cool and wet. Maximum attack occurred in the wetter sections of the Lihue district and in the Kapaa homestead sections. Though there were some strikes in every month of the year, they increased to a maximum in the fall and early winter months.

F. G. HOLDAWAY

CANINE LEPTOSPIROSIS

Leptospirosis in dogs, caused by *Leptospira icterohemorrhagiae* and *Leptospira canicola,* constitutes a problem of veterinary and public health importance. Infestation by the former, which is also found in rats, produces jaundice in about half of the cases, whereas the latter produces jaundice rarely. These organisms are transmitted from dog to dog, and sometimes from dog to man, largely through urine contamination.

Following the first known cases of human and murine leptospirosis in Hawaii (Alicata, 1937), leptospirosis in dogs was suspected. In 1940, Dr. L. C. Moss, local veterinarian, reported (unpublished) that of eleven samples of dog sera submitted to Dr. K. F. Meyer, Hooper Foundation, University of California, San Francisco, seven showed *Leptospira* agglutinins.

In the present study (financed by the Public Health Committee, Chamber of Commerce in Honolulu), microscopic agglutination tests were made on sera of 100 local dogs. Formalinized antigens of *L. icterohemorrhagiae* and *L. canicola* were used. The original cultures were secured through the kindness of Dr. K. F. Meyer and Mrs. B. Stewart-Anderson of the Hooper Foundation.

Incidence of Leptospirosis in Dogs in the United States as Revealed from Serological Agglutination Tests

	TOTAL DOGS EXAMINED	INFECTION WITH— L. canicola		L. icterohemorrhagiae		TOTAL INFECTION	
		Number	*Per cent*	*Number*	*Per cent*	*Number*	*Per cent*
California							
San Francisco[1]	47	16	34.07	0	0	16	34.0
Santa Rosa[1]	28	4	14.3	0	0	4	14.3
Los Angeles[2]	368	105	29.0	0	0	105	29.0
New York[1]	111	10	9.0	3	2.7	13	11.7
Alabama[1]	21	0	0	0	0	0	0
Pennsylvania[3]	105	*L. canicola* 3 times as frequent as *L. icterohemorrhagiae*				40	38.1
Hawaii							
Honolulu[4]	100	19	19	20	20	39	39.0

[1] K. F. Meyer, B. Stewart-Anderson, and B. Eddie, *Amer. Vet. Med. Assoc. Jour.* 95:(753) December 1939.
[2] M. R. Green, *Amer. Jour. Hyg.* 34:(2) September 1941.
[3] C. Raven and K. Barnes, *Jour. Bact.* 40:(2) August 1940.
[4] Present report.

JOSEPH E. ALICATA and VIRGINIA BREAKS

A PROPOSED METEOROLOGICAL EXPEDITION TO MAUNA KEA

Interesting information on the weather and climate of Mauna Kea and vicinity was brought back by the Academy of Science expedition of 1935 and Wentworth-Powers party of 1939. The present plan is to build on this foundation chiefly in two ways: (1) by lengthening the period of continuous observation to two calendar months and (2) by correlating observations on Mauna Kea with simultaneous ship and shore observations elsewhere in the Central Pacific. It is hoped that such study will throw light on the behavior of the summer trades and upper winds, and on the variability of Hawaiian summer rain. Work in atmospheric physics or chemistry would be a particularly valuable addition. It is planned to establish a base at 9,300 feet and to maintain recording instruments near the summit.

The proposal is placed before the Academy at this time for three reasons: First, it is necessary to borrow instruments, and it is thought that Academy members may have, or may know of, instruments which will not be in use next July and August. Thermographs, hygrographs, barographs, and anemometers are especially desired. Second, it may be possible for the party to make some high altitude observations of interest or use to members of the Academy. Third, it would add little to the cost of the expedition but a great deal to its scientific value if others, such as Academy members, students, or assistants, joined the party for part or all of the summer.

STEPHEN B. JONES

STEAM IN VOLCANOES

Eye-witness accounts have been assembled to show that at Mount Pelée the mountain split open suddenly from summit to base, that the outgush was aqueous mud and scalding steam, that the split valley-bottom was an old solfatara on a cross-mountain rift, that the splitting was progressive downward, and that the upjets along the split were misinterpreted by geologists as being downflows of heavy gaseous emulsions flowing gravitatively.

Progressive splitting is proved by speeds of a mile a minute on a flat grade and outgush of mud by the 50-ton boulders transported. Splitting would not be obvious when we realize that the rock crack is covered by deep loose valley fills and with obstruction by the central fan of magma in the rift. The rift itself has old inclined openings, lifted open under exceptional stresses. The pure steam character of Plinian or paroxysmal eruption is due to ground water. The initiation of such paroxysm is engulfment-lowering of magma, after unperceived intrusion-lifting over a period of years, and the failure to fore-cast is due to nothing more than the absence of observatory measurement.

These are the synthetic results of a new approach to a study of such explosive eruptions as Katmai, Pelée, and Tomboro. The approach is new in accenting the credibility of many wounded persons, applying rift doctrine, and in recognizing that pure steam is phreatic from a boiler-mechanism of ground water always existent and renewed by the Herzberg law under volcanic lands close to large salt water bodies.

Detailed observation in Hawaii in 1924 showed at Kilauea a typical explosive steam eruption, with a lava-draining, radial, submarine crack, non-volcanic ground water steam, and engulfment-lowering of crateral lava that progressed along a rift. The lava gases had been noxious, sulphurous and carbonaceous. The explosive vapor was pure steam. The Kilauea investigation made the new approach feasible, and proved steam-blast eruption everywhere to be uniform and totally distinct from magmatic effervescence.

T. A. JAGGAR

NEW COASTS IN ANTARCTICA

(Abstract not received.)

RICHARD B. BLACK

RAINFALL AND REGIONAL ASPECTS OF WATER SUPPLY

Published in full in *Paradise of the Pacific,* 56(2): (February, 1942), 21-23

Rainfall is the source of all surface and ground water used by man. In Hawaii, where there are no long rivers and no distant mountains, the rainfall of each island, or of each segment of an island, sets a limit to the annual amount of available fresh water. There are prodigious variations of annual rainfall from place to place, from season to season, and from year to year. Waialeale on Kauai may receive as little as 250 or more than 600 inches and low rainfall stations may vary still more. But Waialeale is always very rainy and Mana on Kauai or Barber's Point on Oahu are always very dry.

Lacking good records, we can merely deduce that rainfall over the open ocean does not exceed 20 to 30 inches annually. Heavy rainfall on many parts of the Islands is largely due to rise and cooling of the air with condensation in passing over mountains. This is accentuated, as on Waialeale, where deep valleys converge toward a mountain 4,000 or 5,000 feet high and where the summit receives rain under various conditions of wind direction. However, where trade winds blow against the smoother slope of a larger, higher mass like Mauna Kea, the maximum rainfall is reached between 2,000 and 3,000 feet.

In some sections, good agricultural land receives sufficient rainfall, but most of the best soil and favorable topography is in areas where the rainfall is insufficient. This explains why water must be transported by ditches and tunnels from mountainous sections or developed from ground water supplies by extensive systems of tunnels or wells.

MAX H. CARSON

GEOLOGIC STRUCTURE AND GROUND WATER SUPPLIES

Published in full in *Paradise of the Pacific,* 56(3): (March, 1942), 21-23

Much water that falls as rain is absorbed and stored underground in many kinds of open spaces in rocks. Driven by gravity, the water travels through the open spaces that offer the easiest passage. If we know the driving force and the characteristics of the rocks, we can deduce the occurrence of ground water in many geologic situations.

In an oceanic island composed of homogeneous, pervious rocks and receiving little or no rainfall, sea water would gradually make its way underneath the island and would fill all the accessible open spaces in the rock below sea level.

If there is a good deal of rain on such a homogeneous, pervious island, the fresh water, as it descends, will partly displace the subterranean sea water. Since the water can escape only around the shores of the island, the water table (or upper boundary of the zone saturated with fresh water) will slope downward from the middle toward the shores, where it will meet sea level, and will cause shore line springs. The piling up of fresh water in the central region will cause a displacement of the salt water below, such that, at any point, the fresh water will extend about forty times as far below sea level as above sea level. Thus, fresh water will saturate a body of rocks with the shape of a bi-convex lens, with the greater convexity downward. This is called the "Ghyben-Herzberg Lens" in honor of two men who first studied it in Europe.

If the rainy island, instead of being uniformly pervious throughout, is cut by tabular bodies of impervious rock, the percolating ground water may be prevented from getting down nearly to sea level. Such water, held at high levels, is called "perched water." A different condition holds water at high levels in regions near the main channels through which lavas rose during volcanic activity. Here, dikes, the dense and relatively impervious lava-fillings of vertical cracks, form underground "boxes" in which water is held.

If the shores of the island are capped by impervious coastal deposits, lateral escape of the fresh water will be opposed, and the edge of the Ghyben-Herzberg lens becomes thickened. If the impervious cap extends well above and well below sea level, the edge may be greatly thickened, and the fresh water will be confined under considerable pressure.

If the cap is on the whole impervious, but includes pervious beds here and there, moderate amounts of shallow ground water may be found.

HAROLD S. PALMER

WATER AND HAWAIIAN AGRICULTURE

Published in full in *Paradise of the Pacific,* 56(4): (April, 1942), 21-24

Irrigation in Hawaii is of great antiquity. This is shown by the complex systems of ditches and terraces constructed by the ancient Hawaiians for taro cultivation. Rice followed taro as a crop grown in inundated valley flats. Since 1856, an increasing percentage of sugar cane has been irrigated. Ruggedness of the country and marked variation in rainfall and soil are factors which complicate the problem of irrigation and call for engineering skill and heavy capital investment. High soil permeability joined with the expense and general impracticability of large scale water storage further aggravates the problem. Formulas developed to show the year-round cost of cane irrigation indicate that land and water values are reciprocal. Diagrams showing this relationship also indicate that the sum of these two factors is closely fixed by the market price of sugar. An important distinction is that between the average year-round value of a given amount of water and the marginal value of the same amount as an additional supply during a definite time of shortage. Such water may approach the lower limit of value of municipal water ($100 per million gallons), but in general water used for cane irrigation commands a considerably lower price, ranging downward to $5 per million gallons. Water used for taro, rice, and diversified crops is valued in the zone below $5. Only under exceptional conditions can there be real competition between these uses of water.

JOEL B. COX

MUNICIPAL WATER SUPPLY PROBLEMS IN HAWAII

Published in full in *Paradise of the Pacific,* 56(5): (May, 1942), 21-23

The problems of a municipal water supply vary in different regions according to the type and source of supply available, to terrain and climatic conditions, and to requirements of agricultural and industrial users. The three main requirements in any municipal system are that the supply be dependable, sufficient in quantity, and high in quality. Reduction in the daily per capita water requirement is not to be sought by lowering present living standards but by devising the most beneficial utilization of industrial and agricultural water.

Uses of water from a municipal system are varied and one of the problems is that of agricultural water. Because of the high requirements in dependability and quality, in pressure and in adaptation to fire protection in a system built chiefly for domestic supply, it is not generally practicable to furnish water from a municipal supply at rates which will permit small farmers to make a profit in strictly commercial agriculture. At present about 40 per cent of the water taken from the artesian structure is from privately owned and operated artesian well systems. The bulk of this water is used for agricultural and industrial purposes.

Municipal water needs must be anticipated and planned long in advance. Population growth and the shift of population centers must be predicted with all possible accuracy in the development and expansion of a water distribution system. The past years of drought have further complicated the unpredictable increase in water service that came with national defense activities in Hawaii.

WALTER H. SAMSON

ORGANIC MATTER AND THE BASE-EXCHANGE RELATIONSHIPS OF HAWAIIAN SOILS

Published in full as Hawaii Agr. Expt. Sta. Tech. Bul. 1, Honolulu, September, 1943, pp. 41.

The capacity of soil to retain exchangeable bases is resident in two distinct components of the soil. These are the mineral clay fraction and the soil organic matter.

The base exchange capacity of organic matter in Hawaiian soils was found to vary considerably, not only in different areas, but also within the individual profile. A mean value of approximately 200 milli-equivalents per 100 grams of organic matter was obtained.

The influence of organic matter on the exchange capacity of island soils is extremely varied. This variation results (1) from the wide range in organic matter content of the soils and (2) from the varying degrees of laterization and hence of mineral exchange capacities.

In soils of the less humid areas, containing relatively small amounts of organic matter and sometimes possessing substantial mineral exchange capacities, the role of organic matter was a subordinate one. In such soils as little as 10 to 15 per cent of the total exchange capacities was associated with the organic fractions.

The contribution of organic matter to the exchange capacities of the humid region soils was much greater. These soils contain, as a rule, large amounts of organic matter. Moreover, many of them are highly laterized, possessing low mineral exchange capacities. In such soils the capacity to retain exchangeable bases is predominantly associated with the organic matter. Specifically, the organic matter in the humid region soils that were examined accounted for from 50 to more than 90 per cent of the exchange capacities of the entire soils.

Study of the base exchange capacities of the Hilo and Hamakua coast soils in relation to rainfall, showed mineral exchange capacities of these soils to diminish with increasing precipitation. The exchange capacity of the soil organic matter, on the other hand, appeared to be independent of rainfall. Thus the organic matter in these soils plays an increasingly dominant part with increasing rainfall.

ARTHUR S. AYRES

SOME EFFECTS OF PHYTOHORMONES ON PINEAPPLES

Experiments with "Fruitone" (trade name of a commercial product which includes the plant growth regulators, alpha-naphthaleneacetic acid and alpha-naphthaleneacetamide) are reported.

Low concentrations applied to plants prior to normal floral differentiation induced premature floral differentiation and early ripening of fruit. In contrast, high concentrations applied not long before normal floral differentiation delayed flowering and subsequent ripening of fruit.

High concentrations applied after floral primordia had been formed stimulated the growth of the peduncle and of the fruit. Applications made at this time had no appreciable effect upon the time of flowering or ripening of the fruit.

High concentrations of the material restricted development of slips, but low concentrations apparently stimulated the growth of slips when applications were made after floral differentiation.

HAROLD E. CLARK and KENNETH R. KERNS

FOOD STORAGE PROBLEMS UNDER WAR CONDITIONS

War conditions are responsible for many innovations. One of these is the storage of a huge supply of cereal foodstuffs, mainly rice, to care for the needs of our Oriental population. For various reasons, mostly economic, it had not been the custom to keep large stocks of cereals on hand. Therefore, when the Commanding General, Hawaiian Department, early in 1941 requested local importers to begin to store up a six-month supply, all kinds of objections were raised. By October, nothing had been done.

Then came the attack on Pearl Harbor and the declaration of war. Military authorities took over the task of regulating supplies and the Surplus Commodities Corporation became the suppliers and dispensers of twenty food items. By a most fortunate conjunction of circumstances, a new warehouse large enough to hold the whole supply of rice was made available.

Unfortunately, in the hurry of removing stocks from overcrowded wharves, shipments of heavily infested peanuts, corn, and wheat were moved into the warehouse with the rice. By July the accumulation of insects had become so great that it was feared that the rice, valued at millions of dollars, would be lost. Attempted control by spraying the exposed surfaces of bags proved ineffective. It then became apparent that fumigation of the whole warehouse was the only solution. A small warehouse was fumigated as a pilot operation under the direction of members of the Board of Agriculture and Forestry and two weeks later the same crew fumigated the large warehouse. The cost, while necessarily high (the gas alone cost $1,725.00), was very small when estimated in terms of bags treated.

The important factors in effective warehouse fumigation appear to be: (1) construction features of the warehouse; (2) perfect sealing; (3) satisfactory introduction, distribution, and circulation of the gas (methyl bromide in this case).

Where the cereals and cereal products have been stored in warehouses which are old and in poor condition and where a satisfactory seal cannot be obtained, infested stores are being fumigated under tarpaulins.

This operation is not altogether satisfactory. Several lots of cereals and other dry foodstuffs and seeds have been fumigated satisfactorily in the sealed vaults of the Plant Inspection Division.

DAVID T. FULLAWAY

ADAPTATION AND BEHAVIOR OF CERTAIN FOOD CROPS IN HAWAII: VEGETABLES

Contrary to popular belief, the climate in most areas of the Islands is well suited to production of a large number of vegetable crops. Such crops as carrots, beets, many kinds of beans, green onions, sweet potatoes, eggplants, several mustards, corn, and chard are adapted to production at medium to low elevations throughout the year. Seasonal planting, especially at low elevations, is recommended for such crops as cabbage, broccoli, potatoes, celery, and turnips. Bulb onions are sensitive to length of day and have given best yields when planted in fall and early winter.

It is fortunate that we do not have extremes of heat and cold. Our year-round mild climate is admittedly an invitation to attack and build-up of insects and diseases. Scientific agriculture can defeat pests, but no one has found a way to stop climatic extremes.

When potatoes are given good culture it does not pay to attempt to save money by planting small seed pieces. If soil moisture is adequate, the use of ethylene chlorohydrin is practical for treating dormant seed potatoes brought to the Islands in early fall.

Tomatoes are on the very border line of being adapted to growth throughout the year, even at low elevations. Bounty, a 1941 accession of the Hawaii Agricultural Experiment Station, has rapidly become Oahu's commercial summer tomato.

If we are asked today, "What are the overall chances for the successful heavy production of a variety of perishable vegetable crops here?" our answer would be, "If we are willing to contribute enough of our best agricultural land, our irrigation water, and enough of our best agricultural talent to the production of these crops, they can be grown in the quantities necessary for our population."

W. A. FRAZIER

ADAPTATION AND BEHAVIOR OF CERTAIN FOOD CROPS IN HAWAII: SWEET CORN

The high quality mainland varieties of sweet corn such as Golden Bantam and Country Gentleman do not thrive in Hawaii. They are seriously attacked by our corn leafhopper and by the mosaic disease which it transmits. We are fortunate, however, in having a tropical variety which is well adapted to our conditions. U. S. D. A. 34 was developed by the U. S. Department of Agriculture Station at Mayaguez, Puerto Rico, by isolating chance sugary seeds which appeared on ears of a Puerto Rican variety of field corn. It was introduced into Hawaii a few years ago by the Hawaii Experiment Station. It is not immune to mosaic, but it is highly tolerant and it usually escapes without serious damage from this disease.

Sweet corn has much to recommend it as an emergency food crop. It lends itself to mechanical planting and cultivation, is able to survive our local insects and diseases, is easily harvested, and can be grown throughout the year. It is a good energy food and is listed as a good source of vitamins A, B, and C.

In an attempt to develop strains combining high quality with resistance to mosaic disease, the Hawaii Experiment Station and the Experiment Station, H. S. P. A. have crossed U. S. D. A. 34 with Golden Bantam and other high quality varieties. This project is still in its initial stages.

A. J. MANGELSDORF

ADAPTATION AND BEHAVIOR OF CERTAIN FOOD CROPS IN HAWAII: EDIBLE SOYBEAN

The edible soybean is assuming prominence as a source of substitutes for animal proteins and oils in Hawaii's program of self-sustenance.

The high protein content of the green-shelled beans, rapid growth, freedom from serious insect pests and diseases, and cheapness of planting, cultivation, and harvesting all contribute to its value as an emergency food crop.

The soybean is one of a large group of plants which flowers under the stimulus of a long period of darkness. As the days become shorter the plants come into flower before the plant has developed to full size and a small crop results. The effect of short days can be offset by selecting varieties of late genetic maturity.

Success with year-round production of soybeans in Hawaii is dependent upon the correct choice of varieties for planting at the different seasons and upon good cultural treatment involving preparation of seed bed, nitrogen and phosphorus fertilization, and ample irrigation.

C. G. LENNOX

ABRASION HARDNESS

The aim of these studies has been to make a practical, simple instrument to test hardness of substances on a scale of 1 to 1000 to supplant the old crude Mohs scale of 1 to 10. The application of this instrument is not only to minerals, but to rocks, earthenware, glass, cements, metals, woods, and plastics.

Metallurgy uses indentation instruments serviceable for such forms of tenacity as cold malleability but not for brittle hardness as understood by the mechanic with a file, or the mineralogist with a scratching point. The writer's research of 1897 produced a microsclerometer which was used from 1906 to 1908 for a study of the constituents of steel and was limited to use in the field of a microscope. New experiments carry this forward to the use of a high-speed electric drill with both steel and diamond bits, the constants being calibrated to the simplest possible direct weighting and observation of depth of boring.

First results yielded a marked discrepancy in reading time but good agreements were obtained when hardness was read as depth. Thus for Hawaiian woods the following results were obtained (the readings represent thousandths of an inch depth obtained in 15 seconds with a 1/8-inch drill, having 6000 revolutions per second): lama wood 153, milo 150, uhiuhi 143, kolea 126, avocado 118, koa 113, kauila 105, sandalwood 72, ilima 32, lehua 8.2, hala 6.3, kolu 3.8, and kamane (light part) 2.6, the softest woods being drilled the deepest. These results are preliminary and are from single drillings.

A comparison of the results obtained with soft minerals, determined by same method, gives the following readings: gypsum 436, steatite 391, calcite 31, apatite 13.3, fluorite 11.8.

T. A. JAGGAR

CORRELATION OF RAINFALL AND GROUND WATER

Rainfall is the source of all terrestrial water and gives rise to the fractions of evaporated, transpired, surface discharge, and ground water. Ground water is the source of essentially all stored water in Hawaii. The amount of stored ground water at any one time is based on some combination of the infiltrated fractions from recently past rainfall minus the natural leakage, artificial leakage, and utilized discharge. The apparent storage in the Honolulu basal underground system is indicated by the artesian head. Because of the condition of bottom storage in the Ghyben-Herzberg lens and probable lag in its gain or loss, the real storage is probably not accurately indicated by any measurement we can make at present.

Broad relationships between rainfall, artesian head, and total measured discharge in the Honolulu and Pearl Harbor areas can be represented with considerable fidelity by linear multiple correlations, and it is believed that eventually the more important facts of rainfall infiltration, total ground water storage, and ocean and interzone leakage can be determined by statistical analysis.

CHESTER K. WENTWORTH

STUDIES OF THE ORAL SECRETIONS OF *PSEUDOCOCCUS BREVIPES*, THE PINEAPPLE MEALY BUG

The pineapple mealy bug, *Pseudococcus brevipes* (Ckl.), has been successfully fed on agar blocks made up with 2 per cent agar. The insect produces typical feeding tracks in these agar blocks. The diffusion of insect secretion beyond the feeding track was demonstrated by feeding the mealy bugs on solutions of radioactive phosphorus after which they were transferred to plain agar blocks. The presence of radioactive phosphorus in the center of the blocks was demonstrated. Another effect of the insect's secretion was to increase enormously the syneresis of the agar gel.

WALTER CARTER

EPIDEMIOLOGY OF TYPHUS AND LEPTOSPIROSIS IN HONOLULU

Surveys of the incidence of typhus and leptospirosis in man and animals were summarized in tables. Murine typhus was determined as a result of guinea pig inoculations with brain emulsion of rats trapped in seven districts of Honolulu. Each guinea pig received the brain emulsion of two to three and rarely five rats. Of 249 guinea pigs inoculated with brain emulsion from 600 rats, 73 developed typhus. Assuming that each infected guinea pig represented at least one infected rat, 73 or 12.1 per cent of the rats harbored typhus virus.

The prevalence of human and canine leptospirosis was determined by subjecting the serum of these hosts to a microscopic agglutination test using freshly formalinized cultures of *Leptospira icterohemorrhagiae* and *L. canicola* as antigens. Sera of 344 adult humans and 100 dogs were tested. Of the human sera examined, twelve were positive for *L. icterohemorrhagiae* and one to *L. canicola*. Of the dogs examined, twenty showed positive reaction to *L. icterohemorrhagiae* and nineteen to *L. canicola*.

The incidence of leptospiral infection among rats was based on the examination of silver-stained kidney sections of 350 rats trapped in seven districts of Honolulu. In addition, an examination was made of ninety-seven rats trapped along the banks of three fresh water streams. Of the 350 rats examined, an average of 2.9 per cent showed infection, and of the 97 rats from the streams, 8.2 per cent were infected. Of twelve mongooses trapped along Nuuanu Stream, four showed leptospirae in sections of the kidneys.

JOSEPH E. ALICATA

THE BLOOD AND PLASMA BANK IN TIME OF PEACE AND WAR

The Honolulu Blood Plasma Bank originated as a project of the Public Health Committee of the Chamber of Commerce in June of 1941. From June to November only 253 doses of plasma were processed and placed in storage. Then came December 7. People stood in line for hours waiting to be blood donors. Hospitals, big business concerns, and the University gave freely of their equipment and of their personnel for the work of the Blood Bank. Over fifty workers labored without ceasing doing all the tasks necessary to furnishing blood and plasma.

On December 24, 1941, the Blood Bank settled down to its present rate of about one thousand donors a month. In addition, the Blood Bank has sponsored the blood grouping of 24,000 persons on Oahu.

Adequate emergency provisions have been made and all hospitals and First Aid Stations have been advised of donors upon whom they can depend. The Blood Bank operates a peacetime blood bank in that whole blood and/or plasma can be borrowed by any physician for his private patients upon the understanding that the blood and/or plasma will be repaid by members of the family or by friends of the patient.

The Blood Bank, since December 7, has been sponsored by the Office of Civilian Defense and since July 10 has been in its own building on The Queen's Hospital grounds. The Mobile Unit has been in operation since September 21. It goes to the various war projects on Oahu and takes blood donations from civilian workers.

Total donors bled to date number approximately 13,500. Total plasma used to date represents 1,960 doses from a total of 9,154 doses prepared.

FORREST J. PINKERTON

THE FEATHER CAPES OF HAWAII

The feather capes and cloaks which formed the regalia of the Hawaiian aristocracy are the most beautiful in the Pacific area. Two types of capes were made: the rectangular with coarse netting and the larger feathers of the fowl, tropic bird, and man-of-war hawk; and the circular with very fine netting and the small red and yellow feathers of forest birds. In rectangular capes, the netting was made in one piece but in circular capes the netting was cut and stitched to shape, like a tailored garment. In both types, the feathers were tied to the netting with fine thread. Though the netting knot had been forgotten by the Hawaiians, it was rediscovered at Bishop Museum by untying cave fragments under a microscope. A study of garments in various museums shows that the circular cape was developed from the coarser rectangular cape, which in turn probably was derived from the common rain cape made of split ti leaves tied to a piece of fish net in overlapping rows. The rain cape served a primary need, but the Hawaiian craftsmen, by substituting feathers for ti leaves, opened the way to artistic development and social decoration of the highest order.

PETER H. BUCK

A CHEMICAL IDENTIFICATION OF A LARGE STOCK OF STEELS IN ONE WEEK BY SPARK AND SPOT TESTS

The Testing Laboratory at the Pearl Harbor Navy Yard received a request for chemical testing at a local storage yard of a large number of rods of rivet steel. The chemist had to find methods which could be applied rapidly to each piece without disturbing its place in the pile.

Two methods have been used for work of this sort: (1) the "spark test," which consists of placing the steel against a rapidly revolving grinding wheel and observing the form and color of the resulting stream of sparks, and (2) the "spot test," which involves the solution of a portion of the sample in a drop of reagent placed upon the prepared surface and the development of a characteristic color of the element sought by further treatment of the drop.

The main virtue of the spark test is speed. To check samples suspected of being high manganese steels upon sparking evidence, it was decided that a reliable spot test was needed.

It was found that manganese would oxidize at room temperature on a porcelain spot plate and that the approximate amount of manganese in the sample could be estimated from the relative intensity of purple color developed in the drop in the presence of the excess sodium bismuthate oxidizing agent.

For work in the field, a kit was made up containing spot test equipment arranged compactly. The spark tests were made by means of a portable grinder using an Alundum wheel.

During this work, steels were found which gave the orange spearhead characteristic of molybdenum. Drillings were taken from these bars to the laboratory for spectrograph analysis, which verified results of the spark test.

LAWRENCE BOGGS

A CHEMICAL METHOD FOR IDENTIFYING COMPOUNDED COMMERCIAL SYNTHETIC RUBBERS

One of the most evident war changes in manufacturing industries is the substitution of synthetic rubbers for natural rubber. This poses a new problem for the analytical chemist—the problem of identifying the many new types of synthetics.

One of the most interesting and probably the most accurate method of identification is the spectrographic method but lack of suitable equipment has prevented use of this technique in the Testing Laboratory at Pearl Harbor. However, an analytical scheme has been developed in our laboratory which can be employed to discriminate among the most common synthetic rubber types. This consists of a semi-quantitative analysis to determine amount of nitrogen, phosphorus, chlorine, and sulfur present.

The table shows types of synthetics and their chlorine, phosphorus, nitrogen, and sulfur content. This table was assembled from information in current publi-

ELEMENT	TYPE RUBBER	PER CENT ELEMENT IN—	
		Raw polymer	Compounded product
Chlorine	Neoprene	40	20-30
	Koroseal	60	25-40
Phosphorus	Koroseal	None	4-5
Nitrogen	Buna N	13	6-10
Sulfur	Thiokol	64	30-40
	Natural rubber	None	1-3

cations and texts on rubber, and from data made available through the courtesy of the Rubber Reserve Co., Washington, D. C. The figures were further checked by actual analyses of standard samples of compounded synthetics furnished by the manufacturers.

VERNON E. HARGRAVE

SPEEDING UP THE CHEMICAL ANALYSIS OF MISCELLANEOUS FERROUS ALLOYS BY MEANS OF THE SPECTROGRAPH

The spectrograph is the most efficient tool yet used at the Pearl Harbor Chemical Laboratory to speed up the chemical analysis of iron and steel.

This paper is based on notes on speed, precision, and completeness of analysis, as attained in the comparative analysis of two alloy steels under controlled conditions. The samples studied were two Bureau of Standards officially analyzed steels—No. 30C, a chrome-vanadium alloy, and No. 111, a nickel-molybdenum alloy.

One group of men who had had considerable experience with classical methods was given the two samples for analysis. Another man accustomed to using the spectrograph, but with less general experience was given the same two samples. The relative speed of the two crews on the same samples was taken from the official and usual labor time reports.

The analysts were not informed that test runs were underway, but red "URGENT" tags were placed on the samples to encourage maximum speed and to insure against avoidable delays.

A mainland navy yard chemical laboratory cooperated in this research. It was felt that the analysis by classical methods of the same two steels by this staff would be valuable as a control operation.

Results of the test indicated that the spectrograph accomplished in one hour what two independent groups of more experienced analysts using older techniques accomplished in five and a half, and in ten hours, respectively.

FRANCIS FONG

A PHYSICOCHEMICAL METHOD FOR ANALYZING CADMIUM IN THE PRESENCE OF ZINC

The experimental data for this paper were secured by Mr. Vernon Hargrave under the supervision of Dr. Earl M. Bilger in the Laboratory of Physical Chemistry at the University of Hawaii. The author suggested the problem and served in the role of consultant.

Because cadmium and zinc are very similar in their chemical properties, their analytical separation is difficult. Since cadmium invariably occurs in at least trace concentrations in zinc alloys, its separation and determination are required. The standard "A. S. T. M." gravimetric method is cumbrous and demands repeated precipitations by hydrogen sulphide.

Several physicochemical methods have been suggested, particularly electrochemical methods. It was decided to study some of the suggested electrochemical methods for the analysis of cadmium in the presence of zinc, using modern instruments of the University of Hawaii.

The hydrochloric acid-hydroxylamine hydrochloride bath, the sulphate bath, the cyanide bath, and the sodium acetate bath were investigated. The latter, upon exact measurement, proved to make the greatest separation of the decomposition potentials of cadmium and zinc, to give reproducible results for cadmium, to be favored by operation at room temperature, and to be most free from operating difficulties. No change is recommended except to buffer at pH 3.3, operate at room temperature (25-30° C.), and to employ instruments of adequate sensitivity and capacity.

W. H. HAMMOND

A CONCEPT OF THE PAPAYA FRUIT AS AN ANOMALOUS STRUCTURE

Flower forms transitional between the staminate and the pistillate in the papaya (*Carica papaya* L.) furnish evidence that the rudimentary pistil of the staminate flower and the functional pistils of hermaphroditic and pistillate flowers are not homologous structures and that in terms of "true" carpels the papaya fruit is an anomaly.

The staminate flower possesses ten epipetalous stamens inserted on a short staminal ring at the throat of the tube of the gameopetalous, five-lobed corolla. Five of the stamens are subsessile and lie opposite the corolla lobes; five are on slightly longer filaments and alternate with the corolla lobes. A superior pistil is present only as a rudimentary structure devoid of a stigma. A transitional form of staminate flower occurs in which one to ten (usually five) hairlike staminodia arise at the base of the rudimentary pistil and sometimes are adnate with it in part.

The type of hermaphroditic flower called "elongata" corresponds with the staminate flower in numbers and arrangement of stamens and petals, though it is generally of larger size. It possesses a superior, functional pistil derived, not from reversion to functionability of the rudimentary pistil of the staminate flower as is generally assumed, but from the transmutation of one or more of the ten staminodia into carpels fused laterally into a closed ovary.

In the "pentandria" type of hermaphroditic flower the five subsessile stamens lying opposite the corolla lobes have become carpellodic and fused with the pistil. Consequently, the number of normal stamens is reduced to five, and the new pistil is inferior, being adnate with the corolla below the staminal ring.

The pistillate flower has resulted from carpellody of the ultimate set of five stamens. Superficially it appears to be polypetalous and possess a superior pistil, but actually it, too, is gameopetalous and has a slightly inferior pistil.

A rudimentary pistil comparable with the one in the staminate flower is sometimes found at the top of the receptacle within the ovarian cavity of each of the other three types. It serves as additional evidence that the papaya fruit is not the product of a "true" pistil but of staminodia or of stamens which have become carpellodic.

Even the fruits of hermaphroditic and pistillate flowers are not strictly homologous structures, for the fruit of the elongata hermaphrodite is derived only from the inner whorl of staminodia; the fruit of the pentandria hermaphrodite is derived from the inner whorl of staminodia on which have been superimposed five stamens of the outer whorl; and the fruit of the pistillate flower is derived primarily from the ultimate set of five stamens of the outer whorl.

WILLIAM B. STOREY

CRYOLITE: AN IMPORTANT INSECTICIDE FOR SOME VEGETABLE CROPS

In investigations carried out by the Entomology Department of the Hawaii Agricultural Experiment Station on the control of insects of vegetable crops, cryolite has repeatedly been found to be a satisfactory answer to the problem. While time has not permitted us to carry any of these studies to the limit we would wish, practical use of recommendations made on the basis of the studies to date is demonstrating the soundness of the results secured.

Cryolite is the name given to a fluorine-containing mineral mined in Greenland, North America, Russia, and France. As mined, the material contains 98 per cent sodium fluoaluminate or sodium aluminum fluoride. Both natural and synthetic cryolites are now available in satisfactory form for use as insecticides.

Satisfactory control has been secured with cryolite for the following major insects: corn earworm on tomatoes, bean-pod borer, cabbage webworm, pepper weevil, tobacco flea beetle, sweet potato vine borer, and sweet potato weevils.

These eight major insects and nine of lesser importance are controllable on twelve crops. The success which has attended the investigations demonstrating the value of cryolite for so many insects is reflected in the imports of cryolite to Hawaii over the past few years. From none in 1939, imports have risen to an average of 30,395 pounds per annum for 1941 and 1942.

F. G. HOLDAWAY

USEFUL METHODS OF OBTAINING AND PREPARING FOOD FROM COCONUTS

In demonstrating the various uses of the coconut it was evident that many persons long in Hawaii are unfamiliar with the full value of coconut as food.

A good husking stick can be made of guava wood, sharpened to a flat edge. Fix it in the ground firmly. Grasp a nut by the ends, thrust it down upon the husking stick so that the blade jabs into the stem end of the thickest lobe. Bear down until a section of the husk breaks off. Rotate the nut about four inches and repeat the operation.

The liquid squeezed from the grated mature nut is the most useful form of coconut food. A good grater may be made from a piece of coconut shell 1¼ inches along the grating edge and cut to make 15 sharp pointed teeth. Reinforce this piece with another without teeth and lash the two to the end of a stick fixed to a stool or box. Squeeze the grated meat through a cloth, a handful at a time. A little hot water or coconut water may be added to assist separation of the fluid from the fiber of the meat. Allowed to stand a day in the icebox, the cream rises and may be churned with an egg beater. In southern Polynesia, lime juice and salt water are often added to make a sauce—almost liquid butter—into which food is dipped.

Recipes for many delicious dishes are available. Use the cream as milk or cream in any recipe. Grated meat is used in candies, cake frostings, and, when fermented with the juice of shrimps, as a delicious condiment similar to cheese. The interior of the sprouted nuts yields food that is a delicacy and the soft, semi-transparent meat of immature nuts is a nourishing, easily digested food. Cut the meat of a mature nut into thin flakes and dry in slow heat for nutty coconut flakes. The core of the growing part of the tree (heart-of-palm) has a coconut flavored, celery-like texture. The liquid of mature nuts has a laxative effect but young nuts are filled with pure, delicious, cool, potable fluid.

KENNETH P. EMORY

THE DEVELOPMENT OF THE FLUOROGRAM

(Abstract not received.)

C. A. DOUGAN

HAWAIIAN WEAPONS

The Hawaiians used projectile weapons and hand weapons. When the enemy approached within range, slings (*maka*) made with a pouch and two strings, were used to throw elliptical sling stones with pointed ends. On nearer approach, javelins (*ihe*) with barbed points and from six to eight feet long were thrown with great accuracy.

At close quarters, the favorite weapon was the long spear (*pololu*) from twelve to eighteen feet long, with a flattish point and a knobbed butt. When an opponent got inside the point of the long spear, the principal weapon was the dagger (*pahoa*). The commonest form resembled a cut off spear point, about two to three feet long, with a hole through the middle for a wrist loop. The pointed end was used for stabbing and, by shifting the grip, the blunt end was used for striking, the weapon thus forming a truncheon dagger. In some daggers the blunt end was enlarged to form a club and this type was therefore a bludgeon dagger. Two other types were made with the handle at one end, one with a flat two-edged blade and the other with a slightly curved point without defined side edges.

Short clubs were also made of wood and of stone.

The wooden clubs (*la'au palau*) were usually roughly made from a natural knot or root with a short handle. An interesting club was formed of a grooved stone head lashed to a short wooden handle.

A unique type of club (*pikoi*) consisted of a wooden or a stone head to which a long cord was attached. It was thrown at an opponent's legs to wind around them and trip him up whereupon he was readily dispatched. Though the Hawaiian weapons are not particularly spectacular, the daggers and tripping club are unique for Polynesia.

PETER H. BUCK

NECROLOGY

ROMANZO COLFAX ADAMS

Romanzo Colfax Adams, Hawaii's pioneer sociologist, died in Honolulu on September 10, 1942. He was born in Bloomingdale, Wisconsin, on March 22, 1868, and his formative years in this rural, pioneer setting profoundly influenced his subsequent teaching and research interests. His advanced training was obtained at the Iowa State Teachers College, the University of Michigan, and the University of Chicago (Ph. D., 1904). His teaching experience included professorships at Western College, the University of Nevada (1911-1920), and the University of Hawaii (1920-1935).

Dr. Adams came to Hawaii in 1920 as professor of economics and sociology of the University of Hawaii, but his deep interest in people soon led him to devote most of his research and teaching to the more human of these two sciences. It is as an authority on the social relationships between the various peoples of Hawaii that Dr. Adams achieved his greatest renown.

The field of race relationships became his special research interest. His writing on this subject, notably his *Peoples of Hawaii* (1925 and 1933) and *Interracial Marriage in Hawaii* (1938) have attracted the thoughtful attention and acclaim of social scientists the world over. Romanzo Adams was preeminently "a friend of the people of Hawaii" and most of his studies were devoted to the analysis of local problems involving human relationships.

HAMILTON POPE AGEE

Hamilton Pope Agee, consulting agriculturist for Castle and Cooke, Ltd. and the Hawaiian Pineapple Company, Ltd. since 1935, and prior to that time director of the Experiment Station, Hawaiian Sugar Planters' Association, died in Honolulu on December 22, 1942. He was born in Memphis, Tennessee on December 9, 1884. After his graduation from Louisiana State University in 1904, he held several positions in the sugar industries of Cuba and Puerto Rico. In 1909 he became assistant director in charge of the Louisiana Sugar Experiment Station in New Orleans, serving until 1911 when he joined the Experiment Station, H. S. P. A., as agriculturist. In 1913 he was appointed director of the Station in which capacity he served for twenty-two years. One of the founders of the International Society of Sugar Cane Technologists, he held the office of general chairman from 1924 to 1927. From 1925 to 1935 he was a member of the Territorial Board of Agriculture and Forestry. A man of broad vision and sympathetic understanding, Hamilton Agee will be remembered for his contributions to the advancement of agriculture and for the kindly encouragement and wide counsel which helped so many of his younger associates along the path toward greater usefulness.

RICHARD A. COOKE

Richard A. Cooke, prominent Honolulu business executive, died on February 16, 1941, following a heart attack. He was born in Honolulu on January 24, 1884, son of Charles Montague and Anna Charlotte (Rice) Cooke. After graduating from Yale University, he entered a long and active business career in Honolulu, being president of C. Brewer and Company, prominent in the affairs of the Bank of Hawaii, and officer or director in many local corporations. He was a member and president of the Hawaiian Sugar Planters' Association and was long an active student of the economic problems of the sugar industry and zealous in working to achieve and maintain for Hawaiian sugar an equitable place in the national pattern. Mr. Cooke was a member and supporter of The Hawaiian Academy of Science since the year of its organization.

EDWARD MACFARLANE EHRHORN

The death of Edward Macfarlane Ehrhorn, a charter member of The Hawaiian Academy of Science, occurred February 10, 1941, in Honolulu. He was born in San Francisco January 24, 1862, and spent most of his earlier life in California. However, his childhood education was obtained in Europe. Later, he studied entomology at Stanford University, California, after which he was deputy quarantine officer for the California State Board of Agriculture and later county entomologist and horticultural commissioner for Santa Clara County, California and first deputy state commissioner of horticulture. Mr. Ehrhorn came to Honolulu in 1909 as superintendent of entomology at the Territorial Board of Agriculture and Forestry. When plant inspection was organized as a separate division in 1916, Mr. Ehrhorn was placed in charge, a position which he held until his retirement in 1926. The University of Hawaii conferred the honorary degree of Master of Science on Mr. Ehrhorn in 1932. He was a member of the American Association for the Advancement of Science, the American Association of Economic Entomologists, the Entomological Society of America, the Pacific Coast Entomological Society, the California Academy of Sciences, the Hawaiian Entomological Society, and the Hawaiian Botanical Society.

MARY EDITH WINTERS

Mary Edith Winters, laboratory technician, died in Michigan on November 3, 1942. Miss Winters was born in Grass Lake, Michigan on July 11, 1906, the daughter of C. N. and Nina N. Winters. After attending the schools of Grass Lake, Miss Winters entered the University of Michigan graduating in 1928 and receiving a Master of Science degree in 1936. The following year she accepted a position at Queen's Hospital in Honolulu. Three years later she became chief technician at Ewa Hospital where she conducted research on arsenic poisoning. During the weeks following the attack on Pearl Harbor, Mary Winters, though in poor health, spent long, unselfish hours in laboratories where her skill was needed. Miss Winters remained in Hawaii until June 1942, when, because of illness, she returned to her home in Michigan. By the very nature of her work in the Islands, she contributed much to the welfare of Hawaii.

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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

NINETEENTH AND TWENTIETH ANNUAL MEETINGS 1943-1945

Published by the University of Hawaii   Honolulu, T. H., 1945

FOREWORD

This volume of the Proceedings of the Hawaiian Academy of Science covers the Nineteenth and Twentieth Annual Meetings. The publication schedule of the Academy is now brought up-to-date, and it is hoped that from now on each annual volume can be published within three or four months after the final session of the year. A cooperative agreement for publication has been made with the University of Hawaii. This arrangement offers prospect that the present form and editorial procedure can be continued.

Work is in progress on the compiling of an Academy mailing list based as far as possible on learned institutions active in 1945. Academy members are invited to suggest institutions for inclusion on this list.

This volume of the Proceedings carries for the first time since 1940 a list of Academy members. The list has been revised to May, 1945 in accordance with information available to the Secretary.

OFFICERS

1943 - 1944

President, Carey D. Miller
Vice-President, J. L. Collins
Secretary-Treasurer, Mabel Slattery

Councilor (2 years), Thomas A. Jaggar
Councilor (1 year), Peter H. Buck
Councilor (1 year), Harry F. Clements (ex officio)

1944 - 1945

President, J. L. Collins
Vice-President, Peter H. Buck
Secretary-Treasurer, Chester K. Wentworth

Councilor (2 years), Colin G. Lennox
Councilor (1 year), Thomas A. Jaggar
Councilor (1 year), Carey D. Miller (ex officio)

1945 - 1946

President, Peter H. Buck
Vice-President, Thomas A. Jaggar
Secretary-Treasurer, Chester K. Wentworth

Councilor (2 years), Christopher J. Hamre
Councilor (1 year), Colin G. Lennox
Councilor (1 year), J. L. Collins (ex officio)

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE."

THE NINETEENTH ANNUAL MEETING 1943-44

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F. G. Holdaway: Progress in the Control of Insects Attacking Vegetables.

Jane E. Howe: Some Observations on Atopic Conditions.

Bernard Witlin: The Avian Embryo in Research.

DECEMBER 3, 1943

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Elwood C. Zimmerman: Human Filariasis in the Pacific.

Charles P. Lyman: Physiology and Military Aviation.

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David D. Bonnet: Certain Biological Aspects of Mosquito Control in the Territory of Hawaii.

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Thomas A. Jaggar: Active Volcanoes in the War Zones.

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Business Meeting

Installation of Officers

Address by Retiring President
Carey D. Miller: Some Aspects of Growth and Food Needs.

Abstracts

THE ANNUAL MARCH OF DAILY MEAN TEMPERATURE AT HONOLULU

This is a statistical study of daily mean temperatures at Honolulu, for the 53-year period from 1890 to 1942, inclusive. The average values of the daily mean temperature for each of the 365 days of the year for the 41-year period from 1890 to 1930, inclusive, were supplied some years ago by J. F. Voorhees. Two years ago, Harry T. Tanaka tabulated the data for the 10-year period from 1931 to 1940, inclusive. To these have been added the data for 1941 and 1942. Thus averages are now in hand for the 53-year period from 1890 to 1942, inclusive.

The average date of the warmest day is September 6, which gives a lag of 77 days after the summer solstice. Among the causes for this long lag are (1) the great heat capacity of the surrounding ocean water, which makes it not only warm up slowly, but also cool off slowly, and continue to hold Honolulu's temperature rather high for a long period, and (2) the fact that in this latitude the noon sun is high in the heavens for many days after the solstice, so that we continue to get much insolation each day and cooling off is retarded.

February 12 and 13 tie for the average date of the coolest day, but in the following discussion February 12 will be used. The lag after the winter solstice is 53 days, and is rather long, but shorter than the lag of the warmest day.

The extreme temperatures are 78.5° F. and 70.8° F., giving a range of 7.7° F. The period during which the temperature rises is 206 days, and the period of falling temperature is 159 days. Honolulu takes 47 more days in warming up than in cooling off. The warming up period is 30 per cent longer than the cooling off period. The cooling period lasts for 43 per cent of the year, the warming period for 57 per cent.

From mid-January to the end of March there are several minor oscillations, for which no explanation comes to mind.

I am indebted to Stephen B. Jones for calling my attention to the importance of the ocean's heat capacity.

HAROLD S. PALMER

ARE INSECTS AND DISEASES TO BE A CRITICAL FACTOR IN YEAR-ROUND FOOD CROP PRODUCTION?

The successful growing of food crops in Hawaii requires knowledge and skill which can only be gained by experience. If year-round production is expected, adjustments must be made for certain crops to meet local pest conditions. Suggestions are based on the experience of the Victory Garden Committee which has been observing field and garden production for two years. While insects and diseases cannot be considered critical factors in year-round production, they do curtail production and unless they are kept in control by the use of natural enemies, insecticides, etc., they will hamper the production program.

D. T. FULLAWAY

PROGRESS IN THE CONTROL OF INSECTS ATTACKING VEGETABLES

Progress in the control of insects attacking vegetables in Hawaii during the war comprises five main phases: (1) determining the insect problems; (2) the changing crop picture; (3) the occurrence of new insect problems; (4) experimental work on the control of major insects; and (5) changed importance of insect problems due to the changing agriculture.

Changes in Hawaiian agriculture have brought to light an increase in importance of some problems formerly of little account. One of these changes pertains to tomato production.

The introduction of the variety "Bounty" by W. A. Frazier of the University of Hawaii Agricultural Experiment Station in 1941 has led to increased growth of tomatoes during the summer months at low elevations. As a result tomato bug has become more important.

The introduction of "Bounty," control of corn earworm and other chewing insects by means of cryolite, and control of tomato bug by means of talc-nicotine dust have resulted in two years in an increase in commercial summer production of tomatoes of 79 per cent, and on Oahu in an increase of 264 per cent.

F. G. HOLDAWAY

SOME OBSERVATIONS ON ATOPIC CONDITIONS

Allergic rhinitis, allergic dermatitis, allergic gastrointestinal symptoms, and many types of asthma are all conditions which are placed under the heading of atopy. These conditions all have a hereditary basis, although the specific sensitivity itself is not inherited.

Atopy, or hereditary hypersensitivity, is to be distinguished from anaphylaxis, or induced hypersensitivity. Anaphylactic cells can be desensitized—atopic cells cannot; atopy can be demonstrated in passive transfer—anaphylaxis cannot. When atopic conditions were first studied, they were thought to be anaphylactic reactions. But true anaphylactic reactions are probably very rare in man.

In the control of allergic symptoms, general physical health is all-important. A well-balanced diet with regular meals, plenty of rest, and good elimination are the first considerations. Drugs are administered to relieve symptoms, not as cures. However, by injections of small amounts of the specific antigen the patient can sometimes be kept symptom-free over long periods of time.

Climatic conditions seem important in many cases, although all these relationships are not known.

The atopic patient is taught that his condition is a study, not a disease; he must learn to understand it and avoid the atopens.

JANE E. HOWE

THE AVIAN EMBRYO IN RESEARCH

Significant recent developments in medical research have demonstrated the utilization of the avian embryo in the study of certain phases of disease.

On the 44th hour of incubation after fertilization of the avian egg, there is the onset of the embryo's heart beat. By the 8th day of incubation the extensive and highly vascular chorio-allantoic membrane completely envelops the embryo, its protective amniotic sac, and the yolk sac. This is the ideal embryo to employ in research.

Techniques Employing Avian Embryos

INJECTION METHODS	TISSUE CULTURE METHODS
Goodpasture	Carrel Flask
Brandly	Hanging Drop Slide
Burnett	Perfusion Technique
	Tissue—Agar Medium

The utilization of the developing egg in the study of disease emphasizes the possibilities and many uses of the avian embryo in research.

The established advantages are: (1) propagation and study of viruses in pure culture; (2) titration and detection of minute quantities of toxic agents and antiserum; (3) pathologic and serologic study and differentiation of various infectious agents and their products; (4) elucidation of the role of certain nutritional and physiologic factors in disease causation; (5) utilization of egg-cultured and tissue-cultured viruses in fields of immunization; (6) investigations of fundamentals of resistance and immunity; and (7) study of tissue growth.

There is a ready availability of and economy in using developing eggs as compared with the usual laboratory animals. There are savings in quarters, equipment, and feed, and reduction in the hazards of cross-infection, and dissemination of infection outside the laboratory.

BERNARD WITLIN

NATIVE CRAFTS HAVE GONE TO WAR

On February 16, 1943, the Bernice P. Bishop Museum inaugurated a course of instruction on survival in the South Seas for men of the armed forces. Kenneth P. Emory, ethnologist, was detached by Museum Trustees for full-time service as instructor and later he was assisted by Loring Hudson of the Kamehameha Schools. In December, the Army took over the instructors and supplied regular army personnel to assist in the lectures and in procuring and preparing material for demonstrations.

One of the exhibition halls was devoted entirely to exhibits from the Museum collections illustrating native foods and the native methods of procuring them. Specimens from the native crafts which would be useful were also shown and large photographs illustrated the types of islands and the people inhabiting them.

Practical instruction was given in an open courtyard between the Museum buildings, where huts and a lecture room of coconut leaves were built. Men were taught various native practices which might prove valuable in the jungles and atolls of the southwest Pacific. They were taught to recognize various edible plants and fruits, to husk and grate coconuts, to plait mats and baskets from green coconut leaves, to make shelters and sandals, to produce fire in coconut husk, and to cook food in native ovens. During the year about 10,000 men passed through the school and by carrying the instruction to the war zone, the native crafts have literally gone to war.

PETER H. BUCK

HUMAN FILARIASIS IN THE PACIFIC

Filariasis is a disease caused by nematode filarioid worms. It is widespread in many tropical and subtropical regions of the world and is especially prevalent on Pacific islands. It is known better, perhaps, to the layman as elephantiasis; but elephantiasis is only one of its several ultimate manifestations.

The disease is transmitted from one person to another by several species of mosquitoes. The adult worms live in the lymphatic system and give rise to young called microfilaria which swarm into the blood and are in turn sucked up by the mosquito vectors. After undergoing asexual metamorphosis in the mosquito, the worms are capable of infecting human beings by entering through the skin when the mosquito host bites. The sexual cycle is passed in man.

In most places in the world, a peculiar periodicity is noted in the appearance of the larvae in the peripheral blood. None are found during the day, but at night they swarm into the blood to reach a peak of abundance between 10:00 P.M. and 2:00 A.M. In the Pacific from Fiji eastward, there is no periodicity, and larvae may be found in the blood at any time. These factors appear to be correlated with the habits of the vectors in the Pacific, some of which are nocturnal, others diurnal.

The blockage of the lymphatics and other conditions caused by the presence of the worms results in various pathological conditions such as lymph scrotum, varicose groin glands, chyluria, chylocele, and abdominal dropsy. Elephantiasis develops in a certain percentage of long-enduring cases. The lower extremities are affected in most of the cases of elephantiasis seen in the Pacific. In some Pacific islands as high as 75 per cent or more of a local population may be infected with the disease.

Although there are two mosquito vectors of the disease in Hawaii (*Culex fatigans* and *Aedes aegypti*), it is not known that the disease has ever been transmitted in the Territory.

ELWOOD C. ZIMMERMAN

PHYSIOLOGY AND MILITARY AVIATION

Many physiological changes encountered in flying are due to changes in atmospheric pressure. Sea level atmospheric pressure is 760 mm. of mercury. At 38,000 feet the pressure is 152 mm. of mercury.

Anoxia occurs as the partial pressure of oxygen in the lungs decreases with the total barometric pressure. The resulting decrease in the oxygen in the red blood cells causes a lack of oxygen in the tissues. Eyesight and the higher nerve centers of the brain are first affected.

When wearing an oxygen mask the partial pressure of oxygen in the lungs is increased by substituting oxygen for nitrogen. However, above 38,000 feet, even when breathing pure oxygen, the partial pressure of oxygen is so reduced that the flier will suffer from anoxia.

During the decrease of atmospheric pressure nitrogen, oxygen, and carbon dioxide are released as bubbles from solution in the body fluids. Nitrogen bubbles collect and cause aeroembolism. The other gases are picked up by the hemoglobin.

Aeroembolism is of three types: "bends," an aching pain in the joints or muscles; "chokes," a burning sensation in the lungs; and "itch," a variety of uncomfortable sensations in the skin. Presumably these sensations are caused by bubbles pressing on nervous tissue.

Expansion and contraction of gases can cause pain if the middle ear or the sinuses are improperly ventilated. In the former, the eardrum is forced inward on descent, with resulting inflammation and possible infection. In the latter, the membranes lining the sinuses can be partially torn.

The centrifugal force caused by sharp turns in flying will drain the blood in the direction of the force. If the blood is drained from the head, "blackout" or darkening of vision occurs. If in the opposite direction, "red out" and possible cerebral hemorrhage will take place.

Night vision is chiefly dependent on the rod cells of the retina. Sufficient oxygen and ample amounts of vitamins A and D are very important. Red goggles are worn before night flights to dark adapt the eyes, since red light does not affect the rod cells.

CHARLES P. LYMAN

A CHEMICAL AND PHYSIOLOGICAL STUDY OF THE NATURE AND PROPERTIES OF *LEUCAENA GLAUCA* (KOA HAOLE)

Presented by J. H. Beaumont.

Koa haole contains a toxic principle which causes alopecia, cataract, retardation of growth, and other symptoms of ill-health in rats. The toxic properties of koa haole are not attributable to selenium.

The toxic principle mimosine, which occurs in the water soluble fraction of seeds and leaves, was isolated, purified, and its properties determined. Mimosine is an alpha-amino acid possessing phenolic properties. On the basis that one half the nitrogen content is Van Slyke amino nitrogen, the minimum molecular weight of mimosine is 198 ($C_8H_{10}O_4N_2$).

The color reaction of mimosine with ferric chloride can be used as the basis for a spectrophotometric method of quantitative analysis for mimosine. The mimosine content of oven-dry koa haole seeds and leaves was found to be 4.87 per cent and 2.89 per cent respectively.

The addition of soluble iron compounds to koa haole diets or to synthetic diets containing mimosine renders these diets relatively non-toxic to rats. It is believed that the detoxifying action of soluble iron salts is due to the inactivation of mimosine through the formation of an iron-mimosine complex which is less readily absorbed from the digestive tract than uncombined mimosine.

RUTH YOSHIDA

CERTAIN BIOLOGIC ASPECTS OF MOSQUITO CONTROL IN THE TERRITORY OF HAWAII

The distribution of *Aedes aegypti* and *Aedes albopictus* in the Territory of Hawaii has been determined on the basis of 2,000 samples of larvae collected from various types of water-holding containers. In the city of Honolulu *Aedes albopictus* appeared to be six times more abundant than *Aedes aegypti.* This figure depends upon the relative proportion of natural and artificial containers, since *Aedes albopictus* breeds in natural containers more frequently than does *Aedes aegypti.* Further, it was shown that *Aedes aegypti* is not found as widely distributed as *Aedes albopictus* and that the relative proportions in each inspection zone varies from 93 to 0 per cent *aegypti* in different zones (Smith St. and Manoa, respectively).

A preliminary survey of rural Oahu and the other islands has shown that *aegypti* is present in the following towns:

Oahu—Waianae, Waipahu, Ewa, Pearl City, Aiea, Honolulu

Kauai—Waimea, Kekaha

Maui—Lahaina

Hawaii—Hilo, Olaa, Pahoa, Honokaa, Kailua, Kealakekua

In view of the scattered distribution of *Aedes aegypti* and its preference for artificial containers, it is possible that *Aedes aegypti* might be eradicated from the Territory of Hawaii if vigorously attacked by trained men with unlimited supplies and with active, intelligent, and continuous coöperation by the populace.

DAVID D. BONNET

FISHERY RESEARCH IN HAWAII

Records of studies and investigations of Hawaiian fish and fisheries date from the time of early exploration of the Islands. The studies of Jenkins, Cobb, Jordan and Evermann, Gilbert, and of Fowler on our fish and fisheries and of Edmondson on our invertebrate fauna, constitute the background for present day fishery research. The later studies have been largely taxonomic studies and surveys of the fauna of our marine waters. Investigations of reproduction, spawning periods and spawning cycles, development and rate of growth, food, and feeding habits of our ichthyfauna are generally lacking.

The Department of Zoology of the University of Hawaii in 1939 began study of the biological problems of commercial fish ponds. The pond fisheries were selected for study because they appeared to be better suited to initial investigations of biological fishery problems than did the in-shore or open-sea fisheries. These studies have continued and the work has now grown into a program of cooperative fishery research between the Board of Agriculture and Forestry and the University of Hawaii.

Surveys of the fish, copepod and decapod crustacea, polychaetous annelids, and mollusc and insect fauna of the ponds have been carried out systematically. The algae and diatoms of the ponds have also been surveyed. It has been discovered that adult mullet are herbivorous and that their digestive system is morphologically modified to permit them to live on bottom material. Their food consists chiefly of diatoms and protozoa, particularly the former. The problem of pond management is chiefly one of supplying these foods in abundance.

CHRISTOPHER J. HAMRE

EXCHANGEABLE POTASSIUM IN SOME OAHU SOIL PROFILES

Published in full under title of "The Vertical Distribution of Available (Exchangeable) Potassium in Oahu Soils" in *Hawaiian Planters' Record,* 48 (4): (1944), 249-269.

Determination of exchangeable potassium in the profiles of 30 virgin and cropped Oahu soils revealed the existence of essentially two distribution patterns. In soils exhibiting the first pattern, potassium was at a maximum in the 0- to 6-inch horizon and decreased with depth either to the bottom of the section (of the profile) or to a point within the section and thereafter remained constant. In soils exhibiting the second pattern, potassium decreased downward to a minimum value within the section (usually at a depth of 1½ to 2 feet) and then increased with greater depth. In some soils the increase was slight but in others it was very pronounced. The level of potassium at a depth of 3 to 4 feet was frequently many times the minimum value and sometimes even greater than in the surface 6 inches.

It was found that virgin soils subject to moderately high rainfall (90 to 100 inches) were not always low in potassium. Virgin soils in areas of very low rainfall (15 to 20 inches), on the other hand, were not always well supplied with potassium.

Virgin soils were found to contain from 375 to 1,600 pounds of exchangeable potassium (K_2O) per acre in the upper 3 feet. Agricultural soils contained from 335 to 2,150 pounds of potassium in the upper 3 feet, and from 450 to 2,350 pounds in the upper 4 feet. In an exceptional case, potassium in the upper 4 feet of soil amounted to more than 6,000 pounds per acre.

A. S. AYRES and C. K. FUJIMOTO

FLOW OF LIQUIDS THROUGH NARROW CRACKS

The flow of liquids through small tubes takes place at rates which are directly proportional to hydraulic head according to Darcy's law. The relationship to diameter of tube is expressed by the Hagen-Poiseuille law which states that the rate of flow is proportional to the 4th power of the radius. Flow of water through fine natural sediments or through most aquifer rocks is according to Darcy's law.

Experiments with flow of water, organic liquids, and solutions through narrow cracks between walls of stone, glass, and metal, show that Darcy's law holds here also but reveal a remarkable retardation of rate with time, under any given head, in cracks less than about 0.2 mm. across. Reduction of rate is commonly as much as 100 times, in some cases more than 1,000 times, in course of 10 to 100 hours of flow. Possibility of accumulation of air bubbles, solid foreign matter, and various electrolytic effects have been considered, but the most likely explanation is that molecules of the liquid immobilized progressively along the crack walls by adsorption serve to constrict the crack so that effective flow is greatly reduced. Stated in other words, the boundary effects, as in the surface tension film, pervade across the whole crack, so that the random, kinetic state on which liquid behavior is premised is modified and largely destroyed.

Rate of retardation is generally proportional to rate of flow and building of the molecular film seems to proceed by capture of molecules from the margin of a weakened field at rates determined statistically. Films formed can be broken up by mechanical disturbance and rates restored to approximate the initial ones. Cracks so dealt with tend to retard more rapidly the second time.

CHESTER K. WENTWORTH

ACTIVE VOLCANOES IN THE WAR ZONES

The geological and engineering aspects of volcanic disaster are like war. Volcanoes go on the warpath also. Volcanology in crater observatories of Java, Japan, Hawaii, and Italy has grown because preparedness and defense were needed. By a freak of fortune the war and fiery volcanic outbursts broke out in Hawaii and the South Seas, at Rabaul, at Krakatoa, in Mexico, and at Vesuvius. Other volcanoes are doubtless active in the many Pacific fire mountains in the East Indies, the Philippines, Japan, Kamchatka, and the Aleutian Islands from whence all news has been suppressed.

Rabaul has a harbor flanked by two volcanoes that made a disaster in 1937. These, after a big earthquake, erupted again in 1941 and kept it up for nine months. Niuafoou volcano in Tonga, followed its lava eruption of 1936 with another in 1943 that exploded the salt water with lava flow and killed the crops. Mauna Loa in Hawaii followed its summit eruption of 1940 with a lava flow endangering Hilo in 1942, and another minor summit gush in 1943. Krakatoa was still building its new island between Java and Sumatra when the Japanese warships took over in 1942. Japan had a big earthquake on its west coast at Tottori September 6, 1943 killing 1,400 people.

Mexico has a notable lava-piling in progress, building a mountain 2,000 feet high over a cornfield. Starting in February, 1943, by September it had thrown up 2,000 million cubic yards of basalt in pulsations six seconds apart. The new fissure is 50 miles from Jorullo which built a similar mountain during seven months in 1759.

Now comes Vesuvius in the midst of occupation by American troops, just at the March equinox of 1944, and just 38 years after its disastrous climax of engulfment in April, 1906, with great lava flows in three directions and immense heaping of ashes all the way from Pompeii to Naples. The interval of a third of a century between great volcanic crises has many precedents.

THOMAS A. JAGGAR

SOME ASPECTS OF GROWTH AND FOOD NEEDS

Presidential address 1944.

The problem of growth is an exceedingly complex one but scientific evidence is accumulating to show that while heredity defines the potentialities of the individual, the quality of food eaten may determine whether the potentialities are fully achieved.

Height-weight measurements of a large number of high school students and their mothers were obtained through the courtesy of the principal and staff of one of the local high schools. The records of girls of Japanese ancestry were chosen for study because they represented the largest group. Similar data were obtained for 31 women students at the University and their mothers.

The mean height of the 15-year-old high school girls proved to be greater than that of the other three age groups. The mean height of the University girls exceeded that of the high school girls, but this is probably because they represented a more highly selected group rather than that they were older.

The students were from 4.3 to 5.0 cm. taller than their mothers. The mean heights of the mothers vary but little from those reported for Japanese women by other investigators. It appears therefore that young women of Japanese ancestry in Hawaii are increasing markedly in stature in one generation.

It was suggested that in addition to environmental factors such as climate and better medical care, food may be playing a part. An examination of the results of dietary studies made here and in Japan shows that the greatest difference seems to be an increase in the amount of animal protein.

Studies of family diets by Martha Potgieter of the Nutrition Department of the University of Hawaii Agricultural Experiment Station have shown that in comparison with the Bureau of Home Economics standards used in 1941, the diets of rural Japanese families living in Hawaii are markedly deficient in calcium, vitamin A, and thiamine.

Many Japanese girls have short and/or crooked legs which must be due to a disturbed calcium-phosphorus metabolism and perhaps to a lack of vitamin D at some stage of growth.

Numerous studies have shown that dental caries are closely associated with the adequacy of the diet. Figures on students of Japanese ancestry were available for 60 University girls of Japanese ancestry. All had dental caries and the average DMF (decayed, missing, filled) teeth per student was 17.3.

It was pointed out that with increased quantities of almost all the vitamins there is not only increased growth, but also better general well-being, longer life span, a delay of the onset of senility, and a prolonged period of active healthy adult life.

Heights of Young Women of Japanese Ancestry Compared with Their Mothers and Others

RACIAL ANCESTRY, SOURCE, AND DATE	AGE	NUMBER OF CASES	MEAN HEIGHTS (CM.) Daughters	Mothers
Japanese				
McKinley High School 1944	15	102	155.7	151.4
McKinley High School 1944	16	173	154.9	150.6
McKinley High School 1944	17	129	155.2	150.1
McKinley High School 1944	18	42	154.0	149.8
University of Hawaii 1944	18-27	31	157.0	152.0
Japan (Matsumura) 1925	Adults	1,200	149.9	....
Shapiro 1931	20-49	91	150.2	....
Caucasian-Americans				
University of Iowa 1936	15-18	666	161.1	....
Bowles 1932	18-19	500+	164.5	161.6

CAREY D. MILLER

THE TWENTIETH ANNUAL MEETING 1944-45

Program

NOVEMBER 16, 1944

Walter Carter: D-D Mixture: A New Soil Fumigant.

Carl T. Schmidt: Time-Mortality Relationships of D-D Mixture.

Peter H. Buck: Niihau Mats.

H. H. Warner: Some Aspects of the Foreign Economic Administration Agricultural Program.

NOVEMBER 17, 1944

Christopher J. Hamre: A Survey of Nine Commercial Fish Ponds.

Robert C. Brasted: The Role of Cellulose Acetate Artificial Silks and Plastics in the War.

Harry L. Arnold, Jr.: The Two Varieties of Leprosy: Lepromatous and Tuberculoid.

MAY 3, 1945

Joseph E. Alicata and Elwin L. Willett: Sulfaguanidine Therapy in Experimental Swine Coccidiosis.

Robert W. Hiatt: Food and Feeding Habits of Mullet, Milkfish, and the "Ten-Pounder."

Bernhard L. Hörmann: War-Time Research in Public Opinion and Morale.

John A. Rademaker: Methods in Psycho-Social Studies of West Coast Evacuation of Japanese-Americans.

MAY 4, 1945

C. P. Sideris, H. Y. Young, and H. H. Q. Chun: Growth of *Ananas comosus* in Relation to Soil Fumigation and Diurnal Change.

Robert B. Dean: Pink Hibiscus: A Universal *p*H Indicator.

Eugene C. Auchter: Federal Organization of Agricultural Research.

MAY 5, 1945

Annual Meeting

Installation of Officers

Address by Retiring President

J. L. Collins: Interspecific Hybrids in Pineapples.

Abstracts

D-D MIXTURE: A NEW SOIL FUMIGANT

A number of chlorinated compounds were tested as soil fumigants and one of these, a mixture of 1.3 dichloropropene and 1.2 dichloropropane, proved to be the equal of chloropicrin without any of the disadvantages.

D-D mixture, as this compound is designated, can be used effectively without soil cover, and is especially effective in nematode infested soils. In an area where *Anomala* larvae are important factors in a complex which includes *Heterodera* and *Pythium* species, the treatment with D-D resulted in especially significant gains. When drought is a serious factor, the response to D-D mixture is very much accentuated.

The 1.3 dichloropropene fraction of the mixture is evidently the most toxic but there is synergism between that compound and other fractions of the mixture which suggests that the combination of 1.3 dichloropropene with other chlorinated compounds might be a basis for additional research on soil fumigants.

Plant growth is the best criterion of the value of a soil fumigant. It is believed that whatever the effect of the fumigant may be on individual species of the soil complex, the development of good root systems follows effective fumigation.

WALTER CARTER

TIME-MORTALITY RELATIONSHIPS OF D-D MIXTURE

A biological assay method for detecting and estimating concentrations of lethal vapors from small samples is described where the percentage mortality of the rice weevil, *Sitophilus oryzae* (L.), is used as the indicator of concentration.

Mortality of the rice weevil follows a typical sigmoid curve when time is kept constant and concentration is varied. A similar sigmoid relationship holds if concentration is kept constant and exposure time is varied. When both time and concentration are varied, the effect of dosage increase greatly exceeds that of a proportionate increase in time.

CARL T. SCHMIDT

NIIHAU MATS

The Hawaiians made two classes of mats from pandanus leaves: floor mats with coarse wefts, and bed mats with finer wefts and more complicated technique, in which long twists to form the lower and upper edges are peculiar to Hawaii.

On Niihau, the bed mats were made of makaloa sedge with the same technique as pandanus. Colored motifs were added by overlaying strips of the brown sheaths from the base of the sedge. Sedge is soft, and the neat plaiting with colored decoration made the Niihau mats the best bed mats in the Pacific area.

Why did the small island of Niihau produce the best mats in the group? The answer lies in the statement that the paper mulberry did not flourish on Niihau, hence the making of tapa was dropped. The women found a substitute craft in plaiting with sedge and so developed the Niihau mats to their high degree of excellence.

The development in plaiting technique established new styles, including the long bend at the upper and lower edges. The long bend was established first in Niihau mats, in which the softer, rounder sedge took the long bends smoothly. The later application of the style to pandanus wefts did not work smoothly until the flat, thin wefts were twisted into rolls to conform more closely with the qualities of the sedge wefts. Thus, loss in one direction stimulated extra development in another.

PETER H. BUCK

SOME ASPECTS OF THE FOREIGN ECONOMIC ADMINISTRATION AGRICULTURAL PROGRAM

H. H. WARNER

[The arrangement under which this talk was given precluded the possibility of publishing an abstract.]

A SURVEY OF NINE COMMERCIAL FISH PONDS

Eight ponds on Molokai and one on Oahu were particularly examined for flora, plankton, temperature, and salinity and, more generally, for turbidity, depth, and character of bottom. The ponds were examined within a period of two weeks in August and September and, therefore, were subject to the same seasonal influences. The observations were made cooperatively by Isabella A. Abbott, Charles J. Engard, Christopher J. Hamre, and Yoshinori Tanada. The data supplied by these workers were combined by the writer in an effort to construct a picture of the chemical, physical, and biological conditions of our local commercial fish ponds.

The ponds examined varied in area from 4 to approximately 135 acres. All had broad, shallow shore areas and the average maximum depth was about 4 feet. Seven ponds had complete mud bottoms, part of the bottom of one was of sand, and of another, hard coral. The bottoms were devoid of attached plants except for two ponds, one having *Ruppia maritima* and the other *Halophila ovalis*. The temperature of the water varied from place to place in the ponds and from pond to pond, the range observed being 29.9° to 32.4° C. The shallower isolated areas had the highest temperatures. The chlorinity varied from pond to pond, seven showing a range from 10 to 18 parts chloride per thousand parts water, one was uniformly 18 and 19 parts per thousand, and another uniformly at or near 5 parts per thousand.

The total volume of plankton per 25 gallons of water was extremely variable and ranged from 0.01 cc. to 1.2 cc. Total plankton values showed no direct relation to the observed physical and chemical conditions. Diatoms were found to be very abundant in the shallow areas of four ponds, present and fairly abundant in three, and scarce in one.

Fish populations were found to be small and the ponds to be understocked. It was recommended that the ponds be stocked more regularly and heavily since diatoms, which form the greater part of the diet of common pond fish, were abundant.

CHRISTOPHER J. HAMRE

THE ROLE OF CELLULOSE ACETATE ARTIFICIAL SILKS AND PLASTICS IN THE WAR

The cellulose acetate industry contributes approximately 15 per cent of all synthetic textiles and a slightly smaller percentage of plastic materials in the present industrial scheme.

The important structural group of cellulose is cellobiose, which can be hydrolized to the glucose unit. The latter is characterized by its three active hydroxyl groups. Raw cellulose for cellulose acetate is derived from southern pine wood pulp and cotton linters. Cellulose may be dissolved in a mixture of acetone and water after it has been subjected to an acetic acid-acetic anhydride treatment. After solution it can be filtered and extruded through a spinaret to form an end which is subsequently used for weaving. The acetate may be blended with a plasticizer or with cellulose acetobutyrate and used as a molding powder.

The cellulose acetate fiber is used in making Fortisan, the strongest fiber known in the synthetic field. This finds extensive use in weaving parachute cord, tire cord, parachute fabric, balloon fabric, as a diluent or extender for wool in uniforms, and as insulation for Signal Corps wire.

The plastic is made into transparent sheeting for propellers and mechanisms to be guarded from moisture and salt spray during overseas shipment, and is formed into instrument panels, wheels, gears, bomber blisters, and glider noses.

ROBERT C. BRASTED

THE TWO VARIETIES OF LEPROSY: LEPROMATOUS AND TUBERCULOID

The terminology of leprosy has long been an index to the current knowledge of the disease. Among the Greeks it was known under two separate headings: (1) elephantiasis (or leontiasis, or satyriasis), a fearful disorder with a bad prognosis, and (2) leuce, a disease characterized by anesthetic white spots and not much feared.

In the Middle Ages the word "leprosy" appeared, derived from the Greek "lepra," a scaly disease, wrongly translated from the Arabian "juzam."

In the nineteenth century the two forms were again distinguished under the names "tubercular" leprosy, meaning not "tuberculous" but "characterized by tubercles or nodules," and "macular" (spotty), or "anesthetic," or "maculoanesthetic" leprosy.

In 1931 the world's leprologists conferred and renamed these two forms in a most confusing way. They called them "cutaneous" and "neural" respectively. These words meant, to them, "characterized by abundant bacilli and a poor prognosis," and "characterized by scanty bacilli and a good prognosis," respectively. But they continued to be used, at times, to mean "pertaining to the skin" and "pertaining to the nerves." This latter use was frequently most misleading—for a "cutaneous" type of case might involve nerves more extensively than skin, while a "neural" type of case might do the opposite. The change of "cutaneous" to "lepromatous" in 1938 did not undo all this damage by any means.

In Europe, the study of cases by microscopic methods had already led to the establishment of two types of leprosy which had been named "lepromatous" and "tuberculoid." The latter corresponded exactly to so-called "neural" leprosy of skin or of nerves. This classification has been adopted by clinical students of leprosy in South America, and it should be generally adopted in order to clear up the confusion inherent in the now official classification.

HARRY L. ARNOLD, JR.

SULFAGUANIDINE THERAPY IN EXPERIMENTAL SWINE COCCIDIOSIS

Investigations by Mainland workers have shown that sulfaguanidine therapy is of prophylactic value in the control of certain forms of coccidia in poultry, sheep, and cattle. Preliminary observations by the writers, based on the three experiments summarized, indicate that this drug is similarly effective in the control of mixed infections of coccidia (*Eimeria debliecki,* and *Eimeria scabra*) in swine.

Experiment I

Two young pigs, weighing 28 and 30 pounds, respectively, were each fed about 20 million sporulated coccidial oocysts. One of the pigs, No. 3, received three grams of powdered sulfaguanidine daily with the feed. After the infection, the following observations were made:

Pig 3. This animal showed no diarrhea or loss of appetite. Only occasional oocysts were found in the feces between the tenth and thirteenth days.

Pig 4. Diarrhea started on the third day. Coccidial oocysts were found in the feces beginning with the sixth day. At this time the animal showed loss of appetite, a condition which persisted for about two weeks. The highest oocyst output, about 132,000 per gram of feces, occurred on the eighth day. After the twelfth day, only occasional oocysts were found in the feces. Since the diarrhea persisted, beginning with the fourteenth day the animal was given three grams of sulfaguanidine for three consecutive days. Following this treatment the diarrhea ended.

Experiment II

Two young pigs, weighing 47 and 55 pounds, respectively, were each fed about 20 million sporulated oocysts. Pig 5 was given 4.5 grams of sulfaguanidine daily with the feed. The drug was given beginning two days before infection and continued for seven more days. After the experimental infection the following observations were made on each of the pigs:

Pig 5. This animal showed no diarrhea or loss of appetite. Coccidial oocysts, ranging from 800 to 11,200 per gram of feces, were found between the fifteenth and eighteenth day. Thereafter, only occasional oocysts were found.

Pig 6. Diarrhea started on the fourth day and continued up to the ninth day. Coccidial oocysts were found in the feces beginning with the fifth day. The highest oocyst output, 804,000 per gram of feces, occurred on the tenth day. After the twentieth day only occasional oocysts were found in the feces.

Experiment III

Two pigs, weighing 67 and 65 pounds, respectively, were each fed about 20 million oocysts. Pig 7 was given 6.5 grams of sulfaguanidine daily with the feed for nine days. The following observations were made on each of the pigs:

Pig 7. This animal showed no diarrhea or loss of appetite. Oocysts, ranging from 1,000 to 16,000 per gram of feces, were found between the thirteenth and seventeenth day. Thereafter, only occasional oocysts were found.

Pig 8. Diarrhea started on the fifth day and continued up to the tenth day. The highest oocyst output, 582,800 per gram of feces, occurred on the eighth day. After the seventeenth day only occasional oocysts were found.

The above results point out that sulfaguanidine therapy was effective in three pigs in preventing the normal development of two species of coccidia and in preventing the production of dysentery, a condition frequently noted in coccidial infections in young pigs.

JOSEPH E. ALICATA and ELWIN L. WILLETT

FOOD AND FEEDING HABITS OF MULLET, MILKFISH, AND THE "TEN-POUNDER"

The food and feeding habits of the three most important market fish in Hawaiian ponds—mullet *(Mugil cephalus),* milkfish *(Chanos chanos),* and the "ten-pounder" *(Elops machnata)*—were analyzed to ascertain the position of these fish in the food-chains and the food cycle occurring within the ponds.

Mullet subsist primarily on littoral, benthonic diatoms and blue-green algae, the presence of a unique pharyngeal filtering device prohibiting them from swallowing larger forms. No variation in food because of season or size of fish was found.

Milkfish are also herbivores. Juveniles consume minute algae while larger fish take an increasing amount of filamentous algae. Competition for food between mullet and milkfish is greater than hitherto supposed and cannot be diminished under present operational procedures. An increased food supply for both species probably could be achieved by the application of inorganic fertilizers together with the construction of additional shallow areas in the ponds.

"Ten-pounders" subsist largely on mosquito fish and shrimps. No juvenile mullet or milkfish were found in 164 specimens of various sizes taken throughout the year. This species apparently damages pond fisheries less than is commonly supposed; in fact, it may prove an asset to the industry.

ROBERT W. HIATT

WAR-TIME RESEARCH IN PUBLIC OPINION AND MORALE

The problem of measuring and controlling the traits which guide organized groups to a successful or unsuccessful completion of their task is one engaging many social scientists. The War Research Laboratory of the University of Hawaii has felt that Hawaii offered exceptional opportunities for studying this problem.

This paper describes the way the Laboratory has studied morale and public opinion. One piece of research involved a gas mask count taken at first intermittently, then regularly over a period of about a year. The percentage of persons carrying masks dropped from about 70 to about 10, and in May, 1943, when the military stopped carrying their masks, to zero. The reasons why people did or did not carry their masks were also collected and indicated that people could be divided into several types. Some carried their masks to indicate their contribution to the war effort and were thus showing high morale. A second group showed tension or "the jitters" when they carried their masks. A third group of carriers, mainly school children and defense workers, indicated good institutional discipline. Finally, an increasing number took a commonsense view of the situation as it might affect them if they did or did not have their masks. These people increasingly left theirs at home. This attempt to measure morale showed that several things besides morale were being measured also. The measurement of morale may turn out to be impossible.

The public opinion poll based on the representative sample is not adapted for the measurement of morale, but can apparently measure public opinion. An attempt to measure public opinion on the issue of martial law indicates the feasibility of this technique in Hawaii.

BERNHARD L. HÖRMANN

METHODS IN PSYCHO-SOCIAL STUDIES OF WEST COAST EVACUATION OF JAPANESE-AMERICANS

The study selected as a sample demonstration of methods used by sociologists and social anthropologists in observing, recording, and analyzing the behavior of human beings in certain types of situations, was entitled *Evacuee Attitudes on Relocation,* Granada Community Analysis Report No. 2, July, 1943.

The methods used included: (1) training the staff; (2) examination of available information, such as previous efforts to examine the problem, newspaper files, interviews, and discussion of the problem by the staff; (3) determination to use a questionnaire for measurement of attitudes involved and construction of the questionnaire which included (a) selection of questions, (b) phrasing the questions, determining their order, preparing equivalent versions in English and Japanese, (c) setting up tables for the compilation of answers, and (d) determination of set-up and instructions incorporated in the questionnaire; (4) field testing the completed questionnaire by having a representative sample of 120 residents fill out questionnaires, then interviewing these persons to find what they understood by the questions, how the words stimulated them to react, how closely the reactions they gave expressed their real feelings on the matter; (5) revising the questionnaire in the light of this examination; (6) launching the questionnaire, securing the support of the administration and of the residents; (7) editing and tabulating the returns; (8) computing percentages of returns on some questions, testing for errors; (9) analysis of the returns as tabulated and computed; (10) presentation of the results, writing up the analysis by several members of the staff, pooling results, criticizing, revising, consolidating, determining, and executing the methods of presentation in charts; and (11) distribution of the study to responsible administrators and interested people.

JOHN A. RADEMAKER

GROWTH OF *ANANAS COMOSUS* IN RELATION TO SOIL FUMIGATION AND DIURNAL CHANGE

Ananas comosus grown in soil fumigated with chloropicrin at the rate of 90, 180, and 360 pounds per acre or with ethide at 100, 200, and 400 pounds per acre grew better at the higher than at the lower levels of fumigants and the concentrations of certain metabolic products in the leaf tissues correlated with the rate of growth and diurnal changes. In plots with 150, 300, or 450 pounds per acre of D-D mixture, the growth obtained was almost equally good for all three levels of the fumigant and the concentrations of the products of metabolism in the leaf tissues were approximately the same.

The longest leaves of approximately ten-month-old plants were collected September 6, 1944 at 8:00 A.M. and 4:00 P.M., Hawaiian War Time. Sections about eight inches in length of the chlorophyllose region were cut off, measuring from a point five inches below the tip towards the base. Fifty grams of leaf tissue were mixed with 200 ml. of water in a Waring mixer and ground for ten minutes. The mixture was strained and the residue was washed repeatedly with water until the final volume was 500 ml. The residue was analyzed for insoluble nitrogen and the filtrate for acidity, sugars, proteinaceous nitrogen, and crystalloid organic nitrogen.

Leaf weights were greater in the plots with higher levels of either chloropicrin or ethide but those in the D-D mixture, although almost as great as those in the high level plots of chloropicrin or ethide, varied very little between different levels. Titrable acidity values were higher and sugar values lower in the plants from plots with greater amount of chloropicrin or ethide and with a high rate of growth. Titrable acidity values of the 8:00 A.M. samples were considerably higher than those of the 4:00 P.M. samples, while sugar values in the same samples were reversed. These inter-relationships between titrable acidity and sugar values indicate that the sugar was partially oxidized at night or in darkness to organic carboxylic acids, but not completely to carbon dioxide and water. During the day or in light, the carboxylic acids were converted to other more complex metabolic products.

Proteinaceous nitrogen and crystalloid leaf nitrogen were affected less by the different levels of fumigants than by diurnal changes. Proteinaceous nitrogen was lower and crystalloid nitrogen higher in the 8:00 A.M. than in the 4:00 P.M. samples.

Total nitrogen values being smaller in the plants from the plots with none or low than from those with high amounts of fumigants may indicate a reduced rate of nitrogen absorption from the soil on account of root injuries caused by pathogenic and predatory soil flora and fauna.

C. P. SIDERIS, H. Y. YOUNG, and H. H. Q. CHUN

PINK HIBISCUS: A UNIVERSAL *p*H INDICATOR

The coloring matter extracted from common pink hibiscus flowers by boiling water can be used as an indicator over a range of *p*H values from 2 to 14. The colors resulting are approximately as follows: *p*H 2 or less, bright pink; *p*H 4, purple; *p*H 6, grey; *p*H 8, yellow; *p*H 10, olive; *p*H 12, green; *p*H 14, bright green fading rapidly to yellow. If tap water is used to extract the pigments, it should first be boiled and acidified with hydrochloric acid as chlorine in the water bleaches the red anthocyanin pigment which, in its basic blue form, also accounts for the green shades at high *p*H values.

Hot water extracts develop mold in a few days and both water and alcohol extracts fade fairly rapidly. The coloring matter can be absorbed on test papers but these also fade in storage. The indicator is recommended for demonstration purposes and for field use where special indicators are not available. It can be used to detect free alkali in soaps and cleansers which should give a dull olive green and not a rapidly fading bright green.

ROBERT B. DEAN

FEDERAL ORGANIZATION OF AGRICULTURAL RESEARCH

EUGENE C. AUCHTER

[The arrangement under which this talk was given precluded the possibility of publishing an abstract.]

INTERSPECIFIC HYBRIDS IN PINEAPPLES

Presidential address 1945.

The five species of pineapples presently recognized are: *Ananas comosus,* which includes the cultivated varieties, and the wild species *A. bracteatus, A. ananassoides, A. erectifolius,* and *Pseudananas macrodontes.* The four wild species are believed to be native to South America. Varieties of *A. comosus* include three distinct leaf types classified on the character of the leaf margin into piping, spiny tips, and spiny. These types are represented in the germ plasm by two pairs of hereditary genes producing typical mono- and modified di-hybrid Mendelian ratios when intercrossed.

A. bracteatus, a spiny-leaved species, contains a hereditary gene for spines which is different from that contained in *A. comosus. A. erectifolius* contains a modification of the spiny-tip gene of *A. comosus* which prevents the production of spines at the tip of the leaf. *A. ananassoides* has identical genes for spiny leaves, as does *A. comosus,* but also possesses genes for acid and sugar production in the fruit which are more potent than those in the other species.

The crosses between species of *Ananas* produce viable seeds and the hybrids are fertile. The generic cross between *Ananas* and *Pseudananas* produces only about 5 per cent viable seeds. The hybrid plants developed from these viable seeds are fully fertile, with seed viability around 90 per cent. When crossed with Cayenne, a spiny-tip variety of *Ananas,* the F_1 hybrids exhibit much variation in leaf type, with many plants inconstant during development. This is interpreted as due to a threshold condition existing among the potencies of the genes for leaf type, so that they may be tripped one way or the other by different environmental forces during growth.

The species of *Ananas* have 50 chromosomes as the diploid number, but *Pseudananas* has 100 chromosomes. The low percentage viability of the hybrid seeds is associated with this difference in chromosome number. All of the F_1 plants have 100 chromosomes, except a rare few which have 75 chromosomes.

Genetic studies of species relationships supply information for use in the new biological science known as "biosystematics."

J. L. COLLINS

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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

TWENTY-FIRST ANNUAL MEETING 1945–1946

Published by the University of Hawaii Honolulu, T. H., 1946

FOREWORD

The present volume of Proceedings of the Hawaiian Academy of Science is the first to be published in normal course after the delayed and combined volumes recently issued. Cooperative arrangements with the University of Hawaii to continue publication of the Proceedings have been perfected and copies of the last two issues have been sent to a selected list of learned institutions. These institutions have been asked to reply and indicate whether they wish to remain on the Academy mailing list and whether they wish to be sent back numbers. These details are being handled by the University Office of Publications with advice from the Academy secretary. Publications sent in exchange are to be deposited in the University Library in accordance with action taken by the Academy Council.

Attention is called to the inclusion in this number of "The Place of Hawaii in Pacific Research," Peter H. Buck's presidential address. We are gratified to be able to offer this discussion at a time when various mainland and local agencies are making plans for expanded research studies in the Pacific area.

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THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE."

THE PLACE of HAWAII in PACIFIC RESEARCH

Presidential Address 1946

Peter H. Buck

Reports have reached us that the National Research Council proposes to hold a conference in Washington to discuss plans for conducting a scientific survey of the Pacific, particularly in the American-occupied islands. For my retiring address as president of the Hawaiian Academy of Science, I had selected the subject of "The Polynesian Concept of the After-life" but in view of the prospects of opening up a wider field of scientific research, I propose to offer some remarks on "The Place of Hawaii in Pacific Research."

The Territory of Hawaii occupies a strategic position in the Pacific Ocean. It has been aptly termed the crossroads of the Pacific and this term will apply with increasing force as time permits the increased development of sea and air transport. The American occupation of the Marshalls, Carolines, Marianas, and the islands extending north to Japan have brought these islands into regular communication with the United States through Hawaii. Travellers from New Zealand, Australia, western Polynesia, Melanesia, Micronesia, Marianas, Netherlands East Indies, Singapore, French Indo-China, Philippines, China, and Japan going to the United States and returning, must pass through Hawaii by sea or air.

In addition to a favorable geographical position, Hawaii has built up a strong and unique position in the field of science through the establishment of various institutions and the personnel employed by them. Mention may be made of the Bishop Museum, the University of Hawaii, the Hawaiian Sugar Planters' Experiment Station, the University of Hawaii Agricultural Experiment Station, the Pineapple Research Institute, the Territorial Board of Agriculture and Forestry, the Geological Survey, and various Territorial and Federal agencies concerned with the observation and recording of scientific data. In referring to the development which has taken place, I will mention three branches of the natural sciences and one of the social sciences.

BOTANY

The early Hawaiians were the first botanists in these islands. They were practical horticulturalists and they brought with them various cultivable food plants such as the coconut, breadfruit, banana, taro, yam, sweet potato, and arrowroot. They also introduced the paper mulberry and perhaps some other plants. They tested the local trees and found out the best timbers for houses, canoes, weapons, and utensils. They knew the value of pandanus leaves for plaiting mats but they also found the local *makaloa* sedge produced the best sleeping mats. New fiber for strong cordage was found in the bark of the *olona,* house thatch in *pili* grass, and additional material for bark cloth in the *mamake.* Dyes for coloring cloth and remedies for ailments were found in various plants. The plants they introduced were already named but they proceeded to name all the local plants. Some were recognized as resembling known plants and given the same names while others had new names coined for them. The plants of economic value were given special study and hence the later botanists of another race have found a rich fund of information in the Hawaiian knowledge of the local flora.

The first plants for scientific study were collected in 1788 by David Nelson, the botanist with Cook's third expedition. Botanists accompanying later expeditions collected plants and in 1833, the London Horticultural Society sent David Douglas to collect Hawaiian plants but unfortunately he was accidentally killed in a wild cattle pit on Hawaii. The plants collected by visitors were studied in lands far distant from their place of origin.

The first botanist to make a study of plants locally was William Hillebrand, who returned to Germany in 1871 after practicing medicine and collecting plants here for twenty years. His authoritative work on the flora of the Hawaiian Islands was published by his son two years after the author's death. Joseph F. Rock, who was professor of botany at the College of Hawaii, contributed works on the trees of Hawaii. Other botanists made their contributions to the sum of our botanical knowledge.

The establishment of the Bishop Museum in 1889 provided a suitable repository for the botanical specimens of the Territory and various local botanists helped to supply specimens for the herbarium. The joint financing of a chair in botany by the University of Hawaii and the Bishop Museum established botanical cooperation between the two institutions. Teaching was conducted at the University and research work with the collections at the Museum. The Museum sponsored field expeditions to various parts of Polynesia, Fiji, and Micronesia and the plant collection has continued to grow. Plants from the Pacific area have been sent to specialists in all parts of the world for study and report and as a result the Museum has published a large number of taxonomic papers in botany. The Museum herbarium has grown to such an extent that it is becoming difficult to find space for new material. This large collection is available to research workers in botany proceeding to do field work in the Pacific area.

ENTOMOLOGY

The Hawaiians were not so interested in insects as they were in plants for the local insect fauna had no economic value for them and pests were confined to the caterpillars which sometimes invaded the sweet potato crops.

Organized study of the Hawaiian insect fauna was initiated in 1890 by the British Association for the Advancement of Science, which cooperated with the Royal Society of London in setting up a "Sandwich Islands Committee" to direct the collection of specimens and their study. The Bishop Museum cooperated by providing half the cost of publication and one-third the cost of field work. The field work was done by R. C. L. Perkins, a young graduate of Oxford University. The collecting continued for some years and Perkins, in his solitary task, underwent fatigue and danger with determined perseverance and unflinching courage. It is estimated that he collected 100,000 specimens, more or less, which included birds, lizards, and landshells as well as the insects which formed the greater part of the collection. Perkins contributed most of the reports which were published in parts under the title of "The Fauna Hawaiiensis" in three volumes of quarto size, each volume containing six parts. The edition consisted of 500 copies. In addition to its share of the publication, the Museum received the third collection of insects, the first of which was delivered in twenty-seven boxes in 1900. This formed the beginning of the Museum's insect collection.

Entomology received increased support through the local development of the sugar cane and pineapple industries which employed trained entomologists to cope with the depredation of introduced insect pests. The Hawaiian Sugar Planters' Association set up an experiment station and employed Perkins and Muir and other well-known entomologists, including Otto Swezey. In 1907, the Museum made arrangements with the H.S.P.A. to have the services of Mr. Swezey for one-half day each week to work on its insect collection which had been deteriorating from lack of direct supervision. The Helms collection of 24,719 insects was acquired by the Museum in 1915 and the Illingworth collection of 24,000 specimens was loaned to the Museum in 1921. In 1919, E. H. Bryan, Jr., was employed to assist Mr. Swezey in caring for the collection. In 1928, the Pacific Entomological Survey was sponsored by the H.S.P.A., the Pineapple Research Institute, and the Bishop Museum and collecting was conducted in the Marquesas and Society Islands. Large accessions to the Museum's collection were made in 1929 and 1930 and the Museum published reports on the insects of the Marquesas and Society Islands. In 1934, the Mangarevan Expedition to southeast Polynesia collected over 40,000 specimens and E. C. Zimmerman was appointed full-time entomologist to the Museum. The Micronesian and Guam Expeditions added further specimens. In 1937 a census of all insects in the Museum collection showed a total of 226,596 prepared specimens. The Lapham Fijian Expedition in 1938 added over 40,000 specimens and the Samoan Entomological Expedition in 1940 added more than 43,000. At present the Museum collection contains over 400,000 specimens.

The H.S.P.A., in order to study introduced pests in their original habitat and so discover the parasites which would keep them under control, sent expeditions to various parts of the Pacific and countries bordering upon it. The H.S.P.A. Experiment Station has thus acquired a very valuable insect collection. Contributions to entomology have also been made by the Territorial Board of Agriculture and Forestry, the Pineapple Research Institute, the University of Hawaii Agricultural Experiment Station, and the U. S. Bureau of Entomology and Plant Quarantine.

In order to make the greatest scientific use of the insect collections in the Territory, steps are being taken to house study and reference collections of the Bishop Museum and the H.S.P.A. Experiment Station in one building. The two collections would probably number three-quarters of a million specimens and thus form the largest and most diversified collection of the insect fauna of the Pacific area. Research entomologists taking part in the projected Pacific Science Survey would have access to the world's finest reference collection which they could study in Hawaii on their way to their field of work.

MALACOLOGY

Collecting landshells in the Hawaiian Islands aroused interest in many youths in the past with the result that many valuable collections have found their way to the Bishop Museum. Under the leadership of Dr. C. M. Cooke, Jr., collecting expeditions were carried out in Samoa and Fiji but the most important of all was the Mangarevan Expedition of 1934, which visited island groups in southeast Polynesia. The various ethnological expeditions also added specimens to the Museum collection so that the Museum has easily the most extensive and diversified landshell collection in the world so far as Polynesia is concerned. The Micronesian Expedition of 1935 made the largest known collection of landshells from the Micronesia area. The Museum collection now numbers over two million specimens from the Pacific area. The Museum collection of marine shells has been conservatively estimated at half a million specimens but in reality it probably numbers over a million.

ANTHROPOLOGY

In the field of anthropology much has been accomplished in Hawaii. The Bishop Museum was founded in 1889 to be devoted to the subjects of "Polynesian and kindred antiquities, ethnology, and natural history." Up to 1919, attention was devoted to the study of Hawaiian culture. In 1920, the first Pacific Science Conference was held in Honolulu and emphasis was placed on anthropology because of the rapidly disappearing native cultures. A scheme for research work was formulated and Polynesia was selected as the area for immediate undertaking. The Bishop Museum, from a donation of $40,000 by Bayard Dominick, sent out expeditions to Tonga, Marquesas, and the Austral Islands. Research, particularly in physical anthropology and archaeology, was also carried on in Hawaii. The field workers were selected from university graduates in anthropology and for the first time organized research was carried out by men trained in the study of man. A later donation from the Rockefeller Foundation, covered dollar for dollar by local residents, provided the Museum with $100,000 for a five-year regional survey of Polynesia. By 1935, Bishop Museum expeditions had conducted field work on practically every group and island in Polynesia and the ethnological reports were published by the Museum. Easter Island, Manu'a in the Samoan group, Niue, and Chatham Islands were visited by expeditions from other institutions; but the Bishop Museum published their reports. Some of the Museum expeditions were financed by fellowships created by Yale University and the Bishop Museum. Two expeditions were sent to the Fiji group. The Micronesian Expedition of 1935 included an anthropologist. The Museum is affiliated with Yale University and has cooperated with the American Museum of Natural History in working up the field observations on physical anthropology. Up to August, 1945, the Museum had published 124 works on anthropology dealing with the Pacific area, but mostly on Polynesia.

The ethnological collections in the Museum are confined to the Pacific area and valuable material is present on exhibition and in storage from Polynesia, Melanesia, Micronesia, New Guinea, and to a lesser extent from the Marianas. The collections provide good reference material for research workers.

The University of Hawaii has a department of anthropology which pays particular attention to Pacific problems. The University is particularly interested in matters concerning acculturation, social organization, race relations, and government. The Museum specializes in the technology of the arts and crafts and in reconstructing native culture as it existed before foreign contact from Europe and America. During the war, the Museum gave practical courses on south sea lore to men of the armed forces.

Anthropologists from the Mainland will find entirely new complexes associated with the oceanic cultures of the Pacific and, at both the University of Hawaii and the Bishop Museum, research workers may acquire assistance of material advantage in projects concerning the Pacific.

OTHER BRANCHES OF SCIENCE

Other branches of science have received considerable attention in Hawaii. In geology, the Museum has awarded fellowships for the geological survey of various Pacific islands and published reports on the geology of Rarotonga, Mangaia, and Atiu in the Cook Islands, Marquesas, Society Islands, Easter Island, Eua in the Tonga group, and Vitilevu and Lau in the Fiji Islands. Much has also been done and published on the Hawaiian Islands and the Geological Survey has paid considerable attention to the group. The work of Dr. Jaggar on volcanoes is well known.

The Museum has large collections of fish and birds. Considerable attention is being paid to fisheries by Federal authorities and there is likelihood of a research station being established in the future. Marine zoology has received much attention from the Museum and the University.

The University of Hawaii Agricultural Experiment Station has carried out intensive research work in agronomy in which botany, entomology, soil chemistry, animal husbandry, and allied sciences have achieved practical results applicable to tropical conditions.

There are other agencies carrying on observations which all add up to the sum of scientific work which goes on quietly and efficiently in the Territory of Hawaii. I doubt if any other place in the Pacific can show such a diversity of scientific attainment.

COOPERATION

There is one word which we have adopted from the Hawaiians in form and, I hope, in meaning. It is *aloha*—which means love, friendship, good will, cooperation. We need cooperation between institutions and between individual scientists. Between institutions, it has been shown by staff members of one institution being made associate members of another. Institutions have their shortcomings which are sometimes due to lack of sufficient funds and other times to lack of information. The first is difficult to remedy at times but the second may be cured by supplying the information in the spirit of *aloha* or cooperation. Cooperation between institutions and individuals will enable us to raise our standards of scientific efficiency and enable us to work together as one big team to our common advantage. It will enable us to maintain and improve the position Hawaii has achieved as the scientific as well as the geographical center of the Pacific.

THE 21st ANNUAL MEETING 1945-46

Program

NOVEMBER 13, 1945

L. A. Henke: Pineapple Crowns as Cattle Feed.
E. L. Willett, L. A. Henke, and C. Maruyama: Urea as a Source of Protein in Rations for Dairy Cows.
Robert W. Hiatt: Biotic Interaction in Hawaiian Fish Ponds.
Harvey I. Fisher and Paul H. Baldwin: War and the Birds of Midway Atoll.

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F. G. Holdaway and T. Nishida: The Toxicity of DDT to Chinese Rose Beetle.
Leonora Neuffer Bilger and Hiromu Matsumoto: Fluorimetric Analysis in the Assay of Cinchona Barks.
Beatrice H. Krauss: The Chloroplasts in the Leaves of Bromeliaceae.
Charles K. Fujimoto and G. Donald Sherman: The Effect of Physical Treatments on the Fixation and Release of Manganese in Hawaiian Soils.
Peter H. Buck: Hawaiian Dog-Tooth Ornaments.

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Robert B. Dean: A Portable Apparatus for the Analysis of Chloride and Oxygen in Water.
Harold S. Palmer: A Fault at Waimea, Oahu.
Robert C. Brasted and John C. Bailar, Jr.: A Study of Werner Complex Compounds by Instrumental Methods.
A. S. Ayers, J. C. Ripperton, M. Takahashi, and Y. Kanehiro: A Study of the Release of Non-exchangeable Potassium in a Hawaiian Soil.
T. A. Jaggar: Current Revival of Japanese Volcanoes.

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Donald L. Van Horn and W. B. Storey: Chromosome Behavior in a Cattail Millet X Napier Grass Cross.
F. G. Holdaway, O. C. McBride, Y. Tanada, T. Nishida, and W. C. Look: Studies on the Control of Melon Fly in Truck Crops.
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Eva Hartzler, Carey D. Miller, and Winifred Ross: The B Vitamins of Pork Tissues from Pigs Fed Garbage and Grain Rations.
Henry N. Peters: Some Experimental Studies of Human Values.

MAY 11, 1946

Annual Dinner
Business Meeting
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Address by Retiring President
Peter H. Buck: The Place of Hawaii in Pacific Research.

Abstracts

PINEAPPLE CROWNS AS CATTLE FEED

Pineapple tops or crowns, which constitute about 7 per cent of the weight of the fresh fruit, are at present not utilized for feed. Experiments at the University of Hawaii Agricultural Experiment Station show that these crowns are palatable, a milking cow consuming about 60 pounds of the crowns daily. In several experiments in which these crowns were compared with Napier grass as the roughage for cows, milk production was about 6 per cent higher when the crowns were fed.

Pineapple crowns can readily be ensiled. In one trial where silage made from pineapple crowns was compared with Napier grass, milk production was about 8 per cent higher when the silage was fed.

Liveweight gains of cows were less when pineapple crowns or silage was fed but in a 16-week trial with heifers, total gains on pineapple crowns and Napier grass were the same at the end of the period. However, during the first half of the 16-week period, less gain was made on pineapple tops.

Pineapple crowns on the green basis contain about 16 per cent dry matter, half again as much protein and fat as Napier grass, and less than half as much fiber.

The potential supply of pineapple crowns in the Territory of Hawaii should be enough to supply the needed roughage for about 3,000 dairy cows.

L. A. HENKE

UREA AS A SOURCE OF PROTEIN IN RATIONS FOR DAIRY COWS

Since the ruminant can utilize urea in the production of milk or beef, four trials were conducted to determine its value in dairy cow rations under Hawaiian conditions. All trials were of the double-change-over type.

The rations compared and the 4 per cent fat-corrected milk (FCM) production of the cows when on these rations in Trials I and II were as follows: Basal ration, 20.0 pounds FCM; basal plus 2.5 per cent urea, 21.6 pounds; basal plus soybean oil meal, 22.8 pounds. The results indicated that urea was utilized but that production was not as high as when soybean oil meal was the only protein supplement.

In Trial III, rations containing two different levels of urea were compared with a standard ration. The results were as follows: 2.5 per cent urea, 26.5 pounds 4 per cent FCM; 1.25 per cent urea, 27.1 pounds; and standard ration, 28.9 pounds. Less milk was obtained with the urea rations than with the standard ration.

Trial IV was conducted to determine whether the 25 per cent molasses in the concentrate mixture, the amount commonly fed in the Territory, was responsible for the consistently lower yields obtained when feeding urea. The rations and the 4 per cent FCM yields were as follows: Molasses and 2 per cent urea, 21.2 pounds; molasses and no urea, 21.0 pounds; no molasses and 2 per cent urea, 21.3 pounds; and no molasses and no urea, 22.4 pounds. Lower milk production with the feeding of urea was still obtained when molasses was omitted from the ration. None of the differences was significant, however.

It would be profitable to feed urea in the Territory only if ordinary high-protein supplements were not available or if they were considerably higher in price than barley or corn.

E. L. WILLETT, L. A. HENKE, AND C. MARUYAMA

BIOTIC INTERACTION IN HAWAIIAN FISH PONDS

The food and feeding habits of the influent and subinfluent species (eleven fish, four shrimps, and four crabs) in Hawaiian fish ponds were analyzed to ascertain the biotic interaction within the community. The dominant species were treated in a similar way and reported earlier. The ponds are virtually autarchic, and the available food supply is almost totally dependent on the physical features of the biotope. Microbenthos and detritus were found to support most of the herbivorous species while larger benthos, emergent halophytes, and plankton play minor roles. The animal assemblage within the ponds includes not only herbivores and omnivores but is replete with carnivores, several of which are voracious and reach a large size.

Interspecific competition for food and existence is severe. Both mullet and milkfish subsist on microbenthos. Also competing for this source of food are prodigious numbers of top-minnows (*Mollienesia latipinna* and *Gambusia affinis*) and shrimps which, in turn, form the strongest links in the food-chains between plants and predators. Large carnivores prey upon economically valuable herbivores and also prey upon worthless carnivores.

The results of the law of diminishing returns to the pond operators in weight of fish, and therefore in revenue, are operative and seem inevitable if current practices remain unchanged. Since the greatest harvest is to be secured from the marketable herbivores, it follows that rough herbivores and all predators should be eliminated, and every means available should be employed to augment the existing supply of benthos.

ROBERT W. HIATT

WAR AND THE BIRDS OF MIDWAY ATOLL

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The leeward islands of the Hawaiian Chain are world-renowned as a locus for the breeding of certain sea birds. Laysan and Midway are also known as the home of the endemic Laysan Rail and the Laysan Finch. In order to evaluate the effect of the war on insular populations of birds a census was made in May, 1945, of all avian species on Midway, and a particular search was made for the rail and the finch which were thought to be extinct.

Three species have been eliminated from Midway in the last four years—the rail, the finch, and the Brown Booby. Extinction of the rail on Midway probably means complete extinction of the species. The finch may still exist on other islands. Only three Blue-faced Boobies were found, and the total number of Noddy Terns present probably does not exceed ten. The Christmas Island Shearwater, Bulwer's Petrel, and the Gray-backed Tern are only present in relatively small numbers. Despite the presence of hundreds of individuals of these species, the populations are small compared with those of similar but undisturbed islands. Some species are still present in such numbers that if no further decline occurs no concern for their existence need be held. Among these are two species of albatross, Wedge-tailed Shearwater, Bonin Island Petrel, Red-tailed Tropic Bird, Sooty Tern, and the Fairy Tern. The Fairy Tern probably has actually increased in the last ten years.

Usurpation by man of roosting and nesting sites for airplane runways, roads, lawns, and buildings is perhaps the most important single factor in the decline of many species. Rats may have exterminated the Laysan Finch and the Laysan Rail, and no doubt act as a severe check on all the birds. Other factors detrimental to birds are: killing of individual birds by planes, ground vehicles, bombing and gunnery practice; destruction of eggs by men, dogs, and construction work; psychological disturbances due to the presence of thousands of men walking through the colonies; and change of vegetation which has destroyed the plant cover utilized by certain species.

HARVEY I. FISHER AND PAUL H. BALDWIN

THE TOXICITY OF DDT TO CHINESE ROSE BEETLE

The Chinese rose beetle (*Adoretus sinicus*), present in Hawaii for half a century or more, attacks many economic plants by feeding on the leaves. Commonest among these plants are green bean, Maui red kidney bean, soybean, eggplant, broccoli, okra, Chinese cabbage, peanut, corn, litchi, grape, dasheen, rose, and at times mango and banana.

Attempts extending over several years to control it by means of parasites have so far been unsuccessful.

A cage technique for measuring quantitatively the toxicity of materials to the beetle has been developed. This method measures toxicity in terms of survival of beetles and protection of foliage from beetle injury.

Cage studies of the toxicity of insecticides to the beetle during 1941-43 showed that of over 40 materials studied, only one, acid lead arsenate, was worth considering for practical control. Lead arsenate is, however, not a satisfactory material since at times it causes spray injury to bean foliage.

In the latter part of 1943, "Gesarol" dusts and sprays containing dichlorodiphenyltrichloroethane (DDT) were secured and have been found to be much more effective than acid lead arsenate. Concentrations of DDT which effectively control the beetle, *viz.,* a 2 per cent dust or a 2-pound-per-100-gallons spray, are not detrimental to the foliage of green bean.

Evidence secured in the cage studies indicates that DDT acts as a stomach insecticide on the rose beetle. There is also some evidence that it acts as a powerful contact agent as well.

Thus considerable progress has been made toward field control of Chinese rose beetle on green beans and other economic plants.

F. G. HOLDAWAY AND T. NISHIDA

FLUORIMETRIC ANALYSIS IN THE ASSAY OF CINCHONA BARKS

Rapidity and relative accuracy in the assay of cinchona barks are particularly essential in connection with the selection of trees of high alkaloidal content when thousands of individual trees are involved. Although many methods have been proposed they are difficult, tedious, and time-consuming and unless used by skilled analysts are likely to lead to variable and often inaccurate results. The present investigation was undertaken to develop a procedure which would be substantially more rapid than older methods for assaying cinchona barks.

Of the four principal alkaloids—quinine, quinidine, cinchonidine, and cinchonine—present in cinchona bark, the first two possess the physical property of fluorescence. This property was utilized as a basis for the quantitative determination of the alkaloids.

It was found that fluorescence analysis might be put to optimum use in alkaloidal assay by combining it with certain parts of established, chemical procedures. A precipitation-fluorimetric-volumetric method was proposed. Quinine and cinchonidine were precipitated as tartrates, and quinidine and cinchonine were left in solution. Each of the mixtures contained a fluorescing and a non-fluorescing alkaloid. In each case the fluorescing alkaloid was determined fluorimetrically. The mixed free base of each fraction was determined by titration. Cinchonidine and cinchonine were found by subtracting from the respective totals.

Five analyzed samples received from the United States Department of Agriculture were analyzed by this method. The experimental results compared favorably with the recorded analyses.

LEONORA NEUFFER BILGER AND
HIROMU MATSUMOTO

THE CHLOROPLASTS IN THE LEAVES OF BROMELIACEAE

Billings in 1904 reported the chloroplasts in *Tillandsia usneoides,* a species of Bromeliaceae, to be composed of masses of smaller bodies instead of having homogenous structure, the concept prevalent at that time. He named the smaller bodies "microchloroplasts" and the larger bodies of which these form a part, "megachloroplasts." He found that the "microchloroplasts" did not remain conglutinate but became dispersed throughout the cell sap where they showed a lively Brownian movement. Solereder and Meyer in an extensive study on the anatomy of the Bromeliaceae, reported the same phenomenon in other Bromeliaceae.

A recent Pineapple Research Institute study of the chloroplasts in *Tillandsia usneoides* and other Bromeliaceae species—*Ananas comosus, Bromelia penguin,* and *Chevallieria stephanophora*—showed that the bodies which Billings reported as "microchloroplasts" are actually starch grains which are formed in the chloroplast and then become free from that plastid body. Examination of the chloroplasts at different times of day showed that these bodies pass through three distinct phases. (1) In the "resting stage" the chloroplast is ellipsoidal in shape, bright to dark green in color, and the material constituting them appears to have a definite configuration, *i.e.,* structural arrangement. (2) As the day progresses, starch grains begin to form within the chloroplast until this body appears to be made up almost entirely of a conglomerate of starch grains. Individual starch grains "emerge" from the plastid and become free within the cell. They show lively Brownian movement. (3) When no starch grains remain within the chloroplast, the latter body appears as a pale green, sometimes hardly visible body, more or less spherical in shape. There appears to be a limiting membrane. The contents of the chloroplast in this phase appear wholly homogenous. The possibility that the configuration noted in phase (1) of the chloroplast may represent folds in the limiting membrane resulting from collapse of the contents of the chloroplast in this third phase should not be overlooked.

BEATRICE H. KRAUSS

THE EFFECT OF PHYSICAL TREATMENTS ON THE FIXATION AND RELEASE OF MANGANESE IN HAWAIIAN SOILS

A peculiar phenomenon observed on a hillside was the presence of a yellow strip extending from one end to the other of a macadamia nut (*Macadamia ternifolia*) orchard. The trees within this strip were invariably chlorotic. This chlorotic strip widened during the dry summer months and narrowed during the winter months when precipitation was greater. Preliminary determinations showed that soil samples taken within the chlorotic area were without exception higher in exchangeable manganese than those samples taken in the area of normal trees on both sides of the chlorotic band. It was also noted that when plants were grown on normal soils which have had excessively large applications of soluble manganese, a chlorotic condition very similar to the chlorotic condition in high manganese soils developed. Since there seemed to be an apparent relationship between chlorosis and climatic conditions, and since this relationship occurred in areas of soil high in manganese, a study of the effects of various physical treatments on the release and fixation of manganese was conducted.

A gradual increase in exchangeable manganese occurred when soils were air-dried. Oven-drying and steam-sterilization increased the exchangeable manganese from a few parts per million to approximately three thousand parts per million in a number of soils. The release of manganese was increased with increasing incubation temperatures. At lower temperatures the length of incubation influenced the release of exchangeable manganese. When a dry soil was moistened, the level of exchangeable manganese decreased gradually.

The laboratory studies indicate that wetting and drying play an important part in the release and fixation of manganese. From the experimental data it seems plausible that the manganese in soil is influenced not only by the oxidation-reduction conditions of the soil but also by the process of hydration and dehydration.

CHARLES K. FUJIMOTO AND
G. DONALD SHERMAN

HAWAIIAN DOG-TOOTH ORNAMENTS

The dog (*ilio*) was introduced by the Hawaiian ancestors from central Polynesia to augment their meat supply. Dogs were used to pay taxes and were confined in stone pens to await the king's tax collector. An abducted wife could be regained by presenting a dog to the *alii* and a necromancer would read the omens for a fee of a white dog. In the *kuni* ceremony to discover the sorcerer who had killed a relative, dogs formed the medium of revelation—40 for commoners and 400 for an *alii.* Dogs formed payment in treatment of the sick, and mothers after childbirth were fed on broth from dogs' flesh. In addition to the use of the flesh, the teeth were used to make ornaments.

Teeth of various kinds were utilized in Hawaii: sharks' teeth for cutting implements; fish teeth ornaments on a feather baldric; whales' teeth in the pendant of the *lei palaoa* breast ornament; pigs' tusks for bracelets; human teeth on the feather baldric and as an inlay on the slop bowls of chiefs. Dogs' teeth fringed the mouth opening of feather gods.

Use of dogs' teeth in the leg ornaments worn in hula dances was unique. The leg ornaments resembled a kind of legging formed of a close network of *olona* cords which supported close parallel rows of teeth running horizontally. They were tied above the calf and the part which extended downward to enclose the calf was laced together by a cord passing through close loops fixed to each side edge of the legging. After the ornaments ceased to be made, the technique was forgotten and it had to be recovered from the ornaments themselves. Fortunately, an uncompleted specimen in the Bishop Museum aided the study. The details have been carefully worked out and will be recorded in a future work on the arts and crafts of Hawaii.

In a series of thirteen ornaments in the Bishop Museum, the number of teeth used in individual ornaments ranged from 454 to 1,242. What makes the numbers still more interesting is that only the canine teeth were used. As these teeth, situated between the incisors and bicuspids number two in each jaw, as with human beings, one dog supplied four teeth. Thus, the smallest ornament required 114 dogs to supply the 454 canine teeth, and the largest required 311 dogs to supply 1,242 canine teeth. The whole series of 13 ornaments required 2,805 dogs to furnish the total of 11,218 teeth used.

These numbers are extraordinary, for the dog-tooth leggings are by no means rare. Bishop Museum has some old specimens in which many of the teeth have been lost through decay of the network and they are not included in the count given. Specimens also are to be found in England and other European countries. Though David Malo's statement that 400 dogs were used in some of the *kuni* ceremonies is probably an exaggeration like most of his other figures, the practical evidence provided by the dog-tooth leggings supports the fact that the Hawaiians bred dogs in large numbers.

PETER H. BUCK

A PORTABLE APPARATUS FOR THE ANALYSIS OF CHLORIDE AND OXYGEN IN WATER

The apparatus demonstrated was constructed for use in fish pond investigations of the Cooperative Fisheries Research Committee of the University of Hawaii and the Territorial Board of Agriculture and Forestry. Large variations in chloride and dissolved oxygen are found in Hawaiian tidal ponds. Low chloride is an indication of fresh water springs or streams while low oxygen from whatever cause indicates water unsuitable for fish. This apparatus was designed to permit rapid analysis of water samples at the ponds, thus obviating the necessity for sending samples back to the laboratory.

The apparatus consists of a box containing a micrometer burette, a galvanometer and a potentiometer circuit for electrometric determination of end points, two precision Krogh syringe pipettes for taking samples, suitable reagents, and an air-stirring system. Chloride is determined by a new electrometric method that eliminates the use of a salt bridge. A sample of 0.4 ml. of water is added to 10 ml. of saturated copper sulfate. Copper and silver wire electrodes are immersed in the solution and silver nitrate is added from the burette until the potential difference between the electrodes is exactly balanced by a predetermined potential from the potentiometer. At this point all the chloride has been precipitated. The silver nitrate reagent and the volumetric apparatus are calibrated periodically by running a known standard solution of sodium chloride by the same procedure used for the samples.

Dissolved oxygen is determined by a modified Winkler titration using a dead stop electrometric indication of the end point. The reaction between the dissolved oxygen and the manganous hydroxide reagent is carried out according to the method devised by Krogh in 1935 in a 10-ml. syringe pipette. The solutions and volumetric apparatus are calibrated with a standard solution of KIO_3.

The complete apparatus fits in a compact carrying case which contains enough reagents for 50 determinations of each kind. With the exception of the standard solutions and the manganous chloride, all reagents can be refilled at a drugstore.

ROBERT B. DEAN

A FAULT AT WAIMEA, OAHU

Faults make bold cliffs in the newer parts of the Hawaiian Islands, where they have not been subdued by erosion. Such fault cliffs surround Kilauea Caldera. There is a striking fault cliff at South Point, Hawaii. In the absence of extensive, uniform layers of rock, faults cannot be identified by offsetting of strata in Hawaiian valley sides, as in regions of sedimentary strata. In the more deeply eroded parts of the Territory, faults can be identified only by other, less striking topographic effects.

It appears that a fault extends inland from Waimea Bay, Oahu, trending about south-southeast. The block on the northeast has been raised about 200 feet relative to the block on the southwest. Several consequences of such a fault can be deduced, and these consequences are met so as to confirm the hypothesis of this fault. The deduced consequences are as follows:

1. The shore line northeast of Waimea Bay is offset about two-thirds of a mile seaward with respect to the shore line southwest of the bay.
2. The general courses of the 500- and 1,000-foot contour lines are offset similarly.
3. The wave-cut cliffs northeast of the bay are notably higher than those southwest of the bay.
4. Perennial stream courses are especially abundant in what would have been the low strip at the foot of the erstwhile fault cliff.
5. A topographic profile across the valley axes shows summit levels on the northeast about 200 feet higher than the summits on the southwest.
6. "Two-cycle" or "valley-in-valley" topography, such as uplift would cause, is found northeast of the assumed fault.
7. Looking northeastward from Lauhulu Bridge, a little over two miles from Haleiwa, one sees cane fields on the top of the downthrown block, and above and beyond the cane fields, one sees the wooded, much-subdued, and receded fault cliff.

The cumulative evidence of these phenomena seems to warrant assigning them to the existence of a fault.

HAROLD S. PALMER

A STUDY OF WERNER COMPLEX COMPOUNDS BY INSTRUMENTAL METHODS

The coordination complex compounds are peculiarly adapted to instrumental analysis since they are often highly colored, optically active, and possess varying degrees of absorption in the ultraviolet region of the spectrum. Further, they are often difficult to isolate in the pure crystalline state either because of high solubility or due to the small amounts of material which can be prepared.

The present study involves an apparent optical anomaly first observed by the German investigators Pfeiffer and Quehl in 1931. These investigators reported that a three-molar quantity of orthophenanthroline when added to a one-molar portion of zinc hexa aquo d-alpha-bromcamphor-pi-sulfonate caused an exaltation of optical activity. This was inadequately explained as an optical activation or induction of activity. Since no resolution was achieved this might be classified as an asymmetric synthesis. Few such, if any, have ever been found in inorganic complex compounds.

The present authors continued the study of this effect from a new point of view. That is, the effect of the zinc triorthophenanthroline complex cation on the optically active d-alpha-bromcamphor-pi-sulfonate anion. Polarometric and refractometric (by Zeiss immersion instrument) analysis indicated a bond formed between the anion and the cation in solution. Conductometric measurements proved that the compound followed Arrhenius' weak electrolyte theory more closely than the Kohlrausch theory of complete ionization as inferred by the original investigators (from precipitation data).

A rapid method of spectrum analysis was developed to obviate aquation. The absorption curves gave the following characteristics:

COMPOUND	EXTINCTION VALUE	ABSORPTION PEAK (*in millimicrons*)
Ammonium d-alpha-bromcamphor-pi-sulfonate	0.28	235
	0.26	305
Zinc hexa aquo d-alpha-bromcamphor-pi-sulfonate	0.20	280
Zinc triorthophenanthroline d-alpha-bromcamphor-pi-sulfonate	1.15	343 (complete absorption to 330)
Orthophenanthroline	1.13	325 (complete absorption to 315)

Thus an electronic distortion of the center of asymmetry is indicated which could be explained by bonding forces of perhaps the Van der Waal's class. The distortion aspects are being continued at the present time through dipole moment studies.

ROBERT C. BRASTED AND
JOHN C. BAILAR, JR.

A STUDY OF THE RELEASE OF NON-EXCHANGEABLE POTASSIUM IN A HAWAIIAN SOIL

A five-year study was made of the cumulative uptake of potassium by sixteen successive crops of Napier grass at the Poamoho, Oahu, substation of the University of Hawaii Agricultural Experiment Station. During this time a careful check was maintained on the level of exchangeable potassium in the top three feet of soil of the experimental area. The potassium content of the irrigation water was also determined.

Large quantities of potassium were extracted by the crops during the period studied; the amounts ranged from 3,500 pounds of K_2O per acre in the case of a completely unfertilized plot, to 4,275 pounds from a plot receiving nitrogen and phosphate. Since the levels of exchangeable potassium in the soils remained essentially constant and since inappreciable quantities of potassium were present in the irrigation water, it was concluded that practically the entire amounts of potassium absorbed by the crops were derived from nonexchangeable sources.

Electrodialysis of the Poamoho soil also gave evidence of a gradual release of potassium over and above that present in exchangeable form.

It seems probable that most Hawaiian soils possess in some degree the reserve potassium-supplying power displayed in the Poamoho experiment. If such is the case, then the quantity of potassium available to a crop is to be measured, not alone by the amount of potassium present in the soil in exchangeable form at the start of the crop, but by this amount plus that which becomes available during the crop.

A. S. AYRES, J. C. RIPPERTON, M. TAKAHASHI, AND Y. KANEHIRO

CURRENT REVIVAL OF JAPANESE VOLCANOES

The purpose of this paper was to show pictures of the Fuji volcanic chain from Tokyo through the Izu, Bonin, Volcano, and Marianas islands for comparison with Bogoslof of the Aleutians; and to show pictures of Sakurajima activity in 1914.

Throughout March of 1946 these two belts of volcanoes erupted together, approximately a third of a century after they last erupted together in 1910-14. That time was a century and a third after they erupted together about 1779. Multiples of approximately thirty-three years appear among volcanoes to have significance, as in the 132-year interval between the two explosive eruptions of Kilauea, which were times of great engulfment and release of pressure from internal magma sinking. A caldera subsidence was interpreted by running levels after 1914 at Sakurajima, and after the 1924 explosions at Kilauea. And both these episodes happened at times of minima of sunspots, for reasons unexplained.

Omori and Koto both cited sympathy of Kyushu and Izu Islands for 1779 and 1914. Oshima in 1910, 1912, and 1914, Minami Iwojima 1914 (the same month as Sakurajima), and these followed Torishima 1902, Bayonnaise Rocks 1905-1906, and Minami Iwojima in an earlier eruption of 1904-1905. That was the world volcanic decade of St. Pierre, Vesuvius, Santa Maria, the Aleutians, Etna, the Messina and San Francisco earthquakes, and a dozen others.

On March 7, 1946, came the airplane report of a steaming eruption of rocks at sea level near the Bayonnaise Rocks, with boiling green muddy water and sulfur. On March 14, 1946, Sakurajima erupted ash, followed by a lava flow to the south beach. The villages Kurokami and Arimura were evacuated. The lava crater was two miles from shore inland, the moving wall of lava was 21 feet high and a stream of it moved 40 feet an hour. Sakurajima is 500 nautical miles west of the Fuji-Iwojima chain. An account of the Sakurajima disaster of 1914 will be found in the author's book, *Volcanoes Declare War.*

T. A. JAGGAR

CHROMOSOME BEHAVIOR IN A CATTAIL MILLET X NAPIER GRASS CROSS

A selfed line of cattail millet was used as the female parent, and pollen from an East African strain of Napier grass was applied to the cattail millet stigmas. The F_1 seed produced 34 plants which, compared with cattail millet, were classified as follows:

1. Normal flowering, green	7
2. Normal flowering, variegated	9
3. Late flowering, green	18
4. Late flowering, variegated	0
	34

Cytological examinations of root tips and sporocytes were made and revealed that one plant had 28 chromosomes, one had 21, one had 18, several had 16, and several had 14. On the basis of these observations, it appears that when this cross is made using cattail millet as the female parent, aberrant chromosome behavior is induced, probably as a result of a stimulating effect of Napier grass pollen on embryo sac development in cattail millet.

When one genome (7) of cattail millet occurs with one genome (14) of Napier, the hybrids are large and vigorous, and strongly resemble Napier.

When two genomes (14) of cattail occur with one genome of Napier (14) the plants more strongly resemble cattail. Such plants result from the union of an unreduced cattail egg and a normal Napier pollen grain.

Cattail-like, variegated plants seem to be largely aneuploids carrying reduplicated fragments of a cattail chromosome. The cause of fragmentation is unknown but probably relates to an enzyme from the Napier pollen.

DONALD L. VAN HORN AND W. B. STOREY

STUDIES ON THE CONTROL OF MELON FLY IN TRUCK CROPS

This paper outlined the more important results of a cooperative investigation on the control of melon fly in truck crops, by the Entomology Department of the University of Hawaii Agricultural Experiment Station and the Fruit Fly Laboratory of the U. S. Bureau of Entomology and Plant Quarantine. The work was begun in an informal way in 1942 and materialized in a formal cooperative project in 1943. Melon fly is the one insect of diversified crops, which, until now, has been without a satisfactory control. It is a hazard to production of all cucurbits and tomatoes.

Cage studies demonstrated that DDT was superior to any other material yet discovered for killing melon flies.

Results of a field study in which over 80 per cent control was secured with DDT in a crop of tomatoes which was about to be ruined by melon flies were described.

Because cucurbit crops do not tolerate DDT at concentrations necessary for adequate control of the fly, a method of protecting melon fly-susceptible crops has been worked out in which corn, which is attractive to melon fly but not a host, is planted as a barrier crop around the crop to be protected and is kept treated with DDT. By use of this method a crop of cucumbers, with over 80 per cent marketable fruit, has been grown under conditions in which cucurbits 100 yards away were being ruined by the fly.

These studies mark outstanding progress toward a solution of this important half-century-old problem.

F. G. HOLDAWAY, O. C. McBRIDE, Y. TANADA, T. NISHIDA, AND W. C. LOOK

STUDIES OF THE FAT CONTENT OF SOW'S MILK

Fifty-two milk samples were collected from eighteen sows during early and advanced stages of lactation. During each lactation each sow received one of the following rations: (1) Dry concentrate only, (2) one-third dry concentrate and two-thirds garbage, or (3) garbage only. On an air-dry, equal-moisture basis the dry concentrate mixture contained 2.8 per cent fat and the garbage 27.1 per cent fat. The garbage averaged 70.7 per cent water as fed.

The fat content of the milk increased with the increase in garbage (or fat) intake and with the advance of lactation. The average fat contents of the milk when the sows were receiving the different rations were as follows: Dry concentrate, 6.1; one-third dry concentrate and two-thirds garbage, 7.7; and garbage only, 9.6 per cent. The average fat content of the milk collected during the early stage of lactation was 6.9 per cent and during the late stage of lactation 8.8 per cent. The differences were all highly significant.

E. L. WILLETT AND L. A. HENKE

THE B VITAMINS OF PORK TISSUES FROM PIGS FED GARBAGE AND GRAIN RATIONS

The tissues of two carefully paired groups of pigs were assayed by chemical methods for thiamine, riboflavin, and niacin. Group I received a grain ration while Group II received garbage from Army and Navy camps.

Both groups gave normal values for riboflavin and niacin, but the garbage-fed animals gave very low values for thiamine. The average values in micrograms of thiamine per gram of tissue for the garbage-fed animals were: Shoulder 3.2, loin 3.2, and liver 1.7, as contrasted with values for the grain-fed animals of 7.8, 7.7, and 2.7, respectively. This is of nutritional significance for thiamine is the vitamin most likely to be low in our modern dietaries and pork is one of the few foods which is relatively rich in this vitamin.

A study was also made of the losses of these vitamins in cooking. The muscle meats, shoulder and loin, suffered much greater losses than the liver. The greatest losses were of thiamine—60 per cent with roasting and 40 per cent with braising. The losses of niacin were less—35 per cent with roasting and 25 per cent with braising. No loss of riboflavin occurred with either method of cooking. The liver, which was fried, lost 15 per cent of the thiamine, 10 per cent of the niacin, and none of the riboflavin.

Cooked island pork, therefore, is a product relatively low in thiamine whereas cooked mainland pork is one of our richest sources of this vitamin.

EVA HARTZLER, CAREY D. MILLER, AND WINIFRED ROSS

SOME EXPERIMENTAL STUDIES OF HUMAN VALUES

In a series of ten publications in psychological journals (1935-46) a theory of human value has been developed and submitted to repeated experimental verification. The theory has two main aspects: (1) It emphasizes the operational approach to value investigations (aesthetics, pleasantness, feeling) and (2) it hypothesizes central (nervous) conditions of readiness to respond to objects in a positive or a negative way as the fundamental determinants of value judgments. Experimental studies have involved taking a series of relatively indifferent stimuli objects, determining their relative values in a group of human subjects by means of individual psychophysical methods, submitting these subjects to a learning situation in which they are required to establish response readinesses to the objects, and finally taking a second measurement of the relative values of the objects.

Results have uniformly verified the hypothesis: Positive reactions enhance and negative reactions depress the evaluating attitude toward objects. This relationship holds under different methods of measurement, for different time intervals, and with different types of stimuli objects. Several conditions of this relationship have been discovered. Positive reactions have a more intense and more durable effect than do negative reactions. A condition of major significance has been found to be the level of abstractness of the subject's observing set.

HENRY N. PETERS

NECROLOGY

ALEXANDER HUME FORD

Alexander Hume Ford was born in Charleston, South Carolina, on April 3, 1868. He was educated at Porter Military Academy and early devoted himself to magazine and play writing. Beginning in the late 1890's, he travelled widely, especially in the Pacific and in the Orient, and found his life interest in promoting conferences and organizations to foster international and interracial understanding and good will. In Hawaii, where he made his home from 1907 on, he was instrumental in founding the Outrigger Canoe Club and the Hawaiian Trail and Mountain Club. He was largely responsible for the Pan-Pacific Conference held in 1911 and for initiating the celebration of Balboa Day in 1915.

He was the leading spirit in founding the Pan-Pacific Union in 1917, which later became the home office in Hawaii for the successive Pan-Pacific scientific congresses, and sponsor for the Pan-Pacific Research Institution and various activities centered there. It is impracticable to give here a catalogue of his various enterprises. His energy and ingenuity command the greatest respect, whether or not one endorses all the projects in which he took a major part.

He was a charter member of the Hawaiian Academy of Science and was widely known to its membership during its earlier years. He had been in retirement for a number of years and died in Honolulu on October 14, 1945.

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Published by the University of Hawaii Honolulu, T. H., 1947

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE"

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FOREWORD

This volume of the *Proceedings of the Hawaiian Academy of Science* contains the abstracts of papers presented at the meetings of November 7 and 8, 1946, and May 1 and 2, 1947. There is also included a résumé of the address of the retiring president, Dr. T. A. Jaggar, and of reports and historical notes on the Pacific Science Board, the Pacific Science Conferences, the Pacific War Memorial, and the journal *Pacific Science.* This summary of the activities following the dinner meeting of the Academy on May 3, 1947, was prepared by Mr. E. H. Bryan at the request of the secretary.

Replies have been received from various learned institutions on our selected list of depository libraries and about 30 complete sets of *Proceedings* have been sent out in addition to a much larger number of sets lacking one or more numbers no longer available. This is being handled by the University of Hawaii with the understanding that exchanges are to be deposited in the University Library.

The current list of members of the Academy is printed in this number. The membership has shown a fairly steady gain during the past several years as a result of electing members twice a year. However, about 20 to 25 new members a year are required to balance the separations by removal from the Territory, non-payment of dues, and the much rarer request to be dropped. It is evident that no great increase can be expected. According to the constitution, members may be persons interested in science. The majority of our members are connected in some way with scientific work, but a considerable number are citizens otherwise employed who desire to keep informed on scientific work in Hawaii. We need both kinds of members and we need as members persons who can and will pay dues and take part in our work, whether by presenting papers or by attending meetings over a period of years. The secretary finds, from a number of years' experience, that in nearly every large group of newly elected members there will be one or more persons whose names have to be dropped after the initial year because they apparently lose interest and pay no dues. Only the considered judgment of members sponsoring nominees can on the one hand refer to the secretary or to the membership committee all really promising applicants and on the other try to omit those actuated by temporary interest that may not last.

OFFICERS

1946–1947

President, Thomas A. Jaggar
Vice-President, Harold St. John
Secretary-Treasurer, Chester K. Wentworth

Councilor (2 years), Joseph P. Martin
Councilor (1 year), Christopher J. Hamre
Councilor (1 year), Peter H. Buck (ex officio)

1947–1948

President, Harold St. John
Vice-President, John H. Payne
Secretary-Treasurer, Chester K. Wentworth

Councilor (2 years), Joel B. Cox
Councilor (1 year), Joseph P. Martin
Councilor (1 year), Thomas A. Jaggar (ex officio)

REPORT of the MEETING of MAY 3, 1947

Edwin H. Bryan

Following the banquet and business session of the 22nd annual meeting of the Academy held at Hemenway Hall, University of Hawaii, a program was presented, consisting of four short talks and the address of the retiring president, Dr. Thomas A. Jaggar, on "Rock of the Ocean Bottom." The theme of the short talks was cooperation in scientific research in the Pacific. Dr. Peter H. Buck, director of Bernice P. Bishop Museum, described the efforts of the local committee of the Pacific Science Board, of which he is chairman, to establish and equip a research center in Honolulu for accommodation of scientists undertaking research in the Pacific. Such a center has now been set up at the Bishop Museum and equipped through the cooperation of the U. S. Navy.

Mr. Harold J. Coolidge, executive secretary of the Pacific Science Board, told of the organization and work of that Board. Mr. Coolidge, who is connected with the Museum of Comparative Zoology, Harvard University, is an authority on the higher mammals, and related some of his experiences while studying apes in southeastern Asia. The object of the Pacific Science Board as established in Washington by the National Research Council, Mr. Coolidge explained, is to facilitate and coordinate investigation in all parts of the Pacific and in all branches of science except engineering and atomic research. He announced that a research institute had recently been started by cooperating French scientists at Noumea, New Caledonia, using former American military buildings. The hope was expressed that a similar center would be established at Hollandia, Dutch New Guinea.

The aim of the Pacific War Memorial is to further research and conservation in the Pacific, as a living memorial to those who gave their lives in the Pacific during World War II, according to Mr. Coolidge, and it is planned to raise ten million dollars for that purpose. The Memorial will take the form of field stations with laboratories, living accommodations, and transportation facilities. Initial stations are to be on Saipan, Koror, Palau, and Guadalcanal.

In closing, Mr. Coolidge expressed concern over the danger of accidental introduction of insect or other pests in the process of returning disinterred bodies of war dead to Hawaii or to the mainland United States. He urged that special precautions be taken by quarantine authorities. (Since this meeting, a committee of the Academy headed by C. E. Pemberton has interviewed those in charge of this program and expressed confidence in the precautionary measures currently in force.)

Dr. Herbert E. Gregory, who was chairman of the first Pacific Science Conference, held in Honolulu in 1920, and who as former director of Bishop Museum had been intimately associated with scientific investigations in the Pacific, told of pioneer efforts to develop scientific research in the Pacific through cooperation. He reviewed the six Pacific Science Congresses—in Hawaii, Australia, Japan, Java, Canada, and California—and their accomplishments. He paid tribute to the activities of the Hawaiian Academy of Science in furthering research and bringing scientists together during the past 22 years.

Dr. A. Grove Day, editor of *Pacific Science,* reported on the launching of this quarterly "devoted to the biological and physical sciences of the Pacific region," the third issue of which is now in the hands of the printer.

The members of the Academy of Science moved to approve the action of the Territorial Legislature in passing Resolution No. 36, endorsing the Pacific War Memorial.

"Rock of the Ocean Bottom," the address of the retiring president, Dr. T. A. Jaggar, was a plea for direct attack on the problems of the ocean bottom by echo sounding, core drilling from sea dromes, and use of all other available geophysical devices and methods. He began and ended his talk with color motion pictures of the volcanic eruptions of Mauna Loa in 1940 and 1942, and of Paricutin in 1943 and later.

Dr. Jaggar opened his discussion of rock of the ocean bottom by quoting H. C. Stetson, who remarked that "no one knows anything about the bottom of any one of the major ocean basins." Emphasis was laid on the large area in the ocean bottom, of which we know so little, and of the many problems that would be aided by the systematic study of ocean-bottom areas. Copies were distributed of a proposal made by Dr. Jaggar in 1943 for an extensive program of ocean-bottom core drilling and which had been sent to the International Union for Geodesy and Geophysics. Such drilling was to be supplemented by gravity determinations and other methods of study of the rocks and structure of the ocean-bottom areas, with special attention to the Pacific basin.

A letter from Dr. Hans Pettersson of the Oceanografiska Institutet, Goteberg, Sweden, was read, announcing that an expedition would start shortly on a round-the-world cruise, following the general course of the famous Challenger Expedition. In the eastern Pacific it would visit the Galapagos Islands, the Marquesas, Tahiti, and Hawaii, west of which it would keep close to the equator. The vessel, an auxiliary schooner named the "Albatross," would be equipped to take core samples from the ocean bottom with a newly developed Kullenberg piston core sampler, which in 1945 took a core 20.3 meters long from the bottom of the Gullmar Fjord. The ship would have accommodations for a staff of 12, laboratories, store rooms, air-conditioning plant, and electric winches with wires of 7,500-meter length. Dr. Carl Skottsberg might accompany the expedition from Panama to Hawaii. A geothermometer would measure temperature gradients of the deposits, as well as of ocean waters. Light and transparency measurements would be made and the water analyzed for radium and uranium.

Dr. Jaggar noted that the earth seemed to be entering another period of volcanic and seismic activity similar to that which began in 1899 and lasted for 10 years. Starting in 1943 with the outbreak of Paricutin from a Mexican corn field, there has been an extensive series of earthquakes and volcanic outpourings all around the world—18 events in 4 years, and the end not yet in sight.

Throughout his address and in comments on the moving pictures of volcanic eruptions, Dr. Jaggar pointed out our almost complete lack of knowledge of rock-forming processes under and around the ocean and the great need, both in the interest of useful mineral resources and ultimate geologic understanding, of enlisting the support of individuals and foundations in carrying on such studies. Technical wartime advances have shown what can be done; such means can be applied to a more concerted attack on the large, unknown areas of the oceans.

THE 22nd ANNUAL MEETING 1946-47

Program

NOVEMBER 7, 1946

Joseph E. Alicata: Murine Leptospirosis and Parasites of Man on Truk and Ponape, Eastern Carolines.

David D. Bonnet: Distribution of Mosquito Breeding in Honolulu by Type of Container.

E. J. Anderson: Laboratory Studies of Root-Rot Infection in Pineapple in Relation to Nutrient Concentration.

F. R. Fosberg: Present Status of Cinchona.

NOVEMBER 8, 1946

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Christopher Gregory: Unified Field Theories.

Joseph R. Mottl and Kenichi Watanabe: Determination of the Dynamic Modulus of Elasticity by the Electro-Sonic Method.

C. J. Herrick and H. N. Peters: Scientific and Non-Scientific Factors in the Diagnosis of Feeblemindedness.

MAY 1, 1947

Donald P. Rogers: A New Basidial Type.

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F. W. Hartmann: A Colorimetric Caries Survey Method.

Nils P. Larsen: Tooth Decay in Relation to Diet and General Health.

MAY 2, 1947

C. P. Sideris: Ascorbic Acid in Pineapple Varieties.

K. R. Kerns and J. L. Collins: Colchicine-Induced Tetraploidy in the Cayenne Pineapple.

Carey D. Miller, Winifred Ross, and Lucille Louis: The Mineral Content of Hawaiian-Grown Vegetables.

Elwood C. Zimmerman: Biblical Insects.

MAY 3, 1947

Annual Dinner

Business Meeting

Installation of Officers

Address by Retiring President

Thomas A. Jaggar: Rock of the Ocean Bottom.

Abstracts

MURINE LEPTOSPIROSIS AND PARASITES OF MAN ON TRUK AND PONAPE, EASTERN CAROLINES

Reports indicate that cases of human leptospirosis (Weil's disease) have occurred in Micronesia, but, as far as is known, there has been no laboratory confirmation of these reports. Since the endemicity of Weil's disease in an area is dependent largely on the presence of murine infection, a study of the rodent population would assist in determining the true existence of the disease. During July and August of 1946 a study was made to determine the presence of leptospirae among rats on the island of Moen of Truk Atoll and on the island of Ponape. Of 22 rats trapped on Moen and 18 trapped on Ponape, 3 and 2, respectively, showed presence of leptospirae in the urinary tubules. The diagnosis was based on examination of kidney tissues fixed in formalin and stained by the silver impregnation technique. The above findings lead one to believe that human leptospirosis is probably more common in Micronesia than heretofore believed. The presence of high rainfall and abundance of rodents in the area present factors which are favorable to the spread of the disease.

In addition to the above, a study was made to determine the incidence of helminthic infection among natives of Ponape and Truk. A total of 50 stools and 150 bloods was obtained in Ponape and 26 stools and 29 bloods in Moen; a single specimen was secured from each native. The parasites found and their percentage incidences were as follows: PONAPE: *Wuchereria bancrofti* (microfilariae in blood), 14.0; hookworms (species undetermined), 76.0; *Ascaris lumbricoides,* 44.0; *Trichuris trichiura,* 94.0; *Strongyloides stercoralis,* 2.0. TRUK: *Wuchereria bancrofti* (microfilariae), 20.6; hookworms, 57.6; *Ascaris lumbricoides,* 50.0; *Trichuris trichiura,* 88.4; *Strongyloides stercoralis,* 11.5; *Enterobius vermicularis,* 3.8. Clinical cases of filariasis which showed presence of elephantiasis, hydrocele, enlarged epitrochlear, femoral, and inguinal nodes, and epididymis were noted.

JOSEPH E. ALICATA

THE DISTRIBUTION OF MOSQUITO BREEDING IN HONOLULU BY TYPE OF CONTAINER

A study of the distribution of *Aedes* mosquito breeding and type of container found in the city of Honolulu has shown the relative importance of different types of breeding places as the source of *Aedes* mosquitoes.

Although "accidental containers," including bottles, tin cans, tires, barrels, jars, etc., constitute 46 per cent of all containers inspected, they contained 55 per cent of all *Aedes* breeding. "Interior containers," such as vine bowls and flower vases, contained 11 per cent of the breeding and constituted 11 per cent of all containers. "Outdoor plants," including apé and lily plants, were found in equal numbers (each approximately 7 per cent of all containers), but lily plants contained 13 per cent of all breeding and apé plants 4 per cent. "Semi-permanent useful containers," such as ant cups and animal drinking pans, were 24 per cent of all containers, but contained only 16 per cent of the breeding. The "permanent useful containers," such as cesspools, fish ponds, catch basins, etc., constituted 3.0 per cent of all containers inspected and contained only 1.8 per cent of all *Aedes* breeding.

Approximately 1,000 samples of each of the three species in Hawaii were studied and marked differences in the distribution of breeding in the different containers were noted between *Aedes albopictus, Aedes aegypti,* and *Culex quinquefasciatus.* Lesser differences were shown by the two *Aedes* species.

The information obtained from this study is the primary basis for the method of operation currently used in the control of mosquitoes in Hawaii.

DAVID D. BONNET

LABORATORY STUDIES OF ROOT-ROT INFECTION IN PINEAPPLE IN RELATION TO NUTRIENT CONCENTRATION

The occurrence of severe root rot and heart rot, caused by the fungus *Phytophthora cinnamomi* Rands, chiefly in areas of high rainfall and during wet weather when excessive leaching might be expected, suggests that dilution of the soil solution may influence the severity of the disease.

In inoculated water cultures, root-rot infection decreased with increasing concentration of total nutrients and with high potassium in solutions of moderate total nutrient concentration. In tap water, in dilute nutrient solutions, and in all solutions low in potassium, root infection was essentially complete 10 days after inoculation. In concentrated solutions and in solutions high in potassium, infection was evident only after 30 days and reached only 8.5 and 7.5 per cent, respectively, after 35 days when the experiment ended.

Limited observations of the fungus on infected roots indicate that in the more concentrated solutions there is abnormal development of zoospores, the swimming cells that probably account for most of the infection in solution culture. On the other hand, vegetative growth of the fungus in solutions of similar concentrations of nutrient salts in 20 per cent pineapple juice was best in the most concentrated solutions.

In short-term pot cultures of pineapple crowns in naturally infested soil, root rot and heart rot were markedly reduced by heavy applications of a complete fertilizer and by lighter applications of the complete fertilizer plus a heavy application of potassium sulfate. Whether similar results would occur under field conditions remains to be determined.

E. J. ANDERSON

PRESENT STATUS OF CINCHONA

Cinchona, source of quinine, has had perhaps more intensive taxonomic study than any other tropical plant genus. In spite of this, it was, at the beginning of the last war, one of the most poorly understood of major economic genera of plants. This was due as much to the intrinsic difficulty in the genus as to the lack of ability of many of the botanists who had worked on it. It was even more due to the lack of detailed field knowledge.

A valuable by-product of the intensive effort to procure wild cinchona bark during the war was the acquisition of much of the field observation and herbarium material necessary for an understanding of this genus in terms of modern evolutionary taxonomy. Eighteen botanists and a number of foresters were employed in exploring for *Cinchona* in the countries from Peru to Venezuela, in the Andes of South America. Bolivia was not explored at all, though it is one of the most important countries in the range of the genus. Without further explorations in Bolivia and Peru no conclusions can be regarded as final.

The results of these investigations suggest, in the first place, that the arrangement of genera in the immediate relationship of *Cinchona* is unsatisfactory. Rather than four genera, as they are treated at present, there should either be seven, or they should be combined into one. Since the characters separating them seem neither very constant nor very fundamental, the latter course should probably be followed. Thus *Ladenbergia, Remijia,* and *Pimentelia* should be united with *Cinchona.*

The results also indicate that neither of the two widely divergent concepts of the species in *Cinchona* (*sensu stricta*) represents the actual structure of the genus. Rather than a multitude of ill-separated species or only a very few simple ones separated by definite but very superficial characters, the actual situation seems to be as follows. There are four or five complex, more or less wide-ranging, upland species, each composed of a number of geographical varieties, and at least two distinct lowland species which, so far as they are known, are not so complex. The geographic ranges of these upland species are more or less superimposed, though of different extents, and they are more or less separated altitudinally. Where this altitudinal separation breaks down, as is frequent, hybridization usually occurs. So far as is known all *Cinchona* species are interfertile. This hybridization is a rather rare occurrence in Colombia, but seems to be widespread and very common in Ecuador, especially to the south. Several populations of plants in southern Ecuador are difficult to place in the species as outlined, as their characters are intermediate. It is possible that these originated by hybridization long ago and have since become stabilized.

The outstanding single problem yet to be solved is whether the Bolivian *Cinchona calisaya,* most important of commercial species, is distinct from *C. officinalis,* found in the countries to the north. Further field work is planned, to be financed by a Guggenheim Fellowship, during the coming year, to investigate especially the Bolivian and Peruvian Cinchonas, which are not adequately understood.

F. R. FOSBERG

VARIATION OF INTENSITY OF THE 1946 TSUNAMI ON HAWAIIAN SHORES

The primary cause of variation in intensity of the 1946 tsunami was the directional nature of its fault origin. The variation of intensity in the Hawaiian Islands from this factor was probably negligible.

Refraction was the principal factor controlling variation on the Hawaiian shores. Refraction diagrams can be prepared on charts by the Huygens construction. The time of arrival of the wave at Honolulu Harbor computed from such diagrams is in error only 4 per cent of the total travel time. The ratio of average wave height on the south coast of Kauai to the average on the north coast predictable from the refraction diagrams is 6 to 10. This corresponds to a ratio of average measured dash height on the south coast to the average on the north coast of 7 to 10. For Kauai there is qualitative correlation between areas of diagramed convergence, as at the heads of submarine ridges, and measured maximum dash heights, and between areas of diagramed divergence, as at the heads of submarine valleys, and measured minimum dash heights. Diffraction tends to reduce the effects of refraction. Interference between refracted sectors of waves and with wind-generated waves probably added to dash heights on windward coasts and may have added to local variation.

Coral reefs and breakwaters reduced the effects of the waves greatly. The waves dashed higher on steep shores than on gently sloping shores. On lowlands the waves decreased in height as they rolled inland. Buildings and trees quickly reduced the force of the waves. A funnel effect was noted only in small valleys.

A tsunami warning system seems technically feasible. Warnings should be based on occurrence of actual waves, not earthquakes, to avoid numerous false alarms.

Study of refraction and other causes of variation will be of use in predicting intensity variation of future tsunamis.

DOAK C. COX

UNIFIED FIELD THEORIES

Unified field theories are characterized by attempts to render the gravitational and electromagnetic fields essential parts of a geometrical structure. The possibilities for geometrizing the fields have been demonstrated by various investigators but the theories cannot be regarded as successful because of non-uniqueness difficulties which enter in applications of least action principles and the phenomenological appearance of charge-current distributions.

To obviate some of the difficulties inherent in current theories, a new theory was constructed which featured the metric and stress-energy-momentum tensors as playing symmetrical roles. The equations in the new theory were obtained by requiring that fourth-degree equations result for the tensor components as demanded by comparison with quantum mechanics. The complexity of the equations prevented immediate application except to the cosmological problem. No serious disagreement exists if one considers the crudity of the original model and difficulties of measurement.

A new transformation theory of the electromagnetic field which promises to throw light on the nature of electric particles, particularly the remarkable tendency for charges to occur in quanta, has been set forth. Utilizing the fact that a transformation of coordinates exists which transforms the components of a contravariant vector in such a way that only one component, which is constant, remains, the field equations involving the curvature tensor are found to contain the metric tensor together with the constant component of the vector-potential only. On applying an ingenious approximation method proposed by Einstein, Infeld, and Hoffman, calculations indicate that the motion of N singularities in the field conforms to Newton's equations in the first approximation. In the second approximation indications of the electromagnetic and mass-velocity effects are exhibited. The equations of motion involve $N + 1$ constants instead of the usual $2N$. This fact seems to imply the discreteness of electric charge. It is planned to extend the theory to include meson fields of the Podolsky type and to quantize the systems in a classical fashion.

CHRISTOPHER GREGORY

DETERMINATION OF THE DYNAMIC MODULUS OF ELASTICITY BY THE ELECTRO-SONIC METHOD

Recent determinations of the dynamic modulus of elasticity, E, by flexural vibration have been computed on the basis of Goen's solution of Timoshenko's differential equation. Since this equation neglects the effect of damping force and that of forced vibration, E by the vibration method should be somewhat higher than the accepted values, depending on the relative magnitude of the damping force. This deviation should be negligible for substances like brass and steel but would be significant for concrete. Furthermore, the assumption that E is constant with respect to strain is incorrect for substances like concrete. To determine the magnitude of these variations, the summation of the response curves for the signal generator, amplifiers, driver, and pickup must be reasonably flat.

A test apparatus consisting of a Packard Radio, Model 205 AG precision signal generator, a 10-watt amplifier, a loud-speaker driver, and a crystal pickup has been assembled and measurements have been conducted on a number of materials including steel, brass, mortar, and concrete. It is found that the E values, by the electro-sonic method, for steel and brass agree with the accepted values, but for substances like mortar and concrete the values of the E by this method are noticeably higher than the values obtained by the usual compression stress-strain method.

It is believed that E, as determined by the sonic method, for substances like concrete corresponds to the initial slope of the stress-strain diagram obtained by the compression method. This fact accounts for the higher value of E as determined by the sonic method.

JOSEPH R. MOTTL AND KENICHI WATANABE

SCIENTIFIC AND NON-SCIENTIFIC FACTORS IN THE DIAGNOSIS OF FEEBLEMINDEDNESS

The diagnosis of feeblemindedness involves not only the measurement of mental capacity of an individual at the time of examination but also a study of his past history and predictions as to his future. Socio-legal considerations force the psychologist to state his diagnosis not in terms of a scientific measurement of mental capacity, although techniques for arriving at such a statement are available, but in terms of the legal action which ought to be taken with respect to a given individual. The two factors which ought to define this action are the individual's scientifically measured mental capacity, and his scientifically unpredictable future environment. The satisfactory way of taking proper account of future uncertainties in the environment is to use three diagnostic categories: normal mentality, borderline mentality, and feebleminded. Legally, however, the psychologist must diagnose either feebleminded or not feebleminded.

C. J. HERRICK AND H. N. PETERS

A NEW BASIDIAL TYPE

A fungus hitherto undescribed has been several times collected as a parasitic growth on the apothecia of a minute wood-inhabiting ascomycete. The basidia of the parasite are longitudinally septate, as are those of the jelly-fungi belonging to the Tremellaceae, and bear similar epibasidia. Upon the epibasidia are borne very long, slender, fragile sterigmata which produce the basidiospores. The latter are without apiculi, are symmetrical on their sterigmata, and are freed by fracture of the sterigmata. In manner of spore-production the fungus is allied to such gasteromycetes as *Lycoperdon,* which show the same relation of sterigma to spore. It is to be described as the sole member of a new genus within the Hyaloriaceae.

DONALD P. ROGERS

A CONTRIBUTION TO MOLECULAR STRUCTURE

Bond angles in triatomic molecules are of interest because of the information which they give on bond type. Often elements in the same group of the periodic table form bonds with approximately the same angles. Atoms of the sixth group, for example, form bonds at approximately 100°—as OCl_2 at 115°; SCl_2, 102°; Se-Se-Se (in selenium crystal), 105°; and Te-Te-Te (in tellurium crystal) at 102°. The bond angle in tellurium dibromide ($TeBr_2$) has, however, been reported to be between 150° and 180°. In view of the anomalous character of this reported value, a careful redetermination of the angle was made by the electron diffraction method. Contrary to the previous work, the bond angle was found to be $98° \pm 3°$, in agreement with values found for similar compounds.

ROBERT A. SPURR

A COLORIMETRIC CARIES SURVEY METHOD

A colorimetric bacteriologic technique recommended for caries survey work has been applied to saliva specimens obtained from a large number of children living in plantation communities.

The results indicate that the method provides a good estimate of the number of aciduric bacilli in saliva as compared to estimates obtained by plating procedure. It has also been shown that the colorimetric test does not reflect the number of yeast cells present. This is important because the aciduric bacilli are the organisms whose numbers are correlated with the carious state and, as has been demonstrated, the aciduric counts and yeast counts do not run parallel.

The colorimetric test has been found to be a very practical tool for survey studies.

F. W. HARTMANN

TOOTH DECAY IN RELATION TO DIET AND GENERAL HEALTH

An analysis of the tooth condition of over a thousand children compared with previous studies made in 1930 and 1938 indicates that rampant tooth decay is still prevalent in Hawaii. Hawaiians on a high carbohydrate diet (taro) had excellent teeth, Orientals or Polynesians on a rice diet had very bad teeth.

The water of Hawaii is very low in fluorine, 0.02 ppm. to 0.2 ppm. In cities where children were drinking water containing 1.0 ppm. they had 30 to 50 per cent less tooth decay than in sections where children drank water of low fluorine content.

Oxalates in taro and poi are as strong an inhibitor possibly of caries as fluoride. Climate, heredity, calcium-phosphorus ratios, sugar, or any other specific food factors do not seem to be the cause of tooth decay. Prevention can be brought about by adding certain protective factors. The acid-base value of carbohydrates might be important. Factors preventing tooth decay decrease the aciduric bacteria.

Hawaii, having the highest percentage of tooth decay in the United States, is one section where fluorine should be added to the city drinking water in order to decrease the amount of tooth decay by at least 30 per cent.

Tooth decay is a preventable disease. It is not associated with other factors that produce good or bad health as indicated by a study of the newly arrived Filipinos who were in very poor health and yet had excellent teeth.

NILS P. LARSEN

ASCORBIC ACID IN PINEAPPLE VARIETIES

Different pineapple varieties contain different amounts of ascorbic acid in the ripe fruit. Also, these amounts differ at various stages of fruit growth and the gradients of ascorbic acid concentrations from the flowering to the ripening stage of the fruits are ascending in certain varieties and descending in others.

The rate of enzymic oxidation of ascorbic acid to dehydro-ascorbic acid by ascorbic acid oxidase varies at different stages of fruit growth in the different varieties being generally greater in the early than late stages.

C. P. SIDERIS

COLCHICINE-INDUCED TETRAPLOIDY IN THE CAYENNE PINEAPPLE

The action of colchicine on plant tissue is to cause a doubling of the chromosomes. A concentration of 0.4 per cent colchicine in water is sufficient to cause doubling of the pineapple chromosomes. With this doubling (autopolyploidy) the number of genes is increased without changing the genic balance. The cell volume is increased and the plants show physiological changes, such as delayed maturity. The increase in leaf cell size due to polyploidy is shown for the pineapple. Likewise the increase in size of the guard cells of the stoma, the pollen, and the flower parts is shown.

Autotetraploidy has been induced in the Cayenne, the commercial variety of pineapple, both as wholly tetraploid plants and as stable periclinal chimeras. Cayenne clones have been established with the epidermal tissues of the plant tetraploid and the balance of the plant with the normal diploid chromosome number. Likewise clones have been established with a normal diploid epidermis covering a tetraploid plant.

Anatomical studies of the apical meristematic dome of the pineapple, where new leaves and growth are originated, show a histogenic layer of cells, the dermatogen, that becomes the epidermal and possibly the hypodermal layer of cells, in the mature plant parts. It is suggested that colchicine-induced tetraploidy in cells of the dermatogen layer of the meristem produces plants with a tetraploid epidermis and the balance of the plant diploid. Likewise colchicine-induced doubling of the chromosomes in cells inside the dermatogen layer produces plants with a normal diploid epidermis with the remainder of the plant tetraploid. These periclinal chimera types are stable propagating forms.

Sectorial chimera types were produced when the tetraploid tissues involved only a portion of the circumference of the plant, thus forming a wedge-shaped sector in cross section. It is suggested that cells in both the dermatogen layer and inner tissues were affected and yielded wholly tetraploid sectors or plants. Sectorial chimeras are not stable and revert to wholly diploid or tetraploid plants.

The tetraploid and the diploid-epidermis-covered tetraploid plants have stiffer leaves but are not materially larger or more vigorous plants than are the diploid plants. The fruits examined had a reduced weight, eye number, and Brix. The fruits from plants with a tetraploid epidermis covering a diploid plant do not differ materially from normal diploid plants.

K. R. KERNS AND J. L. COLLINS

THE MINERAL CONTENT OF HAWAIIAN-GROWN VEGETABLES

This project of determining the proximate composition and calcium, phosphorus, and iron content of 40 Hawaiian-grown vegetables was undertaken for a number of reasons: (1) to supply more information on the mineral content of vegetables with detailed records of maturity, location grown, fertilizer treatment, and method of preparation; (2) to supply data on composition of locally used vegetables which are not included in existing tables of food composition; and (3) to supply data which could be used in comparing Hawaiian-grown vegetables with mainland vegetables.

A comparison of our values with published values shows that local vegetables are quite similar to those grown elsewhere in proximate composition and calcium and phosphorus contents, but tend to be lower in iron. However, our values are within the range reported in the literature and it can be concluded that Hawaiian-grown vegetables are not deficient in minerals. Variation in mineral content as determined in different laboratories is the rule rather than the exception.

Availability of calcium and iron are more important than the total content of these minerals.

CAREY D. MILLER, WINIFRED ROSS, AND LUCILLE LOUIS

BIBLICAL INSECTS

Comparatively few references are made to insects in the Holy Scriptures. These fall into several groups which apply largely to man's peace and well-being.

Thus, insects which damaged crops and clothing, insects which attacked or pestered man, insects which served as subjects for proverbs and legends, and insects from which food was obtained are included.

Ants, by their teeming industry and social habits, gave inspiration to proverbial passages. The honey bee, ill-tempered ones in the Holy Land, supplied an important item of food. Caterpillars attacked grapevines and other crops. Clothes moths infested woolens. Fleas, lice, mosquitoes, gnats, and flies pestered man and his domesticated animals. Hornets are mentioned because of their vicious attacks.

Manna, although not connected with the insects producing it, is commonly referred to. Manna is a very real thing: it is honey dew which is excreted as excess sugar during the feeding of a particular scale insect, and even today it is an item in the diet of some peoples of the Near East. It is said to consist of 55 per cent cane sugar, 25 per cent invert sugar, and 19 per cent dextrin.

Locusts, or migratory grasshoppers, demand by far the greatest share of the text devoted to insects. These infamous creatures periodically ravaged crops in the Holy Land as they do in many parts of the world today. The terrible locust plagues were thought to be expressions of divine displeasure. Lundius said that "When they rose upon the wing, they intercepted like a cloud the very heavens from their sight and that they are so dreaded by the Jews, that when they make their appearance, they immediately sound a trumpet for a fast."

ELWOOD C. ZIMMERMAN

NECROLOGY

DOUGLAS ALEXANDER COOKE

Douglas Alexander Cooke, a veteran member of the Hawaiian Academy of Science, died on March 13, 1947. Born in Honolulu on April 27, 1901, he was educated at Punahou and Hotchkiss schools and at Yale University from which he was graduated in 1924 with a B.S. degree. He later carried on graduate studies in his chosen field at the University of Leipzig and at the University of California.

Mr. Cooke's interests extended to many phases of biological science, but his special interest lay in the physiology and nutrition of the sugar cane plant. As plant physiologist with the Experiment Station, H.S.P.A., he pioneered the adaptation of the Mitscherlich method of determining plant food requirements to the needs of the Hawaiian sugar industry. The modifications and refinements developed by him resulted in the establishment of this method as an important instrument in sugar cane agriculture.

Endowed with a modest and sympathetic nature, Douglas Cooke could always be depended upon to give a hand where help was needed. The loss of his kindly presence is keenly felt by his associates.

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Williams, John N. S.
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Wismer, Chester A.
Withington, Paul

Yamanaga, George
Yanagihara, Iichi
Yee, Phillip K. H.
Young, H. Y.

Zimmerman, Elwood C.

* Died July 11, 1947.

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Published by the University of Hawaii Honolulu, T. H., 1948

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FOREWORD

The Hawaiian Academy of Science presents in this volume of its *Proceedings* the program and abstracts of papers presented at its twenty-third annual meeting. All sessions, including the annual dinner and business meeting, were held at the University of Hawaii.

In response to requests, the Secretary has prepared for this number of the *Proceedings* a tabulation of the officers of the Academy from 1925 to date.

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1947–1948

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THE 23rd ANNUAL MEETING 1947-48

Program

NOVEMBER 13, 1947

J. L. Collins: Early History of the Pineapple.

Winifred R. Vinacke, John A. Rademaker, and Margaret Chave: Consumer Acceptance of Different Kinds of Rice.

Alfred S. Hartwell: Diagnosis and Prognosis of Rheumatic Fever in Hawaii.

W. Edgar Vinacke: Fascination in Flight.

NOVEMBER 14, 1947

E. H. Bramhall: Problems of Telecommunication.

M. H. Halstead and Luna B. Leopold: Use of the Schaefer-Langmuir Dry-Ice Technique in Hawaii. I. Atmospheric Physics of the Formation of Raindrops and the Role of Dry Ice. II. Meteorology of Hawaii in Relation to Use of the Dry-Ice Technique.

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John H. Payne: Ion Exchange Investigations on Cane Juice.

Leonora N. Bilger: Today's Chemical Laboratory.

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F. R. Fosberg: Salinity and Atoll Vegetation.

H. H. Warner: The Downward Trend in Local Food Production and a Possible Solution.

W. Edgar Vinacke: Stereotyping among Cultural Groups in Hawaii.

MAY 8, 1948

Annual Dinner

Business Meeting

Installation of Officers

Address by the Retiring President

Harold St. John: Origin of the Plants Used for Sustenance in Aboriginal Polynesia.

Abstracts

EARLY HISTORY OF THE PINEAPPLE

Pineapples are indigenous to America and were unknown to people of the Old World before the discovery of America. On November 4, 1493, Columbus and his men, on the second voyage to the New World, found pineapples, "the flavor and fragrance of which astonished and delighted them," growing on the island of Guadeloupe in the Lesser Antilles. At this time the natives of the American tropics recognized at least three distinct varieties, all of which were seedless. The place of origin of the pineapple appears to have been in the eastern part of South America at about the 25th parallel of latitude in the home of the Tupi-Guarani Indians. These people are believed to have been instrumental in its distribution through tribal migrations and border trading. Records of the extent of distribution of the pineapple in pre-Columbian times are meager and consist largely of reports of the fruit having been seen by the early voyagers and travelers. These records, however, indicate that pineapples were widely distributed in the American tropics, from Mexico in the north to central Brazil in the south, in the period before 1493. Oviedo, who lived in Spanish America from 1513 to 1547, wrote that he believed this fruit to be old and very common, for it was found in all of the islands and on the mainland of South America. Two references suggest that the pineapple was known to the ancient Assyrians and one that the ancient Egyptians also had the fruit. The majority of botanists, however, insist that the pineapple was not known to the Old World before the discovery of America. There is some biological evidence that the pineapple has been cultivated in America by aboriginal people for many centuries.

J. L. COLLINS

CONSUMER ACCEPTANCE OF DIFFERENT KINDS OF RICE

Rice is of interest to the nutritionist because of the large amounts used in the Territory; more than 5 million pounds are imported monthly. A high rice diet may have several deficiencies, but the most difficult to remedy is that of thiamine. Converted rice is a processed rice which has twice the thiamine value of white rice, although only one-fourth that of brown. If it is more acceptable than brown rice, it may be of value in improving the diet of the many rice-eating people of Chinese, Japanese, and Filipino ancestry in Hawaii.

Accordingly, the acceptability of brown, white, and converted rice was measured by two methods. Plate waste of rice was measured in six school cafeterias.

Results showed that white rice was preferred and that preference for brown vs. converted was variable. In the University of Hawaii, where educational processes had had the longest time to work, plate waste of the three kinds of rice was the same.

Two hundred Honolulu families were interviewed before and after using converted rice. Tabulation of their answers revealed that 81 per cent preferred white rice, whereas only 3 per cent preferred brown rice. Converted rice was preferred by 12 per cent, being thus more acceptance than brown but less acceptable than white. Caucasians found both brown and converted rice more acceptable than did the Oriental groups.

It is expected that the acceptability of converted rice will increase after the public has had time to become accustomed to this new rice and to be educated as to its value.

WINIFRED R. VINACKE, JOHN A. RADEMAKER, AND MARGARET CHAVE

DIAGNOSIS AND PROGNOSIS OF RHEUMATIC FEVER IN HAWAII

(No abstract.)

ALFRED S. HARTWELL

FASCINATION IN FLIGHT

"Fascination" is an auto-hypnotic phenomenon to which some aircraft pilots are occasionally subject. It differs from "aviator's vertigo" in that whereas the latter is a complex of physiological and psychological response resulting in sensations and feelings which do not accord with objectively correct environmental facts, "fascination" is a state of narrowed attention, associated with excessive concentration on some object or task, with a resulting loss of voluntary control over behavior. Data bearing upon "fascination" were obtained from interviews with 77 U. S. Navy aviators of widely diversified training and experience. They were asked to describe in detail incidents of "vertigo" and "fascination" from their flying careers. About 10 per cent of the incidents primarily involved "fascination" and 3 per cent involved both "fascination" and "vertigo." The phenomenon was reported as occurring in dive (or glide) bombing (where it is often termed "target-fixation"), in formation flight, in landing, in gunnery runs, and in tail-chasing ("dog-fighting"). Poor depth perception, which is likely to feature all of these conditions, probably contributes to its occurrence. A combination of "vertigo" and "fascination" was most clearly indicated in formation flight, in landing, and during "instrument fixation." It is likely that some pilots are more susceptible to "fascination" than others. The introduction of techniques to break up the sequence of events leading to excessive concentration would effectively reduce its occurrence.

[Opinions or conclusions contained in this report are those of the author. They are not to be construed as reflecting the views or the endorsement of the Navy Department.]

W. EDGAR VINACKE

PROBLEMS OF TELECOMMUNICATION

Present problems of telecommunication deal primarily with radio-communication via the ionosphere and hence concern characteristics of the ionosphere as "seen" by radio waves of various frequencies. The ultimate fate of a signal of given frequency impinging on the ionosphere depends almost entirely on two factors: (1) the prevailing maximum electron density at the points of reflection and (2) energy absorption due to low level ionization. These factors set practical limits for the highest and lowest useful frequencies for reliable communication over the path and determine the optimum operating frequency.

Utilization of frequencies approaching the optimum makes for dependability through higher signal strength and for operating efficiency through a decrease in lost transmission time attributable to fading signals. Only by selecting proper frequencies, and thereby reducing the number required for a given circuit, can inter-circuit interference due to congestion in the useful radio spectrum be minimized and maximum reliability of communication realized.

Predictions of temporal and geographic ionospheric variations based on direct measurements by the pulse technique afford the scientific foundation for frequency allocations over new circuits, or changes in those already established. Inasmuch as charts representing world-wide ionospheric conditions involve, of necessity, considerable extrapolation both in time and space—particularly in the Pacific Sector, which comprises about a fourth of the earth's surface—it is desirable to gauge their validity by analysis of traffic data over existing circuits.

Operating logs for a number of long western-Pacific circuits have been examined, and the indicated circuit performance compared with that predicted. With few exceptions satisfactory agreement has been realized.

E. H. BRAMHALL

USE OF THE SCHAEFER-LANGMUIR DRY-ICE TECHNIQUE IN HAWAII

I. ATMOSPHERIC PHYSICS OF THE FORMATION OF RAINDROPS AND THE ROLE OF DRY ICE

The artificial inducement of precipitation through seeding with dry ice in the United States and Australia has apparently been successfully attempted only with clouds penetrating into sub-freezing temperatures.

Since an ample supply of sublimation nuclei is frequently absent, suspended water droplets are often carried into regions considerably below 0° C. before they freeze. In the laboratory, water droplets in air free of sublimation nuclei will reach temperatures of –34° C. before any freezing or sublimation occurs. Dr. Schaefer and Dr. Langmuir of General Electric reasoned that if clouds containing super-cooled water droplets came into contact with particles or objects at temperatures below –35° C., for example, actual ice crystals would be formed which would serve as nuclei for the formation of snowflakes. Then, according to the Bergeron theory of the formation of rain, the snowflakes would grow at the expense of the water droplets because of the difference in the saturated vapor pressure over ice and over water. As the ice crystals reached a sufficient size, they would fall from the cloud as snow or rain.

While the Bergeron theory is generally accepted, an extension may still be added. Once an ice crystal has started to fall it will be colder than its environment, especially after it has entered the layer of air warmer than freezing and has not yet completely melted. While it is thus cooler than the suspended droplets about it, its saturated vapor pressure will, therefore, be lower than that of its surroundings. In the region near freezing, this difference in vapor pressure resulting from a 1° C. temperature difference is roughly twice the maximum gradient between ice and super-cooled water.

It is this extension of the theory which we have tried to adapt to the Hawaiian area. Instead of using actual ice crystals to set up these small-scale temperature gradients, it was expected that much the same result might be obtained merely by the intense cooling of a portion of the existent droplets with solid carbon dioxide. The initial tests indicate that under certain circumstances this may be possible.

M. H. HALSTEAD

II. METEOROLOGY OF HAWAII IN RELATION TO USE OF THE DRY-ICE TECHNIQUE

It is well known that local weather in Hawaii is dominated by the trade winds and topography, but quantitative details of the interrelation of these factors are far from complete.

As in all trade-winds areas, an inversion of temperature results from gradual subsidence of air traveling from the northeast around the semi-permanent high pressure cell over the eastern Pacific. This inversion, the elevation of which averages about 8,000 feet over Hawaii, is a layer of stability hindering the upward movement of air parcels and providing a limiting height to the tops of normal clouds. The inversion also confines the moist air to the layers below it. The inversion has a diurnal change in height, midday maximum and a nocturnal minimum. Day-to-day variations in height and intensity also occur and are related to the passage of pressure troughs or fronts.

Inoculation of clouds with dry ice cannot result in appreciable rain if the cloud cannot build in height by natural processes after the impetus is provided by seeding. The impetus starts a natural chain reaction only if the clouds are already closer to a rain condition than on an average day. These requirements imply that success with the Schaefer-Langmuir technique in Hawaii depends primarily on the choice of day, which in turn requires recognition of the limiting conditions and an appropriate forecast.

Trials to date only roughly define these limiting conditions. It is estimated that only one day in ten or twenty meets minimum requirements, and appreciable amounts of rain can be produced even less often. Nevertheless, under the particular requirements of sugar and pineapple, man-induced rain may still be an invaluable aid in critical periods or in abnormally dry areas.

LUNA B. LEOPOLD

ABRASION HARDNESS OF SUBSTANCES

This paper is an abridgment of an article in three parts entitled: I. Malacometry, or relative softness measurement; II. Tests at high, medium, and low speeds; III. Comparisons and simplification. The original contains 9 tables listing 200 substances, 5 text figures, and 7 plates. The work described was conducted in the University of Hawaii Department of Volcanology between 1942 and 1948 and involved an analysis of the work of Auerbach, who followed Hertz, and the present author's insistence on the kinetic aspect of hardness testing in contrast to the static elastic limit of indentation of Hertz, Auerbach, and Brinell. Adopting abrasion by diamond, the definition of the author is: relative softness is the rate of volumetric yielding to identical collision rhythmically applied. Wear of diamonds is examined, and the best method is found to be an inverted drill press, with a cut diamond octahedron as centered drill bit pointed upward, on the shaft of an inductor synchronous motor revolving at 100 rpm. The specimen surface is clamped to face downward against the window opening of a hinged arm, weighted for 300 grams pressure of specimen on diamond.

Both time and volume methods of evaluating sclerometric and malacometric properties of woods, steels, and minerals are tested, relative to corundum and talc, respectively, as control substances. The essential quality of relative softness is not resistance, as in the case of sclerometry, but internal mobility of the substance, different under different applications of abrading energy. Slow abrasions and long tests give most consistent averages, and massive talc of Macon, Ontario, is the best control mineral. Depth is read to microns by a dial indicator micrometer.

T. A. JAGGAR

DIPOLE MOMENTS OF UNSYMMETRICAL ETHERS

Molecules consist of assemblages of positively and negatively charged particles. In the case of polar molecules the effective center of the positive charges does not coincide with the effective center of the negative charges, so that an electric asymmetry arises. The extent of this asymmetry is measured by the dipole moment of the molecule.

It has been shown by Debye that the dipole moment of a substance can be calculated from its density, refractive index, and dielectric constant. The substance must be in the gaseous state or in dilute solution in a non-polar solvent. This paper describes the determination of the dipole moments of several unsymmetrical ethers in benzene solution. Most of the compounds studied had not been measured in this way before. The work was suggested by previous determinations of the dipole moments of the alcohols, ethers, and cellosolves which seemed to indicate that the dipole moments of the unsymmetrical ethers might change with increasing complexity of the molecule.

It was found that the dipole moments of the unsymmetrical ethers are approximately the same, showing a similarity of structure for all these compounds. The fact that the moments differ from zero shows that the molecules cannot have a linear configuration at the bonds linking carbon to oxygen. Two of the ethers studied had moments somewhat lower than the others; the deviation is perhaps beyond experimental error. It is planned to study this deviation further by the determination of the dipole moments of these same compounds in the gaseous state.

R. A. SPURR AND H. ZEITLIN

ION EXCHANGE INVESTIGATIONS ON CANE JUICE

Laboratory studies have demonstrated the value of ion exchange resins in effecting the separation of many of the constituents of cane juice. These resins are giant organic molecules of two types—the cation exchange and the anion exchange. The cation exchange resins possess active acidic groups which can react with the basic ions of the cane juice by means of ion exchange and thus remove the ions from solution. The anion exchange resins are characterized by active basic groups which can remove the acidic ions from the juice. By a combined action of the two types of resins, the ionic compounds can be removed from the juice, leaving the sugars and other non-ionic compounds in a purer state. The recovery of the sugars by customary methods of crystallization is increased, and a higher initial state of purity for all products is obtained.

The method was extended to semi-commercial scale operation in a raw-sugar factory during 1946 and 1947. The results showed that a good-quality white sugar can be produced in yield averaging 5 per cent higher than present raw sugar operations. Instead of blackstrap molasses, there remains as an end product an edible syrup of 77 per cent total sugar content. The recovery of potassium sulfate, aconitic acid, and various amino acids as by-products is possible.

JOHN H. PAYNE

TODAY'S CHEMICAL LABORATORY

A long and careful study of modern chemical laboratories for university undergraduate and graduate students, inspired by a legislative appropriation for a new laboratory at the University of Hawaii, was made by the inspection of many mainland laboratories, by a study of published books and symposia, and by consultation with experts.

It is generally agreed that laboratories must be built to a well-defined purpose and that plans must be adjusted to available funds, must not be architecturally handicapped by the tradition of campus buildings, and must be flexible, that is, constructed to permit of change.

In view of the great variety found in chemical laboratories and the lack of a recognizable modern pattern, the proposed laboratory for the University of Hawaii is best described as a composite of the desirable features noted among many laboratories.

The three-story, concrete, lanai-type structure, well adapted to climatic conditions in Hawaii, will be built entirely above the ground and will be oriented to north and south exposures.

All laboratories will be provided with separate preparation rooms, balance rooms, spacious hoods individually controlled, built-in steam baths and hot plates, running distilled water, compressed air, suction, a variety of electrical outlets, safety showers, and all-steel doors. The plans include special laboratories for agricultural, industrial, and micro chemistry. Special attention has been given to the planning of stockrooms, lecture rooms, shop, library, and seminar rooms.

First and foremost the building will be functional, but the planning has given attention to beauty of surroundings and to pleasant living within the building.

LEONORA N. BILGER

SOME PARASITIC COPEPODS FROM HAWAIIAN FISHES

A review of the life history, distribution, and economic importance of the parasitic copepods from Hawaii was presented. A discussion of their possible use in connection with zoogeographical studies was made, together with a review of the history of parasitic forms.

The species of parasitic copepods listed below, together with their hosts, have been previously recorded by the author mentioned:

SPECIES	HOST	REPORTED IN HAWAII
Dysgamus atlanticus Steenstrup and Lutkens	Free-swimming	Wilson 1942
Pandarus satyrus Dana	Blue shark	Wilson 1907
Pandarus smithii Rathbun	Shark(?)	Wilson 1932
Lernaea carassi Tidd	Goldfish and amphibia tadpoles	Edmondson 1945
Pseudomolgus hawaiiensis Wilson	Tectibranch mollusc	Wilson 1921
Teredicola typica Wilson	Shipworm *(Teredo milleri)*	Wilson 1942 (a)

The following list of parasitic copepods is here reported from the Hawaiian region for the first time:

SPECIES	HOST
Caligus aliuncus Wilson	Aku, *Euthynnus alleteratus* (Rafinesque)
Euryphorus coryphaenae Kroyer	Mahimahi, *Coryphaena hippurus* Linn.
Brachiella thynni Cuvier	Ahi, *Thynnus* sp.
Elytrophorus brachyptera Gerstaecker	Ahi, *Thynnus* sp.
Gloiopotes sp.	Ono, *Acanthocybium solandri* (Cuvier)

DAVID D. BONNET

SALINITY AND ATOLL VEGETATION

The native flora of coral atolls consists of relatively few species of plants, these mostly widespread strand forms. The vegetation is relatively simple, consisting of several types of forest, scrub, swamp, and, rarely, grassland. These types are distributed on an islet in relation to distance from the inner and outer beaches. From island to island they are distributed in relation to the abundance of rainfall, the more luxuriant forests and the more mesophytic vegetation being found toward the centers of islets and on those atolls where the rainfall is greatest.

The ground water on an atoll is never very far below the surface and it is usually perceptibly brackish, except on islands where there is abundant rainfall.

The clue to the nature of the flora and vegetation is found in the behavior of introduced plants. Numerous species have been brought, either accidentally or deliberately, to the atolls of the Pacific, but relatively few of them have survived and still fewer can be considered successful, even under the protection and cultivation of man. Those that are not especially successful but which still manage to survive show, without exception, signs of a severe chlorosis (yellow coloring) of the type commonly associated with excess of sodium and the resulting deficiency of assimilated potassium. Even some of the plants which survive and reproduce themselves, such as the papaya, often show signs of chlorosis. Also, they are much more successful toward the center of the islets where the salinity is lower. Very few of the introduced plants, excepting those which are themselves strand plants and those which are exceedingly shallow-rooted herbs living in the surface of the soil where the excess of salt is leached out by even moderate rains, have succeeded in becoming naturalized.

On the wetter atolls a specialized type of agriculture has developed which utilizes the lens of relatively fresh water that exists at the center of a land mass surrounded by salt water. Pits into which vegetable refuse is thrown are dug. The pits are deep enough to reach below the water table, and the organic matter decomposes into a muck which will support *Cyrtosperma, Colocasia,* sugar cane, bananas, and even various other plants, such as ornamentals that do not survive or prosper on the ordinary surface of the coral islet. It is probable that this muck, besides providing a more fertile substratum, retards the diffusion outward of the available fresh water as well as the diffusion inward of salt water that always accompanies dry periods.

One may summarize the flora, both indigenous and introduced, of these atolls by saying that only plants that have developed a high tolerance for salinity have been able to survive; thus the flora has been limited to relatively few species. The flora is larger (species more numerous) in more or less direct proportion to the amount of rainfall and the area of the islet.

The vegetation may be summarized by saying that it is heavier and more luxuriant in direct relation to the amount of rainfall and the area of the island. This is because, as is well known, salinity produces a condition of physiological drought. Saline areas are characterized by a sparse vegetation similar to that of deserts. Where the rainfall is sufficient and the area is large enough to maintain a permanent (Ghyben-Herzberg) lens of fresh or almost fresh water, the vegetation of the interior portions is more or less mesophytic and luxuriant.

F. R. FOSBERG

THE DOWNWARD TREND IN LOCAL FOOD PRODUCTION AND A POSSIBLE SOLUTION

Territorial production of fresh vegetables is declining in spite of high dollar returns. Truck crop production in 1947 was 8 million pounds less than in 1946 and 28 million pounds less than in 1945. At the same time, unloads from California of the vegetables commonly grown in Hawaii are increasing. Imports of these vegetables increased nearly 50 per cent in 1947 compared with 1946.

Most local farmers are unwilling to pay prevailing wages for the agricultural labor needed to expand their operations. Moreover, the total acreage required to supply the needs of Honolulu is not sufficient to justify the use of labor-saving equipment in order to lower the labor cost per ton. California growers, however, producing these commodities for shipment to scores of cities the size of Honolulu on the Mainland, reduce the labor cost of production by mechanized operations on large acreages exactly as has been done in the pineapple industry in Hawaii. This trend toward low-cost mechanized farming on the Mainland has caused the sharp decline in local rice production during the last 25 years and is now showing signs of similarly affecting the local production of vegetables.

Mechanized labor-saving production in Hawaii is justified only when supplying the large mainland demand. Existing quarantine barriers prohibit the development of such an outlet. We are faced with a difficult combination of high wages, small farms, and export restrictions.

Recent scientific development indicates possible sterilization and treatment methods by which these quarantine restrictions can be modified. Great advances were made during the war in the application of electronics to the problem of food treatment and sterilization. Similar work was done in the field of supersonics as a means of killing insects by high-frequency vibrations. Practically no effort has been made to apply these new principles to the local problem of sterilizing tropical fruits for shipment to the Mainland. Quick freezing, too, holds other attractive possibilities for mainland shipment, but to date little or no effort has been made to apply the knowledge in this field to the processing of locally grown tropical fruits such as papayas and mangoes.

New emphasis needs to be placed on local research in these fields. If successful in discovering new methods of treatment not injurious to the fresh fruit or satisfactory quick-freezing processes, large new opportunities will be opened up for the production of tropical fruits as well as winter vegetables for export. Such operations could be on a big enough scale to justify the mechanization so necessary to meet the increasing labor costs. Only in this direction is the future bright for those farmers who presently are faced with the serious problems of large-scale, low-cost imports from California.

H. H. WARNER

STEREOTYPING AMONG CULTURAL GROUPS IN HAWAII

Stereotyping is an ethnocentric phenomenon representing a generalized, uncritical characterization applied by one group to another. It disregards individuals of the other group, who are judged in terms of alleged traits of their attributed group. Hawaii affords a particularly good place to study stereotyping because self-characterizations of several cultural groups can be determined as well as their characterizations of other groups. The preliminary data reported here are based upon spontaneous characterizations made by students in a class at the University of Hawaii. They listed traits which they believed descriptive of Japanese, Chinese, Caucasians ("Haoles"), Filipinos, Koreans, Negroes, Hawaiians, and Samoans. Results obtained from the first three of these groups have been analyzed in terms of the traits most frequently assigned to each group, the frequency with which traits were assigned to each, the amount of agreement on terms used (the sharpness of the stereotype), and the favorableness of the stereotype. These preliminary data show remarkable agreement within a given group on terms used to characterize both themselves and the other groups, although some groups are more sharply defined than others. However, Japanese, Chinese, and Caucasians differ in their characterizations of the same group, suggesting important implications with reference to intergroup attitudes and relationships.

Research is continuing, with a more standardized procedure, to collect adequate data from both Koreans and Filipinos in addition to the three larger groups. Further data will permit fuller determination of the stereotypes and a more accurate appraisal of their favorable and unfavorable aspects.

W. EDGAR VINACKE

ORIGIN OF THE PLANTS USED FOR SUSTENANCE IN ABORIGINAL POLYNESIA

Presidential address 1948.

In aboriginal times, the natives of Hawaii obtained their drink from one plant and their vegetable food from seventeen cultivated plants. The natives in other parts of Polynesia used all of these and raised four additional species of food plants that had not been transplanted to Hawaii. Thus the total of Polynesian sustenance plants was 21 for food and one for drink, though the coconut, here tabulated as a food plant, was also used for drink. A close study of these 22 plants was made. As point of origin, 21 of them had the East Indies or Indomalaya. Only one, the sweet potato (*Ipomoea Batatas*) was of South American origin. These economic plants were all in cultivation in the East Indies as far east as New Guinea. Most of them were present in western Micronesia, but they diminished eastward, and in the eastern Carolines, about half of them were unknown. Evidence as to origin and dispersal is found in the vernacular names. For instance, *Colocasia esculenta* was known in Hawaii as "kalo" or "taro," in Polynesia as "taro," in Fiji as "ndalo," in Java as "talies," "tales," and "taloes." Not all of the names could be traced so far, but a definite trend toward the southern group—the East Indian islands and the Indomalayan region—is noted.

From these types of evidence it is deduced that all but one of the Polynesian sustenance plants originated in the Indomalayan region and dispersed, not through Micronesia, but eastward along the East Indies to Melanesia and Polynesia. Similarly it is deduced that the Polynesian peoples followed the same southern route.

HAROLD ST. JOHN

ACADEMY OFFICERS

YEAR	PRESIDENT	VICE-PRESIDENT	SECRETARY-TREASURER	COUNCILOR (1 YEAR)	COUNCILOR (2 YEARS)	COUNCILOR (EX OFFI
1925–26	Frederick C. Newcombe	C. Montague Cooke, Jr.	Edward L. Caum	Frederick G. Krauss	Otto H. Swezey	....
1926–27	Arthur L. Dean	Frederick Muir	Edwin H. Bryan, Jr.	Otto H. Swezey	Charles S. Judd	Frederick C. Newco
1927–28	Guy R. Stewart	John F. G. Stokes	Paul Kirkpatrick	Charles S. Judd	Nils P. Larsen	Arthur L. Dean
1928–29	Nils P. Larsen	Harold S. Palmer	Paul Kirkpatrick	....	Edwin H. Bryan, Jr.	Guy R. Stewart
1929–30	Harold S. Palmer	Harold L. Lyon	Edward L. Caum	Edwin H. Bryan, Jr.	Robert T. Aitken	Nils P. Larsen
1930–31	Edward S. C. Handy	Harold L. Lyon	Edward L. Caum	Robert T. Aitken	Harry L. Arnold	Harold S. Palmer
1931–32	Harold L. Lyon	Charles S. Judd	Edward L. Caum	Harry L. Arnold	D. Le Roy Topping	Edward S. C. Handy
1932–33	Charles S. Judd	Charles H. Edmondson	Edward L. Caum	D. Le Roy Topping	Romanzo Adams	Harold L. Lyon
1933–34	Charles H. Edmondson	Edwin H. Bryan, Jr.	Edward L. Caum	Romanzo Adams	John F. Voorhees	Charles S. Judd
1934–35	Edwin H. Bryan, Jr.	Harold A. Wadsworth	Edward L. Caum	John F. Voorhees	Walter Carter	Charles H. Edmond
1935–36	Chester K. Wentworth	Harold A. Wadsworth	Beatrice H. Krauss	Walter Carter	Edward L. Caum	Edwin H. Bryan, Jr.
1936–37	Harold A. Wadsworth	Walter Carter	Mabel Slattery	Edward L. Caum	Oscar C. Magistad	Chester K. Wentwo
1937–38	Oscar C. Magistad	Walter Carter	Mabel Slattery	Albert J. Mangelsdorf	Willard H. Eller	Harold A. Wadswo
1938–39	Walter Carter	Harry L. Arnold	Mabel Slattery	Willard H. Eller	Cyril E. Pemberton	Ralph J. Borden†
1939–40	Harry L. Arnold	Cyril E. Pemberton	Mabel Slattery	Harry F. Clements	Carey D. Miller	Walter Carter
1940–41	Cyril E. Pemberton	Harry F. Clements	Mabel Slattery	Carey D. Miller	Julius L. Collins	Harry L. Arnold
1941–43*	Harry F. Clements	Carey D. Miller	Mabel Slattery	Julius L. Collins	Peter H. Buck	Cyril E. Pemberton
1943–44	Carey D. Miller	Julius L. Collins	Mabel Slattery	Peter H. Buck	Thomas A. Jaggar	Harry F. Clements
1944–45	Julius L. Collins	Peter H. Buck	Chester K. Wentworth	Thomas A. Jaggar	Colin G. Lennox	Carey D. Miller
1945–46	Peter H. Buck	Thomas A. Jaggar	Chester K. Wentworth	Colin G. Lennox	Christopher J. Hamre	Julius L. Collins
1946–47	Thomas A. Jaggar	Harold St. John	Chester K. Wentworth	Christopher J. Hamre	Joseph P. Martin	Peter H. Buck
1947–48	Harold St. John	John H. Payne	Chester K. Wentworth	Joseph P. Martin	Joel B. Cox	Thomas A. Jaggar
1948–49	John H. Payne	Robert W. Hiatt	Chester K. Wentworth	Joel B. Cox	G. Donald Sherman	Harold St. John

* The 2-year period, 1941–1943, during which activities were curtailed by wartime conditions and the same persons held office, was originally called the Seventeenth Annual Me but was later designated the Seventeenth and Eighteenth Annual Meetings in order to reconcile the numbers with the number of elapsed years since the date of founding.

† Mr. Borden was elected as a 1-year councilor.

NECROLOGY

LUCY VROOMAN COOPER

Lucy Vrooman Cooper, a member of the Hawaiian Academy of Science for many years, died on September 23, 1947. Mrs. Cooper was born in Brisbane, Australia, in 1878, but grew up and spent her early life in San Francisco. She was a graduate nurse from the French Hospital of San Francisco and later studied medicine, receiving her degree as a physician from the Stanford University Medical College.

As Dr. Lucy Vrooman, she came to Hawaii shortly after receiving her degree. Here she met, and, in August, 1907, married William J. Cooper, a reporter on the *Hawaiian Star.*

Mrs. Cooper's interest in medicine and in scientific research continued during her more than 40 years' residence in Hawaii. For many years she and her husband lived on and farmed a homestead in the Kuiaha district on Maui. There she took an active part in community organizations and affairs. In more recent years she and her husband owned and operated the Cooper Ranch Inn at Hauula on this island. In her dual role of charming hostess and producer of delicious food she had a world-wide reputation.

Mrs. Cooper is perhaps best known for her love of flowers and plants and, with her husband, she is responsible for the propagation of many rare and exotic tropical plants. Primarily, she and her husband are famed for the thousands of new varieties of hibiscus which they developed on their Hauula ranch.

JOHN SHAPE DONAGHHO

John Shape Donaghho, charter member of the Academy and professor emeritus of mathematics at the University of Hawaii, died in Honolulu on July 11, 1947. He was born June 11, 1867, at Fredericktown, Pennsylvania. He received both his A.B. and A.M. degrees from Marietta College and later took graduate work at Cornell University, University of Chicago, and Stanford University.

Although he started as a law student and notary public, his interest in education soon lead him into the teaching profession. From 1892 to 1904, he held various teaching positions. During this time, he completed two years of graduate work at Stanford and also became a proficient photographer. Throughout the remainder of his life, photography was of value to him professionally and it also afforded him pleasure and diversion.

Professor Donaghho arrived in Honolulu in August, 1904, and taught mathematics at the Honolulu High School. Four years later, he became the first professor of mathematics at the College, later University, of Hawaii and occupied this position until he retired in 1934.

Professor Donaghho's interest in astronomy lead to the plan for an observatory at Kaimuki which was completed in time to be used by him and his co-workers during the passage of Halley's Comet.

Professor Donaghho's students admired and loved him because of his gentle, kindly spirit and his interest in their welfare and ability to help them understand and enjoy mathematics. The people of Honolulu remember Professor Donaghho for his willingness to open the Kaimuki Observatory and to give them an opportunity of learning something about the wonders of the heavens. Even after his retirement from the University, he maintained his interest in young people until, during the last few years of his life, failing health made it difficult for him to leave the home he had built and loved on the land he homesteaded on Alewa Heights.

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FOREWORD

In this volume of its *Proceedings* the Hawaiian Academy of Science presents the program and abstracts of papers presented at the Fall and Spring sessions of the twenty-fourth annual meeting. As in many years past, meetings, including the annual dinner and business meeting, were held at the University of Hawaii.

Following the practice, started in 1945, of including a membership list in alternate numbers of the *Proceedings,* such a list as of May, 1945, is included in this volume.

Copies of the *Proceedings* now go to over two hundred institutional libraries throughout the world. These libraries were selected by the Academy so that the *Proceedings* would be widely available, and by the University of Hawaii Library on an exchange basis.

OFFICERS

1948-1949

President, John H. Payne
Vice-President, Robert W. Hiatt
Secretary-Treasurer, Chester K. Wentworth

Councilor (2 years), G. Donald Sherman
Councilor (1 year), Joel B. Cox
Councilor (1 year), Harold St. John (ex officio)

1949-1950

President, Robert W. Hiatt
Vice-President, E. C. Auchter
Secretary-Treasurer, E. H. Bryan, Jr.

Councilor (2 years), A. J. Mangelsdorf
Councilor (1 year), G. Donald Sherman
Councilor (1 year), John H. Payne (ex officio)

THE 24th ANNUAL MEETING 1948-49

Program

NOVEMBER 18, 1948

E. H. Bryan, Jr.: A Guide to Publications about the Pacific Area.

Helen E. Peixotto: On the Use of the Wechsler-Bellevue Scale in the Territory of Hawaii.

Sidney L. Halperin: Application of Methods in Human Genetics to the Study of Mental Traits with Special Reference to Mental Defect.

Luna B. Leopold: The Naulu: A Distinctive Rainstorm Type.

C. K. Stidd: Rainfall Distribution in Hawaii.

Edith Lord: Rorschach Records Obtained before and after Brief Psychotherapy.

NOVEMBER 19, 1948

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Albert L. Tester: The Application and Mechanical Recovery of Internal Metal Fish Tags.

George O. Burr and T. Tanimoto: An Improved Micro-Method for the Determination of Reducing Sugars.

Bradley T. Scheer: Action of Crustacean Eyestalk Hormones on Tissue Oxidation.

A. Carl Leopold: The Effect of the Growth Hormone on Flowering of Grasses.

APRIL 28, 1949

E. J. Anderson: Character and Distribution of the Fungus Parasite *Phytophthora cinnamomi.*

Edith Lord: Subcultural Influences on Personality Components.

Ruth A. Aust: Standard Test for Functional Physical Efficiency.

Joseph E. Alicata and George O. Burr: Biological Effects of Radiation on *Trichinella spiralis.*

APRIL 29, 1949

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T. A. Jaggar: Threat of Lava Flow in Hilo.

Bradley T. Scheer and Marlin Ann Scheer: Blood Sugar in the Spiny Lobster *Panulirus.*

T. W. Forbes, Preston S. Abbott, and Christopher J. Hamre: An Action Potential Study of Taste Responses in the Toad.

Harry L. Arnold, Jr.: The Epidemiology of Leprosy: An Alternative Explanation.

APRIL 30, 1949

Annual Dinner
Business Meeting
Installation of Officers
Address by Retiring President
John H. Payne: Sucrose.

Abstracts

A GUIDE TO PUBLICATIONS ABOUT THE PACIFIC AREA

A card catalogue and index guide to publications about the Pacific islands area were advocated and described and cooperation requested. The area to be covered would consist of Polynesia, Micronesia, Melanesia, and possibly New Guinea, with partial coverage (subjects closely related to those in the main area) for adjacent areas. All worthwhile publications would be included, especially in the fields of anthropology, botany, economics, geography, geology, government, health, history, meteorology, military and naval affairs, oceanography, and zoology.

The bibliography would be typed uniformly on 4- by 6-inch cards, with entries following standard library form. In addition to usual bibliographic data, each would give a concise synopsis of contents to indicate the nature, scope, and importance of the publication. These cards would be filed alphabetically by author. Cross-reference cards by subjects and areas might each list several author and abridged title entries. Subjects could be subdivided in as much detail as desired.

All available printed and manuscript lists of publications, including library catalogues, would be consulted in preparing the author cards. With these typed, the cooperation of qualified specialists in many fields would be sought in preparing the abstracts and cross-reference records.

A bibliographic journal is advocated to provide adequate and continuing dissemination of results. This might begin by recording all current publications on the area. Later it could also publish bibliographic entries and indexes, arranged by subjects and/or areas, as these were completed.

E. H. BRYAN, JR.

ON THE USE OF THE WECHSLER-BELLEVUE SCALE IN THE TERRITORY OF HAWAII

At the present time there is considerable interest in the use of sub-test patterns on the Wechsler-Bellevue Scale of Adult Intelligence for purposes of differential diagnosis regarding feeblemindedness and psychiatric syndromes.

This investigation was undertaken to determine whether or not published diagnostic patterns are applicable to an unselected sample of the population of the Territory of Hawaii. The primary interest is in respect to feeblemindedness. There are two reasons for this: first, differentiation of the normally intelligent from those below normal, i.e., feebleminded, is the primary function of the psychologist. Second, there were sufficient cases so diagnosed to permit statistical analysis. There is supplementary information on a few cases regarding psychiatric conditions such as psychopathic personality, organic brain damage, and the like.

The results of this investigation show that over three fourths of the population studied were better in performance tests than verbal tests. Authorities concur that a difference in score of over ten points on the two types of tests is diagnostically significant. Feebleminded should show this difference with the performance score being higher. On this basis only 15 per cent of those diagnosed as feebleminded fall within the expected sub-test pattern. The majority of cases on which psychiatric evaluation was available did not conform to sub-test patterns.

It is concluded that it is not possible to rely on published sub-test patterns in the diagnosis of either feeblemindedness or psychiatric conditions for the population of Hawaii. Although the Wechsler-Bellevue Scale is satisfactory as a measure of general intelligence, in the application of published patterns considerable caution must be exercised.

HELEN E. PEIXOTTO

APPLICATION OF METHODS IN HUMAN GENETICS TO THE STUDY OF MENTAL TRAITS WITH SPECIAL REFERENCE TO MENTAL DEFECT

Several methods commonly used in human and medical genetics that may profitably be employed in the study of mental functions and thus help bridge the unnecessarily wide gap that at present exists between human genetics and psychology are suggested. Examples have been chosen from the author's experience in the field of mental defect.

Following a statement of nature–nurture relationships, the nature of the mode of action of the gene is briefly discussed with special reference to its role in the etiology of psychopathy.

The genetics of gargoylism and microcephaly is presented as an example of the direct application of procedures in human genetics in seeking causes of congenital anomalies of unknown etiology. The genetics of phenylketonuria is briefly discussed as one promising attempt in the biochemical approach to mental dysfunction, while relatively little promise is offered that Rh incompatibility can explain more than very rare cases of mental defect.

Parental matings for intelligence are examined and sources of undesirable genes explored. Several conclusions for eugenics are made, including the need for a careful re-examination of the rather unfortunate association in the public mind of sterilization and public economy; since genetically considered, despite strong and prolonged selective measures, deviate groups requiring special attention are going to continue to be present in our population.

SIDNEY L. HALPERIN

THE NAULU: A DISTINCTIVE RAINSTORM TYPE

"Naulu" is a word used on the islands of Molokai, Lanai, and Maui (Hawaii) as the name of a summertime local rain shower. The rain has the characteristics of a moderate thunderstorm though thunder or lightning is rare. The naulu rain shower typically forms over the dry low portions of an island, blows off shore, and, for the remainder of the afternoon, continues to rain just off shore with little further movement.

The rain comes from cumulus or cumulus congestus clouds, which on naulu days represent increased size of the same clouds generally present in distinctive patterns over these islands. The cloud on Molokai is normally long and narrow, extending east–west and bisecting west Molokai. On Lanai, the cloud extends in a line WSW–ENE and joins the normal orographic cloud over Lanaihale mountain.

The center of these cloud lines over the land coincides very closely with the line where northeasterly tradewinds meet the southerly sea breeze. This line of meeting of the wind systems has been called by the writer the "sea breeze front," and the accompanying cloud the "sea breeze cloud." The cloud line extends out over the ocean where the sea breeze is absent, probably by some dynamical extension of the standing wave caused by the interaction of winds. That the cloud is caused by air rising at the line where opposite winds meet at the surface is borne out by the movement of the cloud line to more northerly positions on days of stronger than usual sea breeze. The interaction of the two wind systems is probably enhanced and conditioned by vertical eddy currents set up by the mountain barrier across the trade wind flow.

Measurements of diurnal pressure characteristics at various positions on Lanai show the on-shore pressure gradient in the sea breeze zone. The pressure gradients in the trade wind zone of the island are anomalous and not yet fully understood.

Wind roses constructed for various points of measurement on Lanai show the diurnal shift of surface wind in the sea breeze zone. The wind shifts from a nighttime trade (NE) to southeast in the morning, thence through south to southwest by afternoon. In late afternoon the wind shifts rapidly back through south to the normal nighttime trade wind.

Upper wind observations near the edges of the sea breeze cloud were taken by pilot balloons. Though the data thus collected were scanty, there were indications that wind flows away from the cloud edges at cloud-top level, which fits nicely the hypothesis that air from the two wind systems converging at the surface rises to form the cloud line.

Summer average rainfall maps of Lanai show a prong of higher rainfall projecting out from the mountain toward the southwest. This prong does not fit the pattern of orographic rainfall and it extends approximately along the line of the sea breeze cloud on those days when the sea breeze is relatively strong. It is a logical conclusion that this wedge of higher rainfall on Lanai is a function of the rainfall from naulu showers concentrated near the mean position of the sea breeze front. This wedge of rainfall extending as it does over the pineapple area is of significant economic importance to the plantations.

LUNA B. LEOPOLD

RAINFALL DISTRIBUTION IN HAWAII

The geographic variation of rainfall amounts is greater in the Hawaiian Islands than in almost any other place in the world. This is thought to be due to (1) the high moisture content of the trade winds and the efficiency of the mountains in the orographic process and (2) the relative infrequency of general storms.

Since over a given period the rainfall may be much greater than normal in one portion of the islands and much less than normal in another, a method is needed by which an overall rainfall picture may be described by the use of a simple quantitative statement.

An investigation of the distribution of rainfall over all the islands of Hawaii leads to the following conclusions: (1) the spacing of the isohyets of mean annual rainfall is approximately logarithmic; (2) the extremely sharp peaks of rainfall maxima at the mountain tops indicate that the mountain tops serve as focal points for rainfall activity under almost all conditions of atmospheric flow; (3) an equation can be found which for all gages will relate the rainfall for a given period to the mean annual rainfall. This equation plots as a straight line on log-log paper. However, over the range of values which are actually observed in Hawaii, a straight line plotted with the same coordinates on Cartesian coordinate paper adequately describes the rainfall distribution.

A straight line on Cartesian coordinate paper can be adequately described by two parameters, slope and intercept, and a quantitative statement of these two parameters constitutes a quantitative description of the complete rainfall picture.

Statistical analyses show a significant difference in parameter values between mean months but no significant difference between islands or between windward locations and leeward locations.

Examination of the annual cycle of two components of rainfall suggested by a formula of the type $y = ax + b$ shows the two components to behave independently.

Synthetic annual march curves for stations with progressively greater mean annual amounts show marked resemblance to observed annual march curves for stations scattered throughout the Territory.

C. K. STIDD

RORSCHACH RECORDS OBTAINED BEFORE AND AFTER BRIEF PSYCHOTHERAPY

Among the numerous unanswered or partially answered questions alive in psychology is one of ever-increasing interest: Exactly what goes on in the subject during a successful psychotherapeutic process?

The Rorschach Ink Blot Test is widely accepted as one of the most acute measures of personality structure available. If this instrument does, in fact, measure personality structure, then a person's Rorschach record should change somewhat after successful psychotherapy, if the therapy has brought about an alteration in personality. The test, too, should give cues as to the nature of the changes.

Rorschach records were obtained on two subjects before and after brief psychotherapy. Both subjects, a year after the initial contact, displayed observable behavioral changes in the direction of more adequate personal and social adjustment.

The test records were analyzed in several ways: (1) by comparing the paired psychograms; (2) by making qualitative comparisons based on usual interpretations of the Rorschach; (3) by computing the Buhler-Lefever Basic Rorschach Scores and determining the integretation levels of the subjects on each of the tests; (4) by examining the negatively and positively weighted components which were present or absent in the two sets of Rorschachs.

Both sets of test data reflected some basic or unchanged negative and positive personality factors. Both sets also contained evidence that, concomitant with the therapeutic process, some negatively weighted personality factors dropped out of the records and some positively weighted factors emerged. One may infer, therefore, that the Rorschach Test reflects both constant and variable personality components.

The records of both subjects had only two altered features in common: (1) a shift from thinking that is out of line with community thinking to thinking that is in line with community thought, and (2) the achievement of a favorable balance between intellectual and emotional components of the personalities. The numerous other additions and subtractions to the personality pictures were apparently disparate functions of the unique configuration of each personality.

EDITH LORD

OCEANOGRAPHIC DEVELOPMENTS IN THE HAWAIIAN AREA

The Hawaiian Islands have been visited briefly by oceanographers on scientific cruises, but now, for the first time in the history of the islands, developments locally portend concentrated analyses of this subtropical island area. The establishment of the Hawaii Marine Laboratory on Coconut Island, through the generosity of the owners of the island, provides unrivaled facilities for marine investigations. The large laboratory and administration headquarters of the Pacific Oceanic Fishery Investigation of the United States Fish and Wildlife Service will be located on the campus of the University of Hawaii where close cooperation between the scientific staffs of both organizations will be effected. Floating facilities available include the *Salpa,* research vessel of the University of Hawaii, the *Makua,* research vessel of the Territorial Division of Fish and Game, and three large vessels operated by the Pacific Oceanic Fishery Investigation.

The research program in physical oceanography includes analyses of bathythermograph records and records from a tsunami recorder by the Scripps Institution of Oceanography, a study of the ecology of the waters in and outside Kaneohe Bay by the University of Hawaii, and a study of sonic means of detection, analysis, and herding of tunas by the Hawaiian Tuna Packers Corporation. Problems involving the interaction of biological processes and their controlling factors are being investigated because they provide a basis for regional productivity—a subject grossly misunderstood in tropical and subtropical oceanic waters. A program of this nature forms the essential liaison between physical oceanography and fisheries biology. Aside from naval uses, applications of oceanographic information have been and are being made principally in fishery biology. Many research projects related to this phase of the program are being carried on by members of the Cooperative Fisheries Research Staff of the Territorial Division of Fish and Game and the University of Hawaii. Greatest emphasis is being placed on the biology of the important tuna baitfish, the nehu. Other projects include a study of pollution in Hilo Bay; deep trolling for tuna; the occurrence of eggs, larval, and postlarval forms of tunas in the high seas bordering the Hawaiian Islands; racial differences or similarities of Hawaiian tunas compared to tunas of other regions; the sponges of Hawaii; and many others.

Hawaii's responsibility in furthering those oceanographic studies for which unique opportunities present themselves here is twofold: first, we should undertake portions of the program for which we have personnel and equipment, and second, we must provide working space and facilities for personnel of cooperating agencies.

ROBERT W. HIATT

THE APPLICATION AND MECHANICAL RECOVERY OF INTERNAL METAL FISH TAGS

Tagging is an important method of determining the extent of migration of fish, the extent of intermixture of populations, and the rate of exploitation of a fish stock by a fishery. With small, relatively delicate species such as herring and sardines, the use of external tags is not feasible. During the past few years, as a result of collaborative studies by American and Canadian investigators, a new method of tagging and tag recovery has been developed in the Pacific Northwest for these species. Internal metal tags are inserted into the body cavity of the fish through an incision in the body wall. The incision heals within about two months. The tags are recovered by means of magnets in the meal lines from fish catches which are processed in reduction plants. This method of study has demonstrated a seasonal migration of sardines between California and British Columbia fishing grounds. In British Columbia, tagged herring have been recovered successfully for several years by means of electronic tag detectors placed in the unloading systems of canneries, salteries, and reduction plants. During this period, successive improvements have changed the electronic detector from a temperamental laboratory gadget to a stable, highly sensitive field instrument. The method has yielded a clear picture of the migrations and intermixture of the populations of herring supplying the commercial fishery. Internal metal tags are now being used by Norwegian scientists to investigate the possibility of a migration of herring between Norway and Iceland.

ALBERT L. TESTER

AN IMPROVED MICRO-METHOD FOR THE DETERMINATION OF REDUCING SUGARS

Clarification of sugar cane leaf extracts with lead or Somogyi reagent fails to remove a considerable amount of non-sugar reducing material which reacts with cold alkaline ferricyanide. Activated carbon (Suchar) has been found to remove this material quantitatively without adsorbing measurable quantities of reducing sugars. At the same time it completely decolorizes the plant extract, making a direct colorimetric reading possible.

Based upon the above observation the following micro-method has been developed. To 5 ml. of alkaline potassium ferricyanide, containing 0.005 milli-equivalents of ferricyanide, is added 2 ml. of clarified plant extract which contains not over 180 micrograms of reducing sugars. After heating for 25 minutes in an 80° C. water bath, the density of the cooled solution is read in a photoelectric colorimeter with a No. 42 filter or in a spectrophotometer at wave length 420 μ, the absorption maximum for potassium ferricyanide. At this wave length the formed ferrocyanide gives no measurable interference and the decrease in density is proportional to the amount of reducing sugar present.

The method is rapid, accurate, and sensitive to 1 microgram of reducing sugars.

GEORGE O. BURR AND T. TANIMOTO

ACTION OF CRUSTACEAN EYESTALK HORMONES ON TISSUE OXIDATION

The eyestalks of crustaceans are known to contain an endocrine gland (sinus gland) which regulates, among other processes, color changes, molting, and carbohydrate metabolism. It has been reported recently by Kuntz that removal of this gland results in a decrease in the activity of oxidizing enzymes (dehydrogenases) in tissues of three species of crustaceans. This is especially significant because it suggests that the other actions of the hormone may be referred to its action on fundamental enzyme systems in the cell.

The present paper reports similar studies with several European crustacean species. Removal of the eyestalks from *Carcinus maenas, Homarus vulgaris,* or *Leander adspersus* appears to decrease the dehydrogenase activity of muscle tissue, as measured by the Thunberg technique with methylene blue, or by the uptake of oxygen in the presence of succinic acid. The addition of extracts of the eyestalks to the tissues of *Carcinus maenas* increased the dehydrogenase activity of the tissues *in vitro* in some cases, but the action of such extracts on tissues of other species was irregular.

The muscle tissues of the crustaceans studied did not dehydrogenate lactic acid in Thunberg tests. There was also evidence that these tissues contain a substrate which is oxidized more readily than succinic acid in the presence of cytochrome.

BRADLEY T. SCHEER

THE EFFECT OF THE GROWTH HORMONE ON FLOWERING OF GRASSES

Since its discovery some two decades ago, auxin, the growth hormone in plants, has been amply demonstrated to have a dualism in its effect on growth. The growth of roots, buds, stems or, in fact, any meristematic tissue, proceeds rapidly in the presence of relatively low concentrations, and conversely, is inhibited in the presence of relatively higher concentrations.

In the course of the last ten years, several plant physiologists have found that they could retard or even prevent flowering in various kinds of plants by treatments with growth substances, or auxins. This situation has given rise to the theory that the growth hormone acts in simple opposition to flowering. The fact that auxins can actually induce flowering in pineapple was looked upon as an exception.

In experiments with two grasses, Wintex barley and Chalco teosinte, the inhibitive effect of heavy applications of auxin on flowering was reaffirmed. It was discovered that the inhibition is a quantitative function—the number of flower primordia becomes smaller and smaller approximately in proportion to the log of the concentration applied. With very heavy doses of auxin, flowering can be entirely eliminated in both species.

On the other hand, very small applications of auxin to barley were found actually to promote the initiation of flowering. For example, one gamma of naphthalene acetic acid per plant produced a 35 per cent increase in the number of flower primordia over that of the controls.

Thus it appears that auxin does not act in simple opposition to flowering. Instead, the dualism of its effect on growth is repeated in its effect on flowering. In barley, as in pineapple, flowering is promoted by relatively low concentrations, and conversely, is inhibited by relatively higher auxin concentrations.

A. CARL LEOPOLD

CHARACTER AND DISTRIBUTION OF THE FUNGUS PARASITE *PHYTOPHTHORA CINNAMOMI*

The fungus parasite *Phytophthora cinnamomi* is a soil inhabiting organism of considerable economic importance. Damage due to the fungus occurring naturally has been reported on 24 plants distributed in the plant kingdom from ferns to composites, and including plants such as avocado, cineraria, fir, oak, orange, pineapple, and yew. In addition, at least five plants are attacked upon inoculation. The fungus attacks roots, stems, and occasionally fruits of pineapple, but is a limiting factor only in very wet areas. It is found under moderately warm, humid conditions, requires free water for spore formation, does well on acid soils, and thrives under poor aeration. In very wet soils it reproduces very rapidly by means of swimming spores and is an aggressive parasite. First described from Sumatra in 1922, it now has been reported from Australia, Malaya, Hawaii, several of the United States, Colombia, Peru, Brazil, Puerto Rico, and Europe.

E. J. ANDERSON

SUBCULTURAL INFLUENCES ON PERSONALITY COMPONENTS

Four personality tests were administered to 108 nine-year-old Honolulu school boys: 34 Japanese, 24 Chinese, 26 Caucasians, and 24 Hawaiians. The Oriental children came from homes where at least one member of the household speaks the language of the subculture.

The present preliminary report includes results on Test V of Carl Rogers' "A Test of Personality Adjustment." This test consists of 21 question-items, each having from three to five possible answers. Test responses were tabulated separately for each subcultural group.

The Honolulu children proved as well adjusted as, or better adjusted than, the mainland children in measures of personal inferiority, social inferiority, and daydreaming; however, the Japanese, Chinese, and Hawaiian children exceeded the average weighted score of the normal mainland children in a measure of family conflict or maladjustment.

The largest number of statistically significant differences within test items was found between the Chinese and the Hawaiians; second was the number between the Japanese and the Hawaiians; third was between the Japanese and Caucasians; in next place, Caucasians differed from both Chinese and Hawaiians an equal number of times; the Japanese and Chinese showed the least number of differences. The Hawaiians played a part in 19 of the 29 significant differences. Each of the other groups played a part in 13 differences.

The Chinese and Hawaiians differed from the Caucasians with equal frequency. The Japanese differed from the Caucasians slightly more frequently. In intensity of differences, as indicated by the size of the chi-squares, the Japanese and Chinese tied for high intensity of differences with the Caucasians; that between the Caucasians and Hawaiians was somewhat less.

EDITH LORD

STANDARD TEST FOR FUNCTIONAL PHYSICAL EFFICIENCY

So many breakdowns due to poor posture and faulty motor habits occurred among civilian and service personnel under accelerated war conditions, that the former faculty of Punahou Girls' Physical Education Department felt it mandatory that every effort be made to safeguard the girls against strains in an unknown future.

This entailed exercises which would be practical and still detect potential mechanical faults as well as develop basic functional efficiency necessary for normal activity.

Normal range of motion per joint (excepting feet, hands, and elbows) and normal muscular strength necessary to maintain such range was tested throughout the body. Limitations in joint range caused by tight fascia or shortened muscles had to be detected. Neuro-motor efficiency was observed by (1) taxing the strength of the muscles in lifting weight, (2) by fixation stress, and (3) in co-ordination. The resulting exercises were based upon years of experience in physiotherapeutically treating patients under orthopaedic supervision.

The exercises have become a standard body mechanics performance for a normal person. As such, the common abuses of occupational habits, limited activity, and faulty alignment are counterbalanced.

Inability to do this set of exercises after a few weeks of practise showed up potential orthopaedic limitations which seemed indicative of future occupational inefficiency or pain.

The test is now being used in more than 200 universities and schools on the Mainland as well as in Y.W.C.A. classes in Honolulu and throughout the country.

RUTH A. AUST

BIOLOGICAL EFFECTS OF RADIATION ON *TRICHINELLA SPIRALIS*

Experiments have been conducted to determine the effects of radiation on meat containing infective larvae of *Trichinella spiralis.* The method used consisted in preparing small cellophane wrappings, each enclosing about 1 gram of trichinous meat, and placing these packets between two tubes containing radioactive cobalt. These items were kept in a refrigerator at a temperature of about 4°C. The dose of irradiation emitted by the cobalt was estimated to be 2,000 roentgens per day. The irradiation was largely gamma rays; the beta rays were filtered out. After irradiation the meat was fed to laboratory rats which were killed after 6 days to determine the presence and condition of the adult trichinae in the intestinal tract, or after 30 days to determine the presence of trichinae larvae in the musculature. In these experiments the following observations were made. (1) Continuous irradiation for 6 days (12,000 roentgens) did not kill the encysted larvae in the meat. These larvae were, however, able to develop to adult males and females when fed to rats. (2) Irradiation showed increased and variable deleterious effects on the reproductive cells of the adult females with increased exposure. Meat irradiated for 4 days yielded in four experiments an estimate of 12 to 86 per cent sterile female worms, i.e., the embryos in the uterus of the female parent failed to complete their usual development. Irradiation for 5 days resulted in the sterility of about 43 to 100 per cent of the adult females. Irradiation for 6 days resulted in the sterility of about 60 to 100 per cent of the female worms. (3) Female trichinae which were not made sterile as a result of irradiation gave birth to larvae which were able to invade the musculature of the host and become infective. Of six rats which received meat irradiated for 6 days and which were killed 30 days later, four showed no larvae in the musculature. (4) In addition to affecting the reproductive tissue, irradiation produced abnormality in the form of irregular elevations or vesiculations on the body wall in some of the parasites.

JOSEPH E. ALICATA AND GEORGE O. BURR

THE MAUNA LOA ERUPTION OF JANUARY, 1949

Mauna Loa resumed eruptive activity on the afternoon of January 6, 1949, after a repose period of 6 years and 8 months. The activity was confined to the summit caldera and the uppermost part of the southwest rift and constituted a summit eruption. During the first hours lava broke out along a series of fissures which extended part way across the caldera and about 1.7 miles down the southwest rift. A flow which originated on the rift outside the caldera advanced rapidly down the western slope of the mountain to a point more than 6 miles from its source but became inactive by January 8. Within 72 hours lava extrusion was restricted to a short length of fissure at the foot of the southwestern wall of the caldera. Lava fountains as much as 800 feet high built a large cinder and pumice cone which was partly banked against the caldera wall and partly resting on the outer slope of the mountain. More than two thirds of the caldera floor was covered by new lava, and flows spilling over the southern edge of the caldera filled to overflowing the adjoining South Pit. A flow which spilled over the low southeastern rim of South Pit on January 25 advanced about 4 miles southward. The principal phase of the eruption ended on February 5. During the rest of February and much of March occasional short periods of glow may have indicated weak lava extrusion. About the end of March activity was resumed with liberation of nearly gas-free lava which built a small cone containing a small lava lake.

The lava of the 1949 eruption is basalt poor in olivine. The total volume of extruded lava was about 75 million cubic yards. Tests for radioactivity in the lava were negative.

GORDON A. MACDONALD AND RUY H. FINCH

THREAT OF LAVA FLOW IN HILO

Succession of recent lava floods from the belt of rift cracks, through the summit crater of Mauna Loa volcano, have had directions as follows:

1933, south at summit crater; 1935, north flank after 2 years; 1940, south at summit crater; 1942, north flank after 2 years; 1949, south at summit crater; 1949, centered at the crater—2 years later would threaten the north flank.

The suggestion of rhythmic recurrences is not new. Summit crater gushings were followed by flank flows, in from 1 to 3 years, in 1849, 1865, 1880, 1896, 1903, and 1914.

When southern Mauna Loa outflows of 1907, 1916, 1919, and 1926 gave place to the northern ones of 1935 and 1942, the locations of the last two were identical with those of 1843 and 1852. They broke out at the same places in about the same volume.

The 1852 eruption was followed by the flow of 1855, the most voluminous flow which ever threatened Hilo. It lasted 14 months. The 1942 equivalent was followed in 1949 by the summit crater equivalent of whatever preceded the 1855 gushing. The 1855 vent was near the present Red Hill camp at 10,000 feet elevation on the northeast rift.

The 1949 eruption is not ended until it produces a flank outflow at about 10,000 feet of elevation. The sealing of the upper end of the southwest rift with tough, red-hot lava was completed in 1933, 1940, and 1949. The mountain is brittle to the north and the earthquakes are mostly there. Alternation and rhythm suggest the end of the 1949 activity is in sight about December, 1950, its location somewhere above Red Hill, and its danger to Hilo definite by analogy with the 1855 intervals, places, and intensities.

In 1855 Kilauea was free flowing. At present Kilauea is sealed, affording no pressure relief to the Mauna Loa threat.

The building of a lava diversion barrier and channel to defend Hilo was surveyed by U. S. Engineers in 1938. It was rejected, but it is still needed.

T. A. JAGGAR

BLOOD SUGAR IN THE SPINY LOBSTER *PANULIRUS*

The normal values for blood sugar concentration in *Panulirus japonicus* and *P. penicillatus* range from 0 to 53 mg. per cent, with a mean of 23.4 ± 5.1. The blood sugar of animals from which the eyestalks have been removed one or more days previously ranges from 0 to 26 mg. per cent, mean 13.1 ± 1.7. These means are significantly different. The difference is ascribed to the secretion by the eyestalk of a diabetogenic hormone. Injection of eyestalk extract prepared from the same or other species of crustaceans results in an increase in blood sugar concentration to a value twice that prevailing before the injection.

The mode of action of this hormone is uncertain, but studies of glucose tolerance suggest that it has an effect on the uptake of glucose from the blood by the tissues. Injection of 100 mg. glucose into the blood stream of normal lobsters was followed by a rapid rise, complete in one half to one hour, to a maximum level averaging 90.9 mg. per cent. In lobsters from which the eyestalks have been removed, the maximum level averages only 59.7 mg. per cent; these values differ significantly. Apparently the normal lobster uses about 80 mg. of the injected glucose within the first 30 minutes after injection, while the eyestalkless lobster uses 85 mg. There is then an almost complete cessation of utilization in the normal lobster for the next hour, whereas the eyestalkless lobster continues to use glucose at a rate of about 3 mg. per hour.

BRADLEY T. SCHEER AND MARLIN ANN SCHEER

AN ACTION POTENTIAL STUDY OF TASTE RESPONSES IN THE TOAD

That branch of psychology known as physiological psychology is concerned with the relation between various psychological processes and underlying physiological processes which play a part in them. In particular, the functioning of various parts of the nervous system is highly important for a fundamental understanding of various aspects of behavior.

Previous purely psychological studies of taste in human subjects have led to the acceptance of four primary taste qualities—i.e., salt, sour, sweet, and bitter—definite but overlapping areas of the tongue being shown to be sensitive to different stimuli.

Previous studies in frogs and in cats, however, have indicated only two or three primary sensitivities; one study indicated the possibility that certain receptor cells might be sensitive to more than one type of stimulus. Thus a rather different type of mechanism might be indicated for taste responses, or the results might represent a difference between these animals and man.

To investigate the question in another animal, taste action potential responses in *Bufo marinus* were studied. Instead of using an excised tongue-and-nerve preparation, the animal was anesthetized and recording was done from the exposed nerve in the intact animal. Thus more nearly normal responses might be anticipated. Recording was from the glossopharyngeal nerve by means of vacuum tube amplifiers and cathode ray oscillograph. Ether and urethane anesthesias were used.

After considerable work on the technique, satisfactory recording was obtained on five animals, each of which gave characteristic bursts of action potentials to acetic acid, quinine sulphate, sodium chloride, and sugar solutions as stimuli but not to distilled water. Time delay between stimulus artifact and potential bursts was unexpectedly large, varying from 2 to 25 seconds. The results will be discussed in relation to findings from other studies.

It is tentatively concluded that *Bufo marinus* exhibits sensitivity to the four taste stimuli reported in human studies.

T. W. FORBES, PRESTON S. ABBOTT, AND CHRISTOPHER J. HAMRE

THE EPIDEMIOLOGY OF LEPROSY: AN ALTERNATIVE EXPLANATION

Leprosy has long been regarded as a feebly and selectively contagious disease, communicable chiefly to children and seldom communicable, even conjugally, to adults. Skin sensitivity to the bacillus is common in both leprous and non-leprous persons over the age of three. In the former, it is almost always associated with more or less effective resistance to the disease; its lack, conversely, is almost always associated with lack of such resistance. Its frequent occurrence in the non-leprous is unexplained.

Similar sensitivity to the tubercle bacillus seems unrelated, or inversely related, to resistance to tuberculosis and is believed to result almost if not quite exclusively from prior infection.

It is suggested that leprosy may be a highly communicable disease with much the same sensitivity-inducing power as tuberculosis but (unlike tuberculosis) with the ability to induce effective resistance in the great majority of infected persons. Persons inheriting a full share of sensitizability are able, upon infection, to resist the development of any recognizable lesions of leprosy and merely develop a positive skin test. Persons inheriting no sensitizability may fail entirely to resist the infection and will develop lepromatous leprosy. Persons midway between these two groups will develop, usually, recognizable leprosy of the mild (tuberculoid) type, with sensitivity, resistance, and, in most cases, eventual self-healing.

This hypothesis helps to explain (1) the frequency of infection in childhood; (2) predilection of the disease for certain racial groups and families; (3) positive skin tests in healthy adults; (4) relative susceptibility of adults in non-endemic areas; (5) relative immunity of adults in endemic areas; and (6) the remarkable contagiousness of leprosy in thirteenth-century Europe and on Nauru in the nineteenth century.

HARRY L. ARNOLD, JR.

SUCROSE

Presidential address, 1949.

To the common fear of destruction by atomic bombs has been added, in recent months, the harassing rumor that mankind is again faced with the spectre of starvation. Thus a very old threat and a very, very new one appear in competition for the downfall of civilization.

These are both terrifying prospects and I doubt if anyone is in a position to predict the possibility of either. However, in the field of chemistry there appear reassurances that the advent of the new threat may offer the means of solving the old.

Sucrose occurs almost universally throughout the plant kingdom in the leaves, stems, roots, flowers, fruits, and seeds of plants. It plays an important part in the life processes of the plant and, as synthesized by the sugar cane and the sugar beet, provides man with one of his most important foods. The production of sucrose from these plants gives a tremendously more efficient utilization of land on an energy basis than any other large production food. That means that the energy of the sun is captured most efficiently in the processes of photosynthesis which lead to the formation of sucrose.

The possible reason for this is just in the process of being discovered. The energy of the sun is believed to be produced by sub-atomic phenomena, involving transformations through a carbon-nitrogen isotope cycle, which result in the regeneration of ordinary carbon and nitrogen atoms in a period of 5 million years. These elements, which appear to be essential to solar energy, are also essential to all life, and the use of sub-atomic phenomena and radioactive isotopes of these elements similar to those involved in the sun has recently given important clues as to the nature of the conversion of sun energy into plant energy.

Radioactive carbon produced by bombarding nitrogen atoms with neutrons from a uranium pile, which had its origin in the atomic bomb research, has been a most useful tool in learning the secrets of photosynthesis. Calvin has shown by this technique that sucrose is the first free sugar produced in the photosynthetic process. Thus sucrose appears to be the basic sugar of plant life and perhaps we are on the road to understanding why sucrose is so efficiently produced and to solving the food problem for a time at least.

Thus the atom bomb research has furnished the means by which the nature of photosynthesis is becoming known. Dr. Seaborg, the renowned atomic energy chemist, recently wrote, "It is not out of the question that a complete understanding of the photosynthetic mechanism might give man the ability to synthesize food and fuel at will."

Of special significance to us in Hawaii is the fact that our common sucrose, which seems so prosaic in the everyday outturn of a sugar factory, is the keystone in this momentous development.

J. H. PAYNE

NECROLOGY

C. MONTAGUE COOKE, JR.

C. Montague Cooke, malacologist of the Bernice P. Bishop Museum, and world-renowned student of Hawaiian and Pacific land shells, died in Honolulu on October 29, 1948. Dr. Cooke was born in Honolulu on December 20, 1874, the son of Charles Montague and Anna Charlotte (Rice) Cooke, both descendents of early missionary families. After graduating from Punahou School in Honolulu he attended Yale University, obtaining the A. B. degree in 1897 and the Ph.D. in 1901. The University of Hawaii conferred the honorary degree of Sc.D. on Dr. Cooke in 1936 in recognition of his outstanding studies of Pacific land shells.

Except for periods of study in the museums of Europe, Dr. Cooke gave nearly a half century of service to science at the Bishop Museum and as leader of many expeditions to various parts of the Pacific, resulting in the unparalleled collection of mollusks at the Museum. Though he was destined by birth and family associations to take an active and discriminating part in various civic and general cultural activities in Honolulu and Hawaii, his daily and unremitting devotion to intensive studies of the molluscan collections and the warm and challenging assistance he gave to various young protégés he gathered around him have been for many years the admiration of fellow scientists.

Apart from the enormous collection whose gathering he had fostered, he contributed to various journals many papers on land mollusks and on the problems of distribution of life in the Pacific, and on his death he made provision for continuation of this work at the Bishop Museum.

ROY A. GOFF

Roy A. Goff, assistant director of the University of Hawaii Agricultural Extension Service, died October 11, 1948, after serving the rural people of the Territory for 19 years.

Joining the Extension Service staff as farm agent in east Hawaii when the east Hawaii office was established in 1929, he served in this capacity until he became assistant director in 1936. Hawaii farmers and their families first learned of the help that the University and the United States government were prepared to provide for them when Mr. Goff made the rounds of their farms as county agent.

Born on a farm near Mapleville, Nebraska, in 1890, Roy Goff moved with his parents to Illinois in early childhood. He received the degree of Bachelor of Science in agriculture from the University of Illinois in 1915. Coming to Hawaii the same year, he taught agriculture at the Hilo Boarding School until 1917, when he became superintendent of the Glenwood substation of the University's agricultural experiment station.

As assistant director, Mr. Goff always listened sympathetically to the problems brought to him by his associates. His practical advice was brightened by a kindly sense of humor. All who knew Roy Goff miss him keenly.

WILLIAM WEINRICH

William Weinrich, former owner and manager of the Weinrich Fence, Bronze and Iron Works, died in Honolulu on January 29, 1949. He was born in Philadelphia on April 24, 1873.

As a young man of 25 years, Mr. Weinrich came to Hawaii 50 years ago with the United States Coast and Geodetic Survey. At one time he grew sisal and became manager of the old Hawaiian Fiber Company at Ewa. Fifteen years ago he bought the Axtel Fence Company, which became the Weinrich Fence, Bronze and Iron Works, Ltd. Here he also maintained a precision shop where he and his men made and repaired delicate scientific instruments and equipment. His wrought iron and bronze pieces are works of beauty in various homes and places of business in the Territory. A hobby of his, repair of fine clocks, became part of his business enterprise, especially in recent years.

Mr. Weinrich was a long time member of the Hawaiian Academy of Science and until his last long illness was a familiar figure at all Academy meetings. Although he was not actively engaged in scientific work, his interest in science was always active and keen.

MEMBERSHIP
MAY 1949

Akamine, Ernest K.
Akana, Theodore K.
Akers, Ernestine
Alicata, Joseph E.
Anderson, Earl J.
Appleton, Vivia B.
Arnold, Harry L., Jr.
Arnold, H. L.
Atherton, Ballard
Auchter, Eugene C.
Aust, Ruth
Awada, Minoru
Ayres, Arthur S.

Baker, Ray J.
Baldwin, Paul H.
Ballard, Stanley S.
Balock, J. W.
Banner, Albert H.
Barnhart, George H. W.
Bartz, Ellwood L.
Baver, L. D.
Beaumont, J. H.
Beebe, James M.
Berk, Morton
Bess, H. A.
Bianchi, Fred A.
Bice, Charles M.
Bilger, Earl M.
Bilger, Leonora N.
Bitner, Harold M.
Bonnet, David D.
Borden, Ralph J.
Bowles, Herbert
Bramhall, Ervin H.
Briggs, Leslie J.
Britton, John R.
Brock, Vernon E.
Brown, E. D.W.
Brown, F. B. H.
Bryan, Edwin H., Jr.
Bryan, L. W.
Bryson, L. T.
Buck, Peter H.
Burr, George O.
Bush, W. M.
Bushnell, O. A.

Campbell, Edward L.
Carson, Margaret K.
Carson, Max H.
Carter, Walter
Caum, Edward L.
Chong, Mabel
Christian, Eloise
Chu, George W.
Chun, Edwin Y.
Clements, Harry F.
Collins, J. L.
Cornelison, A. H.
Cox, Doak C.
Cox, Joel B.
Crosby, William

Davis, Dan A.
Davis, Watson
Day, A. Grove
Dean, Arthur L.
Degener, Otto
de Laubenfels, Max W.
Denison, Harry L.
Dillingham, Frank T.
Doty, R. E.

Edmondson, C. H.
Eguchi, George
Eller, Willard H.
Emory, Kenneth P.
Engard, Charles J.
Enright, James R.

Fagerlund, Gunnar
Farden, Carl A.
Feldwisch, W. F.
Fennel, E. A.
Finch, Ruy H.
Fong, Francis
Forbes, T. W.
Fosberg, F. R.
Foster, Zera C.
Fox, John F.
Frazier, W. A.
Fujimoto, Giichi
Fukuda, Mitsuno
Fullaway, David T.

Giacometti, G.
Gill, Robert F., Jr.
Gladding, Elizabeth
Gortner, Willis A.
Gray, Reed A.
Gregory, Christopher
Gregory, H. E.

Hadden, Fred C.
Halperin, Sidney L.
Hamre, Christopher J.
Hamre, Ernestine K.
Hanson, Noel S.
Harada, M. B.
Harris, Wray
Harry, J. Vernon
Hartt, Constance E.
Hartwell, Alfred S.
Henke, Louis A.
Herrick, Colin J.
Hiatt, Robert W.
Hinkley, Vern
Holdaway, F. G.
Holmes, W. J.
Horan, John S.
Hosaka, Edward Y.
Hosoi, Kiyoshi
Howell, R. Kemper

Ito, Kiyoshi

Jackson, Dean C.
Jaggar, Thomas A.
Jessen, Louise S.
Johnson, Horace
Johnson, June

Kanehiro, Yoshinori
Katsuki, I.
Kaulukukui, Felice W.
Kawano, Henry
Keller, Arthur R.
Kenda, William
Kendall, Mary Conner
Kepner, Gretel Roth
Kepner, Richard D.
Kerns, Kenneth R.
Kim, Peter B.
Kinberg, Hjalmar
King, Maurice V.
King, Will Norman
Kirch, H. William
Kondo, Yoshio
Kopf, Kenneth
Krauss, Beatrice H.
Krauss, F. G.
Kunesh, J. F.
Lam, Janet Chun
Lam, Margaret
Lam, Robert L.
Lamb, Alvin R.
Larrabee, Louise M.
Larsen, Nils P.
Larsen, Norma
Larson, Harry W.
Leeper, Robert W.
Lennox, Colin G.
Leopold, A. Carl
Leopold, Luna B.
Lind, Andrew W.
Linford, Maurice B.
Livesay, T. M.
Lohman, Marion L.
Lord, Edith
Loucks, Burton J.
Loucks, Ruth Baker
Louis, James L.
Louis, Lucille
Lum, C. K.
Lyon, Harold L.
Lyon, Mrs. Harold L.

McCarthy, Harold E.
McCleery, Walter E.
Macdonald, Gordon A.
McGuire, Thomas R. L.
McKibben, Eugene G.
McMorrow, B. J.
Magistad, O. C.
Mainland, Gordon B.
Mangelsdorf, A. J.
Maroney, Verna B.
Martin, Joseph P.
Mason, Leonard E.
Matthews, Donald C.
Mau, Kong Tong
Miller, Carey D.
Miller, Robert C.
Mitchell, Donald
Moe, Clayton R.
Mordy, Wendell A.
Moulton, Margaret

Nakamoto, Goichi
Nakamura, Winters T.
Natsui, Dorothy
Naughton, John J.
Neal, Marie C.
Nickerson, Thomas
Nightingale, Gordon T.
Nishida, Toshiyuki
Nishimura, Earl
Nitta, Doris
Nordfeldt, Sam

Okimoto, Marion
Okubo, Shigeo

Palafox, A. L.
Palm, Harry
Palmer, Harold S.
Payne, John H.
Peixotto, Helen E.
Pemberton, C. E.
Pinkerton, F. J.
Potter, Colin
Powers, Howard A.
Puth, Maybelle J.

Rhead, Clifton C.
Ripperton, J. C.
Rose, Stanley J.
Rosenberg, Morton M.
Rusch, Kenneth H.
St. John, Harold
Sakimura, Kay
Satterthwaite, Ann Y.
Scheer, Bradley T.
Schmidt, Carl T.
Schmidt, Helen D.
Seeley, Delos O.
Shigeura, Gordon T.
Sherman, G. Donald
Sideris, C. P.
Sidwell, A. P.
Simpson, R. H.
Sinclair, Gregg M.
Skromme, A. B.
Slattery, Mabel
Smith, Elbert G.
Smith, Madorah
Smith, R. Q.
Spalding, Philip E.
Spencer, Janina R.
Spencer, R. Donald
Spiegelberg, Carl H.
Spitzer, Blanche H.
Springer, Doris
Spurr, Robert A.
Sterns, Marjorie
Stidd, C. K.
Stokes, J. F. G.
Storey, W. B.
Suehiro, Amy
Suzuki, F. T.
Swezey, O. H.

Takahashi, David
Takahashi, Makoto
Tanimoto, Ralph H.
Tanimoto, Tyrus T.
Taylor, Keith
Tester, Albert L.
Thorne, M. D.
Titcomb, Margaret
Tuthill, Leonard D.

Umeda, Rose M.
Urata, Rokuro

Vaksvik, K. N.
Van Zwaluwenburg, R. H.
Vernon, Mabel D.
Vinacke, W. Edgar
Vinacke, Winifred R.
Voorhees, George

Wadsworth, Harold A.
Wallace, Keith K.
Warner, H. H.
Watson, Leslie J.
Wedge, Bryant
Wentworth, Chester K.
Wentworth, Juliette
Wilbar, Charles L.
Williams, F. X.
Williams, John N. S.
Wismer, Chester A.
Withington, Paul
Witter, Harry C.

Yamanaga, George
Yanigihara, Iichi
Yee, Phillip K. H.
Yuen, George
Yuen, Jane Y. C.

Zimmerman, E. C.

PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

TWENTY-FIFTH ANNUAL MEETING 1949-1950

Published by the University of Hawaii Honolulu, T. H., 1950

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE"

PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE...

TWENTY-FIFTH ANNUAL MEETING 1949-1950

Published by the University of Hawaii Honolulu, T. H., 1950

FOREWORD

The year began with a membership of 288; 22 new members were elected, 4 members resigned, and 2 died during the year, leaving a membership of 304.

The Academy made a financial contribution toward a fund to make possible a series of lectures in Honolulu by Dr. Hans Pettersson, distinguished oceanographer and leader of the expedition around the world on the Swedish research ship "Albatross."

A special meeting was planned for the evening of April 5, 1950, to hear Dr. L. G. N. Baas Becking, head of the Research Council of the South Pacific Commission, but had to be cancelled.

Dr. Herbert E. Gregory was appointed a delegate to represent the Academy at the 7th International Botanical Congress, Stockholm, Sweden, July 12 to 20, 1950, and at the 6th International Congress of the History of Science, Amsterdam, Holland, August 14 to 20, 1950.

A questionnaire was circulated and card catalogue compiled of the scientific skills and interests of the members of the Academy. The cards were classified into some 50 categories for ready reference.

Nearly half of the members of the Academy are listed in the latest (1949) issue of *American Men of Science.*

In this volume of its *Proceedings* the Hawaiian Academy of Science presents the program and abstracts of papers presented at the Fall and Spring sessions of the twenty-fifth annual meeting. As in many years past, meetings, including the annual dinner and business meeting, were held at the University of Hawaii.

OFFICERS

1949-1950

President, Robert W. Hiatt
Vice-President, E. C. Auchter
Secretary-Treasurer, E. H. Bryan, Jr.

Councilor (2 years), A. J. Mangelsdorf
Councilor (1 year), G. Donald Sherman
Councilor (1 year), John H. Payne (ex officio)

1950-1951

President, E. C. Auchter
Vice-President, L. D. Baver
Secretary-Treasurer, E. H. Bryan, Jr.

Councilor (2 years), Harry L. Arnold, Jr.
Councilor (1 year), A. J. Mangelsdorf
Councilor (1 year), Robert W. Hiatt (ex officio)

THE 25th ANNUAL MEETING 1949-50

Program

NOVEMBER 17, 1949

Harry L. Arnold, Jr., and David D. Bonnet: "Swimmers' Itch": Its First Appearance in Hawaii.

Doris Springer: Awareness of Racial Differences by Preschool Children in Hawaii.

W. Edgar Vinacke and Nathalie Van Order Smith: Responses to Humorous Stimuli of Caucasian, Japanese, and Chinese Students.

Leonard Mason: Cultural Adaptation of the Bikini Islanders to a New Environment.

NOVEMBER 18, 1949

Chester K. Wentworth: How Far and How Rapidly Should Man Change His Natural Environment?

G. Donald Sherman: Genesis and Morphology of the Hawaiian Laterite Crusts.

Constance E. Hartt: The Assimilation of Radioactive Carbon Dioxide by Leaves of the Sugar Cane Plant.

R. L. Metcalf: Resistance of Insects to Insecticide Action. (Paper by Invitation.)

APRIL 27, 1950

David T. Fullaway: *Apanteles* in Hawaii.

Calvin W. Schwabe: Manson's Eyeworm in Hawaii.

Carey D. Miller, Adelia Bauer, and Mildred Higa: Enamel Erosive Properties of Fruit and Fruit Juices.

E. S. C. Handy: Genethnics, a New Technique for Systematic Anthropological Appraisal.

APRIL 28, 1950

O. A. Bushnell, Mitsuno Fukuda, and Takashi Makinodan: The Antibacterial Properties of Some Plants Found in Hawaii.

John J. Naughton and Francis J. Norton: Carbon Isotope Ratio in Hawaiian Volcanic Gases.

Sidney C. Hsiao: Effect of Silt upon *Ostrea virginica.*

Chester K. Wentworth, Arnold C. Mason, and Dan A. Davis: Effect of Phosphate Mining on Water Supply on Angaur Island, Palau.

APRIL 29, 1950

Annual Dinner

Business Meeting

Installation of Officers

Address by Retiring President

Robert W. Hiatt: Marine Biological Stations in North America.

Abstracts

"SWIMMERS' ITCH": ITS FIRST APPEARANCE IN HAWAII

During 1948-1949, numerous cases were reported (52 directly to the Board of Health) of a skin eruption consisting of discrete itchy papules, characteristic of insect stings or "bites." They had been sustained by persons immersed for varying periods of time, swimming or searching for crabs, clams, or mussels, in the West Loch of Pearl Harbor and in the Ala Wai Canal, Waikiki, and from no other areas. The eruption was self-limited, requiring only symptomatic treatment for relief.

The Health Department, Territory of Hawaii, attempted to determine the causative agent, with the following results: Jellyfish, hydroids, and annelid worms in these areas were examined and patch tested, but no positive rash could be obtained. Studies of streams of water indicated no external contamination by irritating substances which might cause the swimmers' itch. Not all individuals exposed showed evidence of the rash, indicating some individual resistance or lack of sensitivity. Many individuals reported that the severity of the symptoms increased with multiple exposure. This would indicate the possibility of a sensitization or anaphylaxis phenomena. In an effort to avoid the rash, individuals, while clamming, avoid areas where the mud is stirred up. This would indicate the possibility that a minute, mud-loving organism might be the cause of the rash. To date the causative agent has not been identified positively, but further work will be engaged in to determine the cause, if possible.

HARRY L. ARNOLD, JR., AND
DAVID D. BONNET

AWARENESS OF RACIAL DIFFERENCES BY PRESCHOOL CHILDREN IN HAWAII

This study was an investigation of the development in young children of an awareness of differences in physical characteristics of various national-racial groups. The subjects were 287 children, three through six years of age, of varied national-racial ancestry. Some of the subjects were attending preschools in which many national-racial groups were represented; and others were in preschools in which the children and teachers were almost exclusively Oriental. In individual interviews, the subjects were asked to identify themselves and their brothers and sisters, and to indicate preferences for portraits of children. The thirty portraits used were 5-x-7-inch hand-colored pictures of boys and girls of Chinese, Japanese, Caucasian, Filipino, and Hawaiian-Caucasian ancestry.

The results of the study indicated that the children were conscious of their own physical characteristics and those of their siblings and were able to identify these characteristics in pictures of children of their own race. When indicating preferences, the children tended to choose pictures of their own racial background. Children of mixed racial ancestry chose more non-Oriental than Oriental pictures. Attendance in preschools where many national-racial groups were represented, as contrasted with schools where the children were Oriental, was not related to accuracy of identification but was related to preferences expressed by Oriental subjects. Orientals in heterogeneous groups chose significantly more Caucasian pictures than Orientals in homogeneous groups.

There were no significant age differences. The only sex difference was in the very marked preference of boys and girls for pictures of their own sex at every age. The names of nationalities held significance for many children and influenced their preferences and rejections. Reasons given for their choices indicated that specific physical characteristics were important determinants when identifying actual persons, whereas, judgments of psychological factors based on physical characteristics frequently determined preferences.

DORIS SPRINGER

REACTIONS TO HUMOROUS STIMULI OF DIFFERENT GENERATIONS OF JAPANESE, CHINESE, AND CAUCASIANS*

An experiment was conducted to test the hypothesis that Caucasians, Japanese, and Chinese differ in their responses to jokes. For this purpose, samples of college students and of older persons (median age 45) of these three national-racial groups were tested with jokes falling into a large number of categories. Differences occurred in the "punch" lines supplied for uncompleted jokes. Caucasians supplied more positive and negative completions, Japanese and Chinese more neutral completions. In response to jokes of Chinese origin, younger Caucasians less often rated them as "good"; older Caucasians agreed more closely with the Japanese and Chinese. With respect to Japanese jokes, Caucasians of both generations less often rated them as "good." Differences also occurred in other categories, the consistency of which was evaluated by comparing results obtained under three conditions. In general, there was less difference between generations than between Caucasians and either generation of Japanese and Chinese. Some previously found characteristics of humor do not seem to differentiate between the groups. The conclusion is that differences, and also similarities, exist between these groups in their preferences for jokes, but the experiment is essentially exploratory in nature. Many hypotheses may be advanced to account for the results, but an explanation of the specific dynamic and cultural factors responsible must await further investigation.

W. EDGAR VINACKE AND
NATHALIE VAN ORDER SMITH

* Title of abstract altered by authors from that on original program.

CULTURAL ADAPTATION OF THE BIKINI ISLANDERS TO A NEW ENVIRONMENT

(See: Leonard Mason, The Bikinians: A Transplanted Population. *Human Organization* 9 (1): 5-15, Spring, 1950.)

Requirements of United States national defense prompted the transplanting in March, 1946, of 167 Marshallese from Bikini Atoll to Rongerik, a smaller uninhabited atoll over 100 miles to the east. Both atolls are typical of the poorly endowed northern Marshalls—small, low, coral sand islands surrounding a lagoon and only sparsely covered with coconut and pandanus trees, arrowroot, and scrubby beach vegetation. Drinking water is scarce and is obtained by rain catchment during the wetter period preceding the dry winter months. Only a bountiful marine resource saves Bikini from being sub-marginal in terms of human subsistence.

Within two years the move to Rongerik had proved itself ill-advised, since the smaller land and lagoon areas were inadequate for the needs of the Bikini people. Their physical condition deteriorated; the community became reorganized on a completely cooperative basis in the face of increasing food crises. An extreme situation required extreme measures. The group was moved once more, this time to Kwajalein where, near administration headquarters, a temporary encampment was erected for the evacuees until a final decision could be made as to their permanent residence on some other Marshall island.

In November, 1948, eight months after Rongerik had been abandoned, the Bikinians moved to Kili, a small single island in the better-favored southern Marshalls. The disadvantage of Kili's lack of a lagoon, isolating the population a part of each year during the stormy months, is offset by the luxuriant vegetation and variety of food-producing plants. New foods about which the Bikinians are learning include taro, breadfruit, sweet potatoes, bananas, and papayas. Formerly the site of a commercial plantation, Kili offers the new residents a considerable source of income in production of copra for export. Marshallese agree that Kili is a good exchange for Rongerik, perhaps even for Bikini, but a planned program of education, such as learning to handle small craft in rough surf, to cure copra by artificial heat during the frequently rainy weather, and to cultivate and process the strange foods to which they have been introduced, is necessary to aid the newcomers in adjusting themselves to their new environment.

LEONARD MASON

HOW FAR AND HOW RAPIDLY SHOULD MAN CHANGE HIS NATURAL ENVIRONMENT?

Drastic excavation, the stripping of soil, the sale of top soil, and the very marked upsetting of vegetation and moisture conditions in progress in various inland subdivision areas raises the questions: Is this sort of thing good? Will it lead to objectionable consequences that from a community standpoint may outweigh any immediate advantage or convenience? Will the effect of deep cutting on one property be restricted to that property, or does the adjacent owner sustain a tangible change in his property as well?

A definition of conservation is favored that includes use as well as preservation, but community prudence suggests restrictions be put on use so that renewable resources may continue to be renewed.

A running stream is a natural feature in which adjacent land holders have certain rights. Owners of land adjacent to lakes also have certain rights and responsibilities. Movement of injurious or harmful plants and animals is rightfully restricted. We recognize the need and try to administer protections against too rapid and disorderly commercialization in our various zoning procedures.

An acre of forest or field or any other terrane, formerly in the midst of many acres of the same, and now cut around by deep excavation, stripping of vegetation, and various ecologic and microclimatic changes, is by no means the same acre. Some redress may be had for damage done, but is the rate of modification wise?

In the interest of a common good, such facilities as highways, airfields, harbors, or other industrial installations may involve almost complete destruction of natural terrane and ecological pattern. But is this likewise good in residential tracts? Should the owner of property retain the undisputed right to change the vegetational regime and microclimate adjacent to his neighbor? Are we starting something that we cannot finish and that may finish us?

CHESTER K. WENTWORTH

GENESIS AND MORPHOLOGY OF THE HAWAIIAN LATERITE CRUSTS

(Published in full in *Pacific Science* 4 (4): 315–322, October, 1950.)

The laterite crust has developed in three general areas of the Hawaiian Islands: namely, the southern and western slopes of leeward Kauai; the westerly slopes of the main mountain range of Molokai; and on the white trachyte cliffs of West Maui. Laterite crusts are found on the long slopes which have a region of very high rainfall at the higher elevations and a semi-arid condition at the lower elevations of the slope. The areas of laterite crusts are located at higher elevations which have a definite alternating wet and dry season.

The laterite crust profiles have a hard, slaglike surface horizon, which has a very high apparent specific gravity. This layer is underlain by a friable layer of a thickness varying from 4 to 36 inches. This always lies over an impervious layer of either rock or a plastic clay. The hard surface horizon is rich in iron and titanium oxides and very low in volatile matter. The friable layer is made up of iron oxides, which may make up as much as 80 percent of the soil.

A hypothesis is advanced as to the genesis of these laterite crusts. This would involve the movement of iron and hydrated titanium oxides in the percolating waters from the soils developed on the wet areas of the higher elevations by lateral movement through the impervious subsoil layers and their subsequent accumulation in the surface horizon by capillary action in regions having an alternating wet and dry season climate. The hydrated iron oxide and titanium oxides are stabilized by dehydration and are converted to hematite and anatase in the surface horizon. This gives rise to the hard compacted surface horizon having a very high apparent specific gravity.

G. DONALD SHERMAN

THE ASSIMILATION OF RADIOACTIVE CARBON DIOXIDE BY LEAVES OF THE SUGAR CANE PLANT

Radioactive carbon dioxide is being used at the Experiment Station of the Hawaiian Sugar Planters' Association in studies of the formation and transport of sugar in the sugar cane plant. The experiments show that glucose is formed before sucrose in photosynthesis. The sugars were isolated and purified after dilution with a carrier. Using a mica window counter, no radioactivity could be detected in sucrose formed in 5- or 15-second exposure to sunlight, whereas the glucose was definitely radioactive. Using an internal counter, the relative total counts per minute per mg. of tissue were: for 5 seconds, glucose 149.5 and sucrose 5.6; for 15 seconds, glucose 286.4 and sucrose 25.0. The relative specific activities of the undiluted sugars were: 5 seconds, glucose 242,000 and sucrose 181; 15 seconds, glucose 461,000 and sucrose 902. Glucose and sucrose were separated chromatographically. After crystallizing the glucose, glucose penta-acetate was prepared and recrystallized to constant radioactivity. With longer exposures more sucrose accumulated than glucose or fructose; at 300 seconds the total counts were: sucrose 49,773, glucose 3,349, and fructose 5,734.

Total counts in the barium-zinc precipitate at 5 seconds were 220, and these increased to 56,541 at 300 seconds. Total counts in the 95 percent alcohol-insoluble fraction were 252 at 5 seconds, increasing to 32,830 at 60 seconds, and decreasing to 24,208 at 300 seconds. Total counts in the residue after alcohol were 27 at 5 seconds, increasing to 13,382 at 300 seconds. The petrol ether extract began at 0 counts and reached 64.8 total counts. The water-insoluble fraction began at 0.3 counts and reached 115 total counts at 300 seconds.

Leaves fed radioactive invert sugar in the dark made radioactive sucrose.

Radioactive glucose, fructose, and sucrose have been prepared from both green and albino blades fed radioactive carbon dioxide in total darkness as well as in sunlight.

CONSTANCE E. HARTT

RESISTANCE OF INSECTS TO INSECTICIDE ACTION

(Paper by Invitation)

Examples were given of strains of insects which had developed resistance to the toxicity of various insecticides. They included resistance of flies and mosquitoes to DDT and other sprays, citrus scales to HCN gas, citrus thrips to nicotine compounds, and blue ticks in Africa to arsenic dips and benzene hexachloride. Even bacteria may become resistant to penicillin.

Flies are especially useful in testing chemical sprays because of their rapid breeding (over 30 generations a year) and the relationship between their resistance and the spacial arrangement of the formula of the insecticide. It was found that resistance does not disappear when treatment is stopped. After 30 generations without exposure to DDT, the progeny of resistant flies were still resistant. In most spraying operations, some "strong" flies get away before they get a lethal dose and produce resistant offspring. When flies become resistant to all sprays, we will have to go back to the fly swatter.

R. L. METCALF

APANTELES IN HAWAII

Species of *Apanteles* are microwasps which specialize in the parasitism of lepidopterous larvae. Since the Lepidoptera constitute one of the largest orders of the class Insecta and, with very few exceptions, are harmful insects from our standpoint, these microwasps, which parasitize them and hold them in check, are likely to assume an important role in any localized fauna, especially with respect to species of Lepidoptera which are crop pests.

There are hundreds of species of *Apanteles,* but they appear to be a very homogeneous group. Efforts to separate them into smaller divisions have been unrewarding. Definite, but microscopically fine, characters of form and structure readily distinguish the different species. Dr. C. F. W. Muesebeck of the U. S. National Museum has published a key to the 164 Nearctic species; Dr. C. Watanabe has done the same for 44 Japanese species. According to Wilkinson of the British Museum of Natural History, there are 62 Ethiopian species and 74 in the Indo-Malay region.

Although Hawaii has close to a thousand species of endemic Lepidoptera, there are no endemic *Apanteles.* The species occurring here are either immigrants or were introduced purposely. During the nearly half a century that I have collected and studied them in Hawaii, the number of species has increased from three to nine. Five of these, possibly a sixth also, we know positively were introduced, all to control crop pests, as follows:

Apanteles glomeratus, from Japan in 1923, to control the cabbage worm, *Pontia rapae.* The wasp larvae are gregarious and probably result from multiple parasitism, in contrast to most species, which are solitary.

Apanteles scutellaris and, possibly, *A. dignus* from Southern California in 1933, to help control the potato tuber moth, *Gnorimoschema operculella. A. dignus* is specifically attached to the tomato pin worm, *Kliferea lycopersicella.*

Apanteles marginiventris, from Brownsville, Texas, in 1942, to aid in the control of the grass armyworm, *Laphygma exiguae,* a grass feeder and pest in sugar cane cultivation and cattle ranching.

Apanteles bedelliae, from Kansas in 1945, to help control the sweet potato leaf miner, *Bedellia orchelella,* a serious pest of sweet potato vines.

Apanteles praesens, from Southern California in 1925, to help control *Anacamptodes fragilaria,* a pest common on leguminous plants, especially koa haole *(Leucaena glauca),* an important forage shrub. Not having been recovered from the field, its establishment is not certain.

The three immigrant species not purposely introduced include: a handsome species with banded wings, described by Dr. Muesebeck as *A. trifasciatus; A. carpatus* (once called *A. hawaiiensis*), a parasite of the clothes moth; and an unidentified species bred from the pink scavenger caterpillar, *Batrachedra rileyi.*

Efforts have been made to introduce the Australasian species *A. antipoda,* but without success.

DAVID T. FULLAWAY

MANSON'S EYEWORM IN HAWAII

This nematode parasite, first described in Amoy, China, has been known in Hawaii since before 1913. It is widely distributed in warmer regions of the world. It is found in the eyes of domesticated poultry and other birds. Part of its life cycle is spent in the burrowing roach, *Pycnoscelus surinamensis* (L.), which is not seriously affected by the nematode. Poultry eat the roach, the nematode ascends the oesophagus and soon enters the eyes.

Poultrymen are likely to attribute any eye trouble to this parasite. To learn the extent of its infestation, a study was made (1) of the life cycle, which was found almost identical to the species in Australia; (2) of the importance of the nematode in poultry raising; and (3) means of control.

The maximum number of nematodes found in the eye of a chick was 200. Large numbers, constantly in motion in the eye, cause considerable irritation to the chicks and a definite tissue response but no pathological results, such as blindness or destruction of the eyeball, are caused as long as the birds are well cared for. When not well cared for, the irritation may permit entry of other infections. It is believed that the damage caused by the nematode is overrated.

Suggested control measures include: (1) Killing the parasites in the bird's eyes by mechanical removal or creolin solution; this leaves the eyes exposed to reinfection. (2) Making the eye an unsuitable habitat for the nematode by removing the nictitating membrane by a simple operation with no ill effects on the chick. (3) Controlling the roach or preventing its serving as intermediate host. Growing the chicks on wire helps to keep them from eating roaches. With floor brooding, insecticides may be used to control the roach. There is no known effective natural enemy of the roach.

In the life cycle of the parasite, about 51 days are spent in the roach. Parasites require 2 weeks to reach maturity and lay eggs in the bird. The eggs pass down the ducts and out with the feces, to be taken up by the roach.

CALVIN W. SCHWABE

ENAMEL EROSIVE PROPERTIES OF FRUITS AND FRUIT JUICES

(Published in full as follows: Carey D. Miller. Enamel Erosive Properties of Fruits and Fruit Juices. *Journal of Nutrition,* 41 (1): 63–71, 1950.)

Five tropical and semi-tropical fruits—grapefruit, guava, Java plum, mango, and pineapple—and juices prepared from them were fed to standard rats to determine their enamel erosive properties.

The *p*H and titratable acidity were determined for each lot of sweetened fruit and fruit juice used.

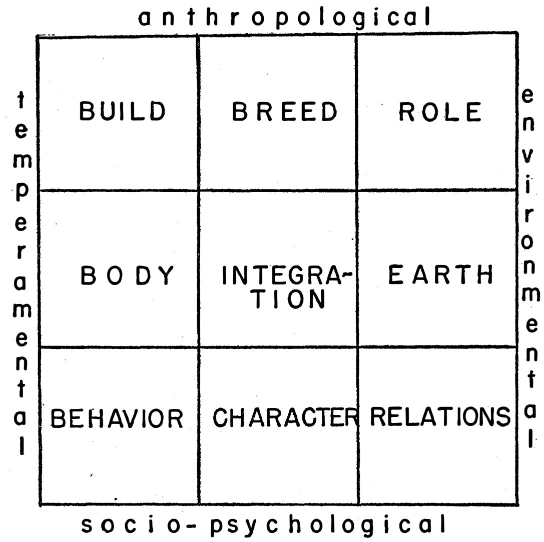
Quantities of juice equivalent to the daily fruit supplement had three to ten times the enamel erosive properties of the fruits themselves. No adequate explanation for the different effect of fruit and fruit juice can be offered at the present time, but it appears not to be related to the titratable acidity of the two.

Data given for five fruits of widely different species and preliminary experiments with two other fruits appear to justify the postulate that acid fruits generally have a slight enamel erosive effect, in contrast to the marked effect of the juices made from them.

CAREY D. MILLER, ADELIA BAUER, AND MILDRED HIGA

GENETHNICS, A NEW TECHNIQUE FOR SYSTEMATIC ANTHROPOLOGICAL APPRAISAL

Genethnics is a graphic means for indicating the interrelationship between man or other organisms and their environment. This is done in a systematic manner by means of symbols placed in the eight squares ("panels") around the "genethnic screen" shown below.



Applying this screen to man, his name is placed in the center square and the eight panels contain the following data: "Body"—the twelve accepted anatomical-physiological "systems" of the body. "Build"—the relative fat, brawn, or leanness within five body regions and overall, obtained by photographs or body measurements. "Breed"—characteristics in racial-ethnic terms observed in the same five body regions or from facts of heritage. "Role"—cultural attainments of the person. "Earth"—environmental conditions and factors. "Relations" with persons, individually or collectively, and to places and things. "Character" comprising interests, aptitudes, and talents. "Behavior" actually observed in the person studied. The roles which a person plays at particular times in life do not necessarily reflect either his aptitudes or his interests (i.e., "Character"). He may in fact be cast by conditioning and changing circumstances in active roles quite at variance with either aptitude or interests, in which case the cross-currents and probable frustrations will reflect themselves significantly in "Behavior" and "Relations" and, as psychosomatics now recognizes, in "Body."

E. S. C. HANDY

THE ANTIBACTERIAL PROPERTIES OF SOME PLANTS FOUND IN HAWAII

(Published in full in *Pacific Science,* 4 (3): 167–183, 6 tables, July 1950.)

Tissue juices expressed from different parts of 101 species of Hawaiian plants collected at random were tested *in vitro* for their antibacterial properties against *Micrococcus pyogenes* var. *aureus, Escherichia coli,* and *Pseudomonas aeruginosa.* Extracts from 13 of these plants were very effective in their action against the bacteria. Determinations of effectiveness were made by testing extracts by the Oxford cup method developed for the assay of penicillin.

Extracts obtained from the following plants were the most effective: uluhe (*Dicranopteris linearis*); red ginger (*Alpinia purpurata*); koa (*Acacia Koa*); tamarind (*Tamarindus indica*); lime (*Citrus aurantifolia*); sand-box (*Hura crepitans*); three species of passion-fruit (*Passiflora edulis* f. *flavicarpa, P. foetida* var., and *Passiflora* sp.); pomegranate (*Punica Granatum*); mountain apple (*Eugenia malaccensis*); ohia lehua (*Metrosideros macropus*); and guava (*Psidium Guajava*).

O. A. BUSHNELL, MITSUNO FUKUDA, AND TAKASHI MAKINODAN

CARBON ISOTOPE RATIO IN HAWAIIAN VOLCANIC GASES

Volcanic gases were collected at the Kilauea fume vents, and extracted from pumice thrown up in the 1949 eruption of Mauna Loa. The method of collection and extraction using high vacuum equipment was demonstrated. Also illustrated was the method of fractionation used to isolate and concentrate the carbon dioxide, sulfur dioxide, and hydrogen sulfide present in the gas. These gases were sent to Dr. Francis J. Norton of the General Electric Research Laboratory, who will determine the ratio of the isotopes of the elements present. In particular a comparison will be made of the ratio of the isotopes of carbon (C^{12} and C^{13}) in the volcano gas to the ratio of these isotopes in the carbon found at the earth's surface.

A preliminary result which seems to show differences in the carbon isotope ratios which are of significance has been received from Dr. Norton. These differences seem to indicate a concentration of the heavier isotope of carbon (C^{13}) in the volcano gas. Interpretation of this result has not as yet been attempted, but it may be due to diffusion fractionation of the isotopes.

The mass spectrogram received also showed a peak at mass 14. This, in conjunction with other peaks, seemed to indicate the existence of the radioactive mass 14 isotope of carbon. However, tests for radioactivity by Dr. George Burr of the Experiment Station of the Hawaiian Sugar Planters' Association were completely negative.

For confirmation of the results mentioned we are awaiting the results of complete and more exact experiments by Dr. Norton, and by Alfred O. C. Nier of the University of Minnesota, who has agreed to cooperate in the work.

JOHN J. NAUGHTON AND FRANCIS J. NORTON

EFFECT OF SILT UPON *OSTREA VIRGINICA*

The effect of silt upon the activities of oysters has been investigated in the laboratory by the use of kymographs and continuous circulation of sea water containing known amount of silt in suspension. The following results were obtained: 1. The more turbid the water, the more irregular the respiratory-feeding movements of the shells of the oysters. 2. When graded silt suspension was used, increasing from 100 to 15,000 parts per million, the animals, compared with the controls in approximately 20 p.p.m. sea water, showed decreasing activity. On the average, total duration of shell movement decreased from 78 to 15 percent of the total time of exposure, with extremes, in the 15,000 p.p.m. suspension, as low as 3 percent. 3. Reduction in turbidity of the medium was followed immediately by increase of shell movement in both duration and amplitude, returning to 100 percent when the turbidity became the same as that of the control.

When silt suspended in very turbid sea water was allowed to settle and deposit upon the oysters so as to cover them, it was found that the animals responded immediately by cessation of shell movement for 16 to 19 hours. Later, with irregular movements, they attempted to reopen their shells in an effort to get rid of the silt. Oysters recovered if the silt deposited upon their shells did not remain for more than 2 days. If the deposition remained on the oysters beyond 3 days the animals died.

SIDNEY C. HSIAO

EFFECT OF PHOSPHATE MINING ON GROUND WATER ON ANGAUR ISLAND, PALAU

Rock phosphate has been mined on Angaur in the Palau Group since 1903, first by the Germans, between the wars by the Japanese, and recently by a Japanese company set up under the Army command in Tokyo. Mining was resumed soon after the end of the Pacific war to provide phosphate urgently needed for Japanese agriculture. Angaur has an area of 3 square miles and effective mining requires excavation below sea level. Resulting ponds and lakes at sea level are found to affect adversely the ground water lens resulting from the 115-inch annual rainfall, and the native people, despite royalty payments, have increasingly questioned the wisdom of action that could possibly lead to serious future damage.

Protests to the office of the Trust Territory have led to conferences between the Army and the Navy, and the writers were appointed as a joint hydrologic team to survey existing and probable future damage to water supply and agricultural land. From our 9-day survey it appears that there has been an increase in salinity of some lakes and ground water in the northwestern third of the island and that such increase will continue unless remedial measures are taken. The stability of the fresh ground water in the southeastern and larger sector indicates that rainfall is sufficient to maintain a functional fresh Ghyben-Herzberg lens where suitable rock structure exists. It was recommended that the mining operations be permitted to continue on condition that a program of hydrologic observation be set up and that extensive backfilling and subdividing of lakes be commenced in an effort to retard, and perhaps reverse, the increase in salinity due to the mining. It is impossible to say categorically how much remedy can be achieved, but it is believed that this course offers the best prospect and that in any event some very valuable gains in understanding of fresh-water–salt-water relations in small islands can be made.

CHESTER K. WENTWORTH, ARNOLD C. MASON, AND DAN A. DAVIS

MARINE BIOLOGICAL STATIONS IN NORTH AMERICA

Presidential address 1950, by ROBERT W. HIATT

Reporting an 8-month trip, during which he visited some 55 centers of marine biological investigation in North America, Dr. Hiatt traced the history and trend of scientific work being done. Twenty-three of the stations were located on the Atlantic coast, 9 on the Gulf of Mexico, and 23 along the Pacific coast.

Outstanding were the institutions at Woods Hole, Massachusetts; La Jolla and Pacific Grove, California; Friday Harbor, Washington; and Nanaimo, Vancouver Island. The setting and facilities of these and several others were described and illustrated with Kodachrome slides.

The trend was noted from early emphasis on taxonomy to present-day problems of physiology and experimental fields. International aspects of fishing and other marine biology were discussed.

It was stated that 70 species of fish yield some two million pounds of commercial product. Concerning 30 of these species we have little or no scientific knowledge; there is some knowledge about one-third; and only one-sixth are known at all well, after 90 years of investigation.

New tools for fishery research—the bathythermograph, high speed plankton net, methods of age determination, statistical analysis, and oceanographic data —were discussed.

More funds seemed to be available for oyster research than for all other fishery studies combined. Many of these funds came from oil and paper pulp companies, in connection with lawsuits involving millions of dollars.

The contrast was noted between the amounts being spent annually by Federal agencies for fisheries research (24 cents per capita), agricultural research ($6.66 per capita), and national defense ($132 per capita).

NECROLOGY

G. H. W. BARNHART

George H. W. Barnhart, sugar technologist and engineer, died in the Queen's Hospital, February 17, 1950, following a brief illness.

He was born in Honolulu, August 8, 1892, and educated at McKinley High School and the College of Hawaii. After graduating with the class of 1914, he returned for 2 years of graduate study in chemistry and sugar technology. During this period he served as instructor in engineering.

A position as assistant mill engineer with the Hawaiian Sugar Co., Makaweli, Kauai, was interrupted by a call to service in World War I. Commissioned a second lieutenant at Schofield Barracks, he was assigned to command the S.A.T.C. unit at the College of Hawaii and, later, units at Schofield.

He joined the sugar technology department of American Factors in 1919 and continued in their employ as an engineer, punctuated by periods of teaching sugar house engineering at the University of Hawaii, from which he received the degree of Master of Science in 1921.

J. N. S. WILLIAMS

John Norman Spencer Williams, retired construction engineer, died February 11, 1950, at the age of 92.

Born in Cowbridge, South Wales, May 11, 1857, he accompanied his parents to Canada as a child and was apprenticed to a New Brunswick engineering firm. He came to Hawaii in 1886 as a representative of the Risdon Iron Works of San Francisco. He became manager of the Union Iron Works of Honolulu in 1890, and, later as engineer for the Honolulu Iron Works, he designed sugar mills at Ewa, Olaa, and Puunene. He went to Cuba in 1893, but returned in 1898, becoming active in sugar and other engineering enterprises, including the Hawaiian Commercial and Sugar Co., Kahului Railway, and Theo. H. Davies and Co.

"Retired" in 1931, he interested himself in sugar chemistry, specializing in uses for cane cellulose. This led to his association, as an official and director, with Hawaiian Cane Products Co., manufacturer of wallboard made from sugar cane fiber. In 1943, at the age of 86, he earned a Master of Science degree at the University of Hawaii. He was active in scientific, professional, and fraternal organizations.

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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE...

TWENTY-SIXTH ANNUAL MEETING 1950–1951

Published by the University of Hawaii — Honolulu, Hawaii, 1951

FOREWORD

The year began with a membership of 304. Nineteen new members were elected at the fall meeting and 35 at the spring meeting. Nine members resigned, 24 were dropped, and 3 were lost through death. The present membership is 322, largest in the history of the Academy.

Seventeen scientific papers were presented at the meetings held November 30, December 1, and May 10 and 11 (one by title only). At the request of the University of Otago, New Zealand, the Percy Smith medal was presented to Dr. Peter H. Buck for outstanding work in Pacific anthropology.

The Academy, with the material assistance of the Secretariat of the Pacific Science Council, sponsored the Hawaii Symposium on Scientific Research in the Pacific on March 9 and 10. This was attended by about 130 of the leading scientists of the Hawaiian Islands. After hearing addresses and reports of current research being carried on by institutions and organizations represented in Hawaii, 11 committees met and presented more than 150 recommendations. The Proceedings of the Symposium are summarized in this publication.

Because of illness, President Auchter was not able to be present at the Symposium or the spring session. His place was taken by Vice-President L. D. Baver, who presided over these two series of meetings and also presented the annual address, entitled "Science versus Phobias."

OFFICERS

1950-1951

President, E. C. Auchter
Vice-President, L. D. Baver
Secretary-Treasurer, E. H. Bryan, Jr.
Councilor (2 years), Harry L. Arnold, Jr.
Councilor (1 year), A. J. Mangelsdorf
Councilor (1 year), Robert W. Hiatt (ex officio)

1951-1952

President, L. D. Baver
Vice-President, Harry L. Arnold, Jr.
Secretary-Treasurer, E. H. Bryan, Jr.
Councilor (2 years), J. H. Beaumont
Councilor (1 year), Andrew W. Lind
Councilor (1 year), E. C. Auchter (ex officio)

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE."

THE 26th ANNUAL MEETING 1950-51

Program

NOVEMBER 30, 1950

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Doak C. Cox: The Makaweli Depression of Kauai—A Graben.

Sam Naiditch and Herrick L. Johnston: A Differential Microadsorption Apparatus.

Harold L. Lyon: What Habitat Will the Spotted Deer Choose if Liberated on the Island of Hawaii?

DECEMBER 1, 1950

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R. H. Simpson: Meteorological Aspects of the Great Pacific Haze of June, 1950.

Leonard Mason, Robert W. Hiatt, and Doak C. Cox: The Arno Atoll Project.

Chester K. Wentworth: Mauna Loa Eruption of June, 1950.

MAY 10, 1951

Ruth Ann Aust: Contributions to Physical Therapy from Analysis of Yoga Technique.

Reed A. Gray: Composition of Honeydew Excreted by Pineapple Mealybugs (*Pseudococcus brevipes* Ckll.) as Determined by Paper Chromatography and Radioautography.

Masaru Nakata and Sam Naiditch: Further Investigations of the Physical and Chemical Behavior of the Vortex Tube.

Doak C. Cox and Walter H. Munk: Analysis of Tidal Fluctuation in Basal Ground-water Bodies.

MAY 11, 1951

George W. T. C. Chu and John L. Pelgen: The Presence of a Marine Schistosome in Hawaii.

P. B. van Weel: Degeneration and Regeneration in the Tropical Fresh-water Sponge, *Spongilla proliferens* Annand.

Sidney C. Hsiao: Embryonic Chemical Heterauxesis in Some Poeciliids.

R. H. Simpson: Some Peculiarities of Kona Storm Development and Behavior.

MAY 12, 1951

Annual Dinner

Business Meeting

Installation of Officers

Address of Retiring President, L. C. Auchter, delivered by L. D. Baver: Science versus Phobias.

Abstracts

HURRICANE HIKI—A CLIMATIC CURIOSITY

During the third week of August, 1950, the Hawaiian Islands came under the influence of a tropical cyclone of full hurricane force, the first in nearly 50 years of meteorological record in this area. As the first such storm, it was christened "ABLE" in the phonetic alphabet, which in the Hawaiian language is "HIKI," and became widely known as Hawaiian Hurricane Hiki.

In evaluating the factors which led to the development of this storm, so unusual for these meridians, the importance of warm sea-surface temperatures to the development and maintenance of hurricane intensity in a tropical storm, as stressed by Palmèn, must be considered. During the summer, sea-surface temperatures between Hawaii and the Mainland are characterized by a tongue of cool water which protrudes equatorward, east of Hawaii. This tongue of cool water is believed to be of importance in segregating the tropical cyclogenetical regions off the west coast of Central America from that area to the south and west of Hawaii, and tends to shelter the Hawaiian Islands from frequent onslaught of dangerous tropical storms.

It is argued that, should the recently discovered trend of warming in polar regions continue in equal magnitude during the next 50 years, this protective tongue of cool water between Hawaii and the Mainland may recede sufficiently, in connection with the subsequent readjustment of ocean currents, to remove one barrier which protects Hawaii from westward-moving tropical cyclones.

R. H. SIMPSON

THE MAKAWELI DEPRESSION OF KAUAI—A GRABEN

The Makaweli depression is defined as the triangular area lower than the surrounding terrain, bounded on the west by the west wall of Waimea Valley and on the northeast by a southwest-facing scarp crossed by tributaries to the Waimea River from Koiae Stream to Olokele Stream. It is shown to be a graben or down-faulted area, partly filled by flows of the Waimea Canyon series, and not, in the main, a partly filled erosional valley.

The west fault is indicated by the discordant course of the Waimea River that flows south, where streams consequent on the flanks should flow west and southwest. The course of the Waimea might be explained by displacement caused by flows from a course along an early caldera fault that controls the position of Waiahulu Stream and that disappears under later flows in the Makaweli depression. However, the sections across the depression provided by the Waimea tributaries indicate the filling of an already existing, wide depression, instead of a valley being simultaneously widened westward, except at the extreme western edge.

The northeast fault is indicated by the straightness of the buried part of the northeast scarp. There are no buried valleys entering the depression as tributaries to the Waimea, as there would certainly have been if the scarp had been the wall of an erosional valley.

The fault origin is further suggested by the presence of a few dikes cutting the talus buried along the west scarp, numerous dikes cutting the clinkery flows that poured over the northeast scarp, and feeding vents that contributed to the fill of the graben. Except for these dikes along the margins, there are no dikes in the fill of the graben.

The fault origin is also borne out by the petrographic picture. The bulk of the graben fill appears to be more closely related to the Waimea Canyon series that makes up the main part of the Kauai dome than to the post-erosional Koloa series. No evidence of an erosion interval in Waimea Canyon time sufficient to permit the carving of the depression is indicated elsewhere on Kauai. There are in the depression a few dense columnar flows, typical of the post-erosional Koloa series, but these are definitely limited to terraces in the Olokele–Makaweli, Kahana, and upper Waimea Valleys that cut the fill of the main depressions. In Makaweli Valley these columnar flows rest on coarse gravels also confined to the valleys.

The history of the Makaweli area may be summarized as follows:

1. Growth of the southwest flank of Kauai dome by accretion of successive Waimea Canyon flows.
2. Faulting on the caldera fault along Waiahulu Stream, with downthrow to the north.
3. Filling of the caldera by Waimea Canyon flows, probably in part synchronously with faulting, probably to overflow in the Makaweli area.
4. Graben faulting, forming the triangular Makaweli depression.
5. Partial fill of the graben by Waimea Canyon flows pouring over the northeast scarp from vents farther north and also by flows from vents along the northeast fault, with thin intercalated gravels near the northeast edge of the depression and thick talus along the west scarp.
6. Erosion of valleys essentially to present shape.
7. Partial fill of Olokele–Makaweli, Kahana, and Waimea Valleys by flows of Koloa series.
8. Re-excavation of valleys by erosion, leaving only terraces of the Koloa fills.

DOAK C. COX

A DIFFERENTIAL MICRO-ADSORPTION APPARATUS

Gas adsorption studies were undertaken to find out whether the surface forces of normal tin are different from those of superconducting tin and to establish the order of magnitude of such difference if any is found. Helium was used as the adsorbate since (1) it is the only gas with a sufficiently high vapor pressure to be practical with the techniques used; and (2) the helium-helium interactions in the adsorbed film are sufficiently weak so that the adsorption isotherms should be sensitive to small changes in solid-gas interactions.

In carrying out this program, two experimental approaches were used, namely, (1) the determination and comparison of the separate complete adsorption isotherms of helium on both normal and superconducting tin powder with a Pease-type apparatus; and (2) the investigation of the relative adsorption of helium on tin in the two states of the metal with a differential apparatus. A magnetic field was used to cause the transition from superconducting to normal tin. A differential method is advantageous since comparisons of adsorption can thus be made on a single sample of solid in two different states with identical submicroscopic surfaces at the same temperature. After admitting helium gas to the system, the equilibrium pressure above the superconducting tin is recorded. Then a magnetic field is applied to destroy the superconductivity, and the new equilibrium pressure is measured. After correcting for the effect of the magnetic field on the pressure of the helium in the cell, any remaining difference might be attributed to the difference in surface forces in the two states of the tin powder.

The use of an external magnetic field to destroy superconductivity precludes the use of the gravimetric adsorption techniques such as the quartz spiral balance. Initial experiments were carried out with a modified Pease-type volumetric apparatus. Highest sensitivity of the adsorption apparatus is necessary with low pressures when the amount of helium adsorbed is considerably less than a monolayer, since, under these conditions, co-operative interactions between the adsorbed helium atoms are at a minimum. The differential sensitivity and accuracy of the Pease-type apparatus at 2°K with half a monolayer of adsorbed helium was of the order of 10 per cent. No differences were established between normal and superconducting tin under these conditions. In order to increase sensitivity from about 1 part in 10 to 1 part in 1,000 the apparatus was modified considerably.

Micropirani gauges at liquid-air temperatures were used, rather than mercury manometers or McLeod gauges, in order to (1) reduce the dead volume of the manometer; (2) avoid the introduction of mercury vapor into the adsorption cell; (3) eliminate small fluctuations in the volume of the apparatus due to fluctuations in the mercury levels in the manometers; and (4) obtain a high sensitivity to small changes in pressure at low pressures.

The capillary connecting the adsorption cell with the system outside the helium bath was fitted with a Dewar in order to maintain a constant thermal gradient in this capillary even though the liquid-helium constant-temperature bath level changed considerably during the experiment.

A gas pipette system was substituted for the conventional mercury gas burette. This pipette operates without mercury. The volume, temperature, and initial pressures were kept constant during a run, only the residual pipette pressure varied. By reducing the number of operating pipette variables to one, considerable simplification resulted both in experimental work and in subsequent computations.

SAM NAIDITCH AND
HERRICK L. JOHNSTON

WHAT HABITAT WILL THE SPOTTED DEER CHOOSE IF LIBERATED ON THE ISLAND OF HAWAII

On May 23, 1950, the Territorial Board of Commissioners of Agriculture and Forestry (hereinafter referred to as the Board), by a majority vote, adopted a game-development program which included the liberation of a herd of axis deer (spotted deer) in the vicinity of Pohakuloa on the island of Hawaii. This action of the Board was promptly and vigorously objected to by so many people in these Islands and on the Mainland that, at its meeting on June 29, the Board decided to "defer action on this matter for further consideration at some other time." This does not mean that the Board abandoned its plan to put the deer on Hawaii. It did not delete this project from the program which it adopted May 23; it merely placed the matter in suspense. Since the Board is going to give "action on the matter further consideration," the public should do likewise.

The axis deer is native to India and Ceylon. The best authorities on this deer tell us that in India it dwells in the low-lying, hot, forest jungles, not venturing above 4,000 feet elevation. The Board initiated a study of the axis deer on Molokai and learned that the deer do not venture much, if any, above 3,000 feet elevation. The only wet forest remaining on Molokai lies above 3,000 feet elevation and, because the axis deer on Molokai do not roam in this forest, the Board would have us believe that these deer would not enter the wet forests below 3,000 feet on Hawaii.

Four of man's domesticated animals—cattle, goats, sheep, and swine—were allowed to run wild on the island of Hawaii, and, during the years, they have wrought such enormous damage to the native forests on the island's watersheds that now Hawaii suffers sometimes from water shortages and sometimes from floods. In recent years the cattle have been confined within prescribed boundaries, but the goats, sheep, and pigs still roam at large and continue their depredations. The goats choose the dry and semi-dry regions which provide their natural habitat. The sheep seek, and confine themselves to, their natural habitat, which is the sparsely forested areas at the higher elevations on the mountains. Both the goats and the sheep shun the wet forests at the lower elevations. The pigs do not limit their depredations to any particular habitat but range not only the wet forests, but also the habitats of both the sheep and the goats.

Now, the Board proposes to turn loose on the island of Hawaii another forest-destroying animal, the axis deer. These deer will not compete with the goats in their habitat nor with the sheep in theirs, but will promptly invade the low-lying wet forests which afford their natural habitat.

HAROLD L. LYON

SOME IMPLICATIONS IN RAINFALL FREQUENCY DISTRIBUTIONS IN HAWAII CONCERNING LARGE-SCALE CIRCULATION PATTERNS IN THE PACIFIC

By constructing daily rainfall frequency distributions for each of the months of the year, a relationship becomes apparent between the seasonal variation in storm frequency and the sizes of rains experienced in various climatic zones in Hawaii.

Relationships can also be shown between the frequency of light trade-wind rainfall and the persistence of trade winds in summer. The annual march of average monthly rainfall amounts, which is observed for very wet stations throughout the Territory, exhibits three maxima and three minima. By combining the greater frequency of trade-wind showers in summer with the greater intensity of storm rainfall in winter, an explanation is given for the complicated character of these annual march curves.

W. A. MORDY AND C. K. STIDD

METEOROLOGICAL ASPECTS OF THE GREAT PACIFIC HAZE OF JUNE, 1950

During the second and third weeks of June, a curious, dry haze reduced visibility over vast areas of the north Pacific between latitudes 10° and 30°. Streaks of this haze extended from 1,500 miles east-southeast of Hawaii, westward to a point 500 miles north of Guam. Visibilities were lowered to 1 mile at many stations and occurred with remarkable suddenness in some places, such as Wake Island, where visibility fell from greater than 20 miles to 2½ miles in less than 1 hour.

While the most obvious source of haze particles was the volcano Mauna Loa, which was in active eruption during this period, several factors were present which made it difficult to attribute the entire effect to the volcano. These were: (1) no reduction in visibility was reported from any station during the first 7 days of the eruption; and (2) the haze, reported at great distances east of Hawaii, could have reached that area from the volcano only by means of an extensive clockwise loop movement that would have carried it first northwest, then north as far as the 45th parallel.

In an attempt to trace the source of haze particles, whose diameters were of the order of 0.2 microns, and which filled the air with more than 500 times the normal number of suspended particles, air trajectories were computed in reverse from each station affected, beginning with the time visibility first lowered, and working backward in search of plausible sources. This was done for the gradient level (2,500 feet), 10,000 feet, and 18,000 feet. These three levels were considered because the volcano produced two sources of effluent. One source was along the rift, 10,000 to 12,000 feet above the trade-wind inversion. The other, below the trade-wind inversion, combined fumes and ash from the flowing lava with pulverized lava particles and atomized sea water, produced by the explosive action which occurred as aa lava flowed into the sea. These trajectories indicated that (1) the air reaching Wake at the time visibility first lowered had a high-level source over Japan and low- and intermediate-level sources from the east, no horizontal current of which had its origin at or near the volcano; and (2) air reaching stations in Hawaii on the day they were first affected by haze had a low-level source in southern California and a high-level source near the volcano after describing a mammoth 8,000-mile clockwise loop over the northeastern Pacific.

It is concluded, therefore, that (1) the transport of volcanic materials was the prime source of haze; (2) a secondary source may have been provided by dust from deserts in southern California; (3) haze particles experienced considerable vertical transport while being scattered horizontally; and (4) concentrations of the material were maintained by gently converging streams of air which followed paths somewhat to the left of the trajectory required of a parcel which conserves its absolute vorticity.

R. H. SIMPSON

THE ARNO ATOLL PROJECT

The Arno Atoll project was the culmination of ideas first set forth at the Pacific Science Conference held in Washington, D. C., in 1946, and later made Project E.6., The Economic Development of Coral Islands, in the recommendations of the Economic Development Committee of the Research Council of the South Pacific Commission in 1949. By a grant of funds from the Office of Naval Research, through the Pacific Science Board of the National Research Council, the present project was organized and the field work was completed during the summer months of 1950. Co-operating agencies were the Department of the Navy, Military Air Transport Service, the Civil Administration of the Trust Territory of the Pacific Islands, and the various universities which supplied personnel and equipment. Project outlines for the various scientific disciplines included in this survey were formulated around the general theme—the human carrying capacity of an atoll. Members of the scientific staff from Cornell University were J. W. Wells and Donald Squires, Geology, and Earl Stone, Soils and Agriculture; from Arizona, Joe T. Marshall, Vertebrate Zoology; from the University of California, Robert Usinger, Entomology; from the University of Hawaii, Leonard Mason and John Tobin, Anthropology, Gerald Wade, Geography, Robert W. Hiatt and Donald Strasburg, Marine Zoology; and from the Hawaiian Sugar Planters' Association Experiment Station, Doak C. Cox, Hydrology. The results of the integrated study will appear in a volume on Arno Atoll and in suitable technical journals.

LEONARD MASON, ROBERT W. HIATT, AND DOAK C. COX

MAUNA LOA ERUPTION OF JUNE, 1950

This paper consisted chiefly of the showing of moving pictures taken from an airplane by Mr. and Mrs. James Humpert. The pictures were of the source part of the eruption during the early morning of June 2, continuing down the flow, and of the west coast of Hawaii on the afternoon of the same day, with a narrative by Mr. Humpert.

The flank eruption of Mauna Loa, which had been expected since the summit eruption of January, 1949, broke out on the evening of June 1, 1950, along a rift above and below 12,000 feet. About an hour later the chief activity had been transferred to between 8,000 and 10,000 feet elevation, on the southwest rift zone. About 2 hours after its first appearance, the northern flow from the lower vent had crossed the main Kona Road at Hookena and, ½ hour later, had reached the sea. Soon afterward, in the early morning of June 2, a new flow started down the mountainside, crossed the highway about 5:00 A.M., and entered the sea just after noon. Meanwhile, about midnight, a new flow had started from the lower line of fissures between 7,500 and 9,000 feet, crossed the road about 4 miles south of the previous flow about 2:00 P.M. on June 2, and reached the sea at 3:30 P.M. There were other, smaller lava tongues, but this latter one accounted for nearly half of the total volume left on land and probably more than half of an estimated 100 million cubic yards which entered the sea. The total is estimated by Macdonald and Finch as more than 600 million cubic yards, probably somewhat greater than the 1859 Mauna Loa flow and, hence, the greatest during the 150 years of recorded history.

Despite the sparseness of settlement on the west slope of Mauna Loa, there was considerable property damage, and several dwellings were destroyed. The capacity of the lava flows to cross the highway and reach the sea at more than one point in a few hours from vents 15 miles away was impressive and emphasizes the continued importance of preparedness and remedial measures. The large and small eruptions of the past century indicate a rate of growth of the upper part of Mauna Loa comparable to the rate of about 10 feet per century in the 30,000 years since the last glacial epoch suggested by the meager geologic evidence. We cannot say that the volcanic activity of Mauna Loa is either increasing or decreasing, as viewed during the historical period.

CHESTER K. WENTWORTH

CONTRIBUTIONS TO PHYSICAL THERAPY FROM ANALYSIS OF YOGA TECHNIQUE

Prepared by the secretary.
Author's abstract not available.

The East-West Philosophers' Conference, held in Honolulu in 1949, provided opportunity for a comparison between yoga and physical therapy, and for ascertaining what the latter could learn from this Indian philosophy. Stages in progress for yogi include (1) motivation, the relinquishing of worldly desires; (2) being in rapport with the teacher (guru); (3) the rapport of the guru with the pupil, desire to help; (4) development of insight, confidence, and peace of mind; (5) establishment of emotional disciplines, purging the mind; and (6) muscle–mind disciplines.

An analysis of Hindu yoga showed a similarity to Western psychology. It indicated that physical therapy had much to learn from yoga, especially in the following: (1) The relationship between patient and physician, (2) peace of mind of the patient, and (3) emotional control in muscle training. The polio patient, particularly, could profit by fixing the mind to achieve muscular control.

RUTH ANN AUST

COMPOSITION OF HONEYDEW EXCRETED BY PINEAPPLE MEALYBUGS (*PSEUDOCOCCUS BREVIPES* CKLL.) AS DETERMINED BY PAPER CHROMATOGRAPHY AND RADIOAUTOGRAPHY

The general view that plant-sucking insects, which excrete copious quantities of excess carbohydrates in their honeydew, must take in large amounts of plant juice in order to get sufficient amounts of amino acids and proteins was not found to be the case with pineapple mealybugs. Relatively large amounts of as high as 19 different amino acids and amides have been found in the honeydew excreted by pineapple mealybugs

(*Pseudococcus brevipes* Ckll.), by the method of paper chromatography. The number of amino acids excreted was shown to increase with the period of feeding by the bugs. The amino components of the honeydew, which have been identified from their R_f values, are cystine, aspartic acid, glutamic acid, serine, glycine, asparagine, threonine, alanine, glutamine, tyrosine, tryptophane, valine, phenylalanine, histidine, and proline.

At least five amino acids were found in the honeydew which were not found in the food source. There may be a relationship between the presence of certain amino acids in the excretion and symbionts within the bugs as well as between the presence of certain amino acids and the toxicity of the bugs.

The carbohydrate components were identified by different sprays and radiograms of honeydew excreted by mealybugs while feeding on a radioactive pineapple leaf. The leaf was made radioactive by allowing it to photosynthesize in an atmosphere of $C^{14}O_2$. The compounds identified are fructose, glucose, sucrose, glucose-1-phosphate, and possibly maltose. A new spray test was found for identifying ketose sugars.

Malic acid, citric acid, and salts of citric acid were also found in the honeydew.

REED A. GRAY

FURTHER INVESTIGATIONS OF THE PHYSICAL AND CHEMICAL BEHAVIOR OF THE VORTEX TUBE

A series of studies was undertaken to improve the efficiency of thermal separation of the Ranque-Hilsch tube and to explore the applicability of this device to the separation of chemical mixtures. Johnson reported negative results on the chemical separation of air, using the vortex tube. Improvement in the thermal separation was undertaken, as it appeared likely that conditions for good thermal separation might be closely associated with those for chemical separation.

Results that are comparable to those of Hilsch were obtained for the thermal study. However, it was found that diaphragm shape influenced thermal separations. Typical results for air at 50 psi are shown below:

Diaphragm	Difference between temperatures of hot and cold tubes (°C.)	
	no throttling	*throttling*
Concave surface projecting into vortex chamber	45	81
Convex surface projecting into vortex chamber	43	76
Flat	51	96
Concave surface projecting away from vortex chamber	59	104
Convex surface projecting away from vortex chamber	61	102

Chemical separation studies were made with carbon dioxide–argon mixtures, using a differential method of analysis of the outgoing gases. Measurements were made with a thermal conductivity unit which was calibrated against a volumetric gas analyzer. With the mixture at 50 psi and no throttling, the following results were obtained:

Input gas composition, mol fraction of carbon dioxide	Difference in composition between hot and cold sides, mol fraction of carbon dioxide	Difference in chemical separation factors between hot and cold sides
0.947	0.0053	0.106
0.880	0.012	0.114

If we let r_c denote the chemical separation factor of argon on the cold side and r_h that on the hot side, it follows that, for the foregoing results,

either 1.106 is not less than r_c is not less than 1.053 or 0.947 is not less than r_h is not less than 0.894 and

either 1.114 is not less than r_c is not less than 1.057 or 0.943 is not less than r_h is not less than 0.886.

The separation factor thus exceeds that for diffusion alone, since the separation factor for Graham's Law is 1.050. The carbon dioxide content in the hot gas was increased.

Note added in proof: Elser and Hoch have carried out a striking series of studies. Their results correspond to $r_c = 1.033$ for oxygen in air. This is of the same magnitude as our results, although it is smaller than the Graham's Law separation factor of 1.068. Similarly, for carbon dioxide in air, their results are of the order of $r_c = 1.09$, compared to the Graham's Law value of 1.23. The facts that our separation factor exceeds that for diffusion alone, and that the argon, rather than the carbon dioxide, was enriched on the cold side both appear to be incompatible with the theory presented in their paper.

MASARU NAKATA AND SAM NAIDITCH

ANALYSIS OF TIDAL FLUCTUATION IN BASAL GROUND-WATER BODIES

Tidal fluctuation is often noted in basal ground-water bodies whose discharge is controlled by sea level. Computation of mean water levels indicative of climatic or draft changes requires analysis of the tidal fluctuation.

The ground-water tides may be correlated with ocean tides if the semidiurnal and diurnal tidal components are separated by harmonic analysis, and if the lags and damping of each component are analyzed separately. For either component:

$$\delta w - \delta o = \log_e \frac{A_o}{A_w}$$

where $\delta w - \delta o$ = phase lag between ocean and well in radians.

A_o/A_w = ratio of amplitude at ocean to amplitude at well.

The phase lags of different components are inversely proportional to the square root of the periods of the components, and a single constant, describing the difference between the tides at a well and those in the ocean, may be computed from any component and from either phase lags or damping ratios:

$$C = \sqrt{\tau/\pi}\,(\delta_w - \delta_o) = \sqrt{\tau/\pi}\,\log_e (A_o/A_w)$$

where C = tidal difference constant, with the dimensions of $\sqrt{\tau}$.

τ = the period of the tidal component.

For a simple, ideal case, considering an unconfined ground-water body in a shallow aquifer underlain by an impermeable layer, and assuming instantaneous vertical transmission of pressure, as would be the case if the boundary between aquifer and ocean were vertical:

$$C = x\sqrt{\frac{f}{kd} \cdot \frac{\mu}{\rho g}}$$

where x = distance from shore
f = porosity of aquifer
k = coefficient of permeability
d = depth of aquifer
μ = viscosity of water
ρ = density of water
g = acceleration of gravity

Theoretical application to other more realistic cases has not yet been made.

The analysis is presented in its present stage of development because it already has valuable uses: (1) Computation of mean water-table altitudes from single measurements of the water-table altitude for wells whose tidal difference constants are known, at any time when ocean tides are known; computation of a static level with tidal fluctuations from a given mean static level, as a base from which to measure drawdown; (2) computation of long-period tidal fluctuations to permit separating them from long-period fluctuations originating from draft or climate changes; (3) analysis of relative permeability through comparison of tidal difference constants.

It is hoped that the theory may be extended to provide a better tie between the tidal difference constants, distances from the shore, and permeabilities.

DOAK C. COX AND
WALTER H. MUNK

THE PRESENCE OF A MARINE SCHISTOSOME IN HAWAII

Marine snails, identified as *Littorina pintado* Wood, were collected from Bird Island (Moku Manu) near Kaneohe on November 24, 1950, and found infected with a species of schistosome. This same species of schistosome was also found recently in *L. pintado* snails obtained from Rabbit Island (Manana), near Waimanalo, Oahu. Both of these islands are Bird Reserve areas where a large number of sea birds of such common species as the sooty terns, wedge-tailed shearwaters, etc., nest and aggregate. (Acknowledgment is made to Mr. Wray Harris, marine malacologist, of Bishop Museum, Honolulu, Hawaii, for the identification of the snail intermediate host.)

In studying the anatomy of this schistosome, the mean measurements in millimeters of 50 specimens show that the sizes for the various structures are: body length, 0.248; width of body, 0.091; length of head organ, 0.088; length of tail stem, 0.203; length of furca, 0.109; diameter of ventral sucker, 0.029; and distance from ventral sucker to posterior end of body, 0.087. Although these measurements are at variance with the schistosome cercariae described by Penner (1950), we believe there is no significant anatomical structure which would show the schistosome cercariae found in Hawaii to be of a different species. Therefore, we tentatively identified these schistosome specimens as *Cercaria littorinalinae* Penner 1950 until we know the morphology of the adults.

That the cercariae are of the dermatitis-producing type was confirmed by the experimental infections of five human volunteers. A double layer of cotton gauze, cut to approximately 2 cm. x 1½ cm. was saturated with 80–100 cercariae in sea water. This piece of cotton gauze was then placed on the forearm of a volunteer. In all five patch-tested individuals, the sensation of itching was experienced. Two produced typical schistosome dermatitis lesions, two had erythema around the points of entrance, and one individual was not reactive.

Normal human serums (77.8 per cent of 54 specimens), after inactivation at 56°C. for 30 minutes, had the power in low titers (1–2 to 1–8) to form agglutinates with the individuals of this marine schistosome cercaria in vitro at room temperature. Inactivated serums, when guinea pig complement was added to each in the proportion of 1–10, also showed a precipitin reaction around the tail as well as on the body. Certain fresh human serums, without previous inactivation, developed the precipitin reaction in similar ways. Investigations are now in progress to study the immunological relationship, if any, involved in the formation of precipitates or agglutinates by *C. littorinalinae* in human and animal serums.

GEORGE W. T. C. CHU AND
JOHN L. PELGEN

DEGENERATION AND REGENERATION IN THE TROPICAL FRESH-WATER SPONGE, *SPONGILLA PROLIFERENS* ANNAND

Because degeneration and regeneration are normal physiological processes in sponges, neither process can be considered separately from the other. The sponge reacts under unfavourable conditions by degenerating totally, but, at the same time, it forms gemmules from which new sponges will develop as soon as conditions grow better, thus starting regeneration at the same time degeneration sets in. In *Spongilla proliferens,* contrary to the claims made in other species, no special or specific cells play a part in either of these processes. In fact, this sponge has very few different cell types with which to perform all life processes.

Degeneration starts with the formation of protein reserve material — oval-shaped, strongly eosinophile bodies in the phagocytes. Many of these cells and a few amoebocytes form cell packets, or immature gemmules, at the base of the sponge. The next stage is a rapid degeneration of the epithelium of the flagellated chambers. The resulting cell debris is invaded by protozoa and phagocytes of the sponge, which phagocytize this amorphous mass. Following this stage, the cells of the sponge, not participating in the formation of gemmules, clump together and degenerate, so that eventually only naked spicules and gemmules remain.

In the meantime, scleroblasts gather around the young gemmule and start producing a wall of spicules. After finishing this wall, they secrete a thin layer of spongin and then die. The gemmules themselves produce a thicker spongy layer at the inner side of the spicule wall.

Small wounds are healed by the normal cells of the sponges moving toward the wounds. Closing of a wound is characterized by the formation of a bud which may remain but often disappears after a few weeks.

P. B. VAN WEEL

EMBRYONIC CHEMICAL HETERAUXESIS IN SOME POECILIIDS

This is a report on the heterauxesis of chemical entities during the embryonic development of several species of poeciliids collected in Honolulu. Growing ova (from 0.1 mm. to maximum size attained at maturity) were analyzed for protein, using the submicro Kjeldahl nitrogen estimation method, and for total lipids, and the data so obtained were correlated with diameters of the ova and with dry weights. There is a constant ratio between total protein and dry weight during the period when the ova grow to half their maximum size. After that, there is a rapid increase in the deposition of lipoid substances, and the ratio assumes another value. After fertilization there is a further increase in size of the ovarian follicles, indicating continued growth by the uptake of material from maternal source. The total protein laid down in the mature ovum cannot account for all the protein in the embryo at parturition. Lipids are used at a later stage of the gestation period.

SIDNEY C. HSIAO

SOME PECULIARITIES OF KONA STORM DEVELOPMENT AND BEHAVIOR

A study of 76 kona storms which occurred over a 20-year period has revealed two sources of development for this subtropical cyclone of the central Pacific. One source is in connection with the occlusion of a frontal wave cyclone whose northward movement is blocked and the source of cold air cut off by an anticyclone moving rapidly eastward. When this occurs, the occluded cyclone becomes circular, frontal discontinuities disappear, and the central cold vortex is encircled by warm tropical air. This vortex, which becomes the nucleus of the kona storm, is associated with widespread cloudiness, heavy rains, and squally winds, all of which increase outward from the cyclone center and reach a maximum some 200 to 500 miles east of the low-pressure center.

A secondary source of kona storm development is through cyclogenesis in the trade-wind easterlies. This is associated with a pre-existing cyclone in the upper troposphere which intensifies and extends its counterclockwise circulation earthward to the surface.

The movement, subsequent intensification, and behavior of kona cyclones—like most cold lows—is erratic, but distinguished by marked tendencies to move westward for considerable distances before dying or recurving northward.

The ultimate stages of development of the kona cyclone depend upon the environment which its meandering path may provide. This path usually leads to a new source of cold air which favors frontogenesis and allows the low center to reintensify as a wave cyclone. In some instances, however, the kona cyclone may develop the characteristics of a tropical cyclone, in which strongest winds and heaviest rains are very near the center. In this case the storm is more violent and has the eye characteristics of a tropical storm. This development occurs, apparently, from an impetus in the upper troposphere which causes isallobaric convergence of tropical air about the cold low of the cyclone. This intrusion of the rain-laden currents of tropical air causes release of large quantities of latent heat of condensation near the low center. This results in a reversal of horizontal temperatures as the core of the lower vortex becomes warmer than its surroundings. As this transformation is completed, the surface currents which converge upon the storm center rise and are slung centrifugally outward from the vortex and circulate in a kinetic energy-releasing sense, which could not be realized as long as the core of the cyclone was cold. This provides energy for rapid intensification of the storm. A detailed analysis was made of such a kona storm which affected Oahu in March, 1951, and whose structure illustrates these principles.

The kona storm is a significant feature of subtropical circulations in both Atlantic and Pacific Oceans, though it occurs less frequently in the Atlantic. It is a cyclone uniquely intermediate between the well-known wave cyclone of extratropical origin and the tropical cyclone and should be properly identified as a *subtropical* cyclone.

R. H. SIMPSON

SCIENCE VERSUS PHOBIAS

Presidential address, 1951.

During recent years there has been an epidemic of phobias, especially in the field of agriculture. The scientist is motivated by the search for facts; the phobist, probably, by the urge to get into the public eye faster by disguising half truths as whole truths.

Some examples of agricultural phobias include: (1) "Plowman's folly"—the belief that vegetables will grow better without plowing; (2) the desirability of having large numbers of earthworms in the soil; (3) organic versus natural products such as fertilizers; and (4) "hidden-hungeritis," the notion that crops grown on worn-out soil are not fit to eat.

Regarding the fourth it was noted that, if there is sufficient fertility in the soil to produce a crop, this will have adequate food value for the users. One way to judge soil is to note how the weeds grow. Nowadays a man can care for soil deficiencies. Clay soils may have more minerals, but, with careful management, sandy soil can be made to produce good crops. The formula for successful productivity is soil plus weather plus *man.* Lowbrow plants can become highbrow plants through man's care. Poverty usually precedes poor nutrition. These and other similar phobias were discussed.

L. D. BAVER

RESOLUTIONS

The following resolutions were moved and adopted unanimously at the annual meeting of the Hawaiian Academy of Science, May 12, 1951.

RESOLVED, That the Resolutions adopted by the Hawaii Symposium on Scientific Research in the Pacific, sponsored by the Hawaiian Academy of Science, March 9 and 10, 1951, be adopted as recommendations of the Academy; and be it further

RESOLVED, That the Pacific Science Council Secretariat be invited and authorized to draw to the attention of appropriate agencies, through the Pacific Science Association's established channels of communication, resolutions that may be of concern outside Hawaii; and be it further

RESOLVED, That the Hawaiian Academy of Science express its thanks to the Secretariat of the Pacific Science Council, Pacific Science Association, for its aid in organizing and conducting the Hawaii Symposium on Scientific Research in the Pacific, and that the Academy compliment the Secretariat on so effectively fulfilling one of its terms of reference in thus assisting Pacific scientists.

NECROLOGY

JOHN F. EMBREE

John F. Embree was born in New Haven, Connecticut, August 26, 1908, the son of Dr. Edwin R. Embree, authority on the Far East and President of the Julius Rosenwald Fund. John Embree received degrees from the University of Hawaii (A.B., 1931), University of Toronto (M.A., 1934), and University of Chicago (Ph.D. in Anthropology, 1937). He returned to Hawaii in 1937 as research associate and (1940–41) assistant professor of anthropology. Interested in the acculturation of ethnic groups, he made a study of a Japanese village, Suye Mura, and then of people of Japanese ancestry in Kona, Hawaii. Returning to Toronto (1941–42) he applied his knowledge of the Japanese to wartime intelligence—for the Office of Strategic Services (1942), the War Relocation Authority (1942–43), and as head of Japanese area studies at the Civil Affairs Training School in Chicago (1943–45). He was associate professor of anthropology at the University of Hawaii (1945–47) and in 1947 he was the first cultural relations attaché to the U. S. legation in Thailand. In 1948 he became associate professor of sociology and Southeast Asia studies at Yale University and, in July, 1950, director of Southeast Asia studies. His untimely death occurred on December 22, 1950, through an automobile accident. Dr. Embree was a research associate of Bernice P. Bishop Museum and an adviser to various other scientific organizations, such as the National Research Council, the Council of Learned Societies, and the Social Science Research Council. As a consultant for the Foreign Economic Administration, he advised on problems of Micronesian administration. His many studies are reported in numerous scientific papers. Anthropology has lost a promising authority on the peoples and cultures of East Asia and the Pacific in his passing. (For a tribute to his work, see *American Anthropologist* 53 (3): 376–382, 1951.)

VERN HINKLEY

Vern Hinkley, journalist, was born in Sioux City, Iowa, July 12, 1892. He was graduated from Cornell College (Mt. Vernon, Iowa) in 1915. He came to Hawaii in March, 1922, to join the staff of the *Honolulu Star-Bulletin.* He edited the *Hilo Tribune-Herald* from 1924 to 1926, but returned to the *Star-Bulletin,* becoming City Editor in 1927, a position he held until shortly before his death. Mr. Hinkley was interested in various branches of natural science, but particularly in volcano research. He died on January 7, 1951.

HORACE JOHNSON

Horace Johnson, retired engineer, died on August 20, 1950. He was born at Newburyport, Massachusetts, August 12, 1878, educated in the public schools of Massachusetts and in Abilene (Kansas) high school, and graduated from the Massachusetts Institute of Technology. He came to Hawaii in 1900 to accept the position of chemist at the Waialua plantation. In 1911 he went to Pepeekeo Sugar Company and the following year became supervising chemist of all plantations represented by C. Brewer and Company. In 1915 he became a vice-president of that organization and also a director of the Onomea, Pepeekeo, Honomu, Hilo, Wailuku, and Waimanalo plantations. He retired from C. Brewer and Company on September 1, 1934. One of Mr. Johnson's outstanding contributions to sugar technology was the designing of the mill at the Waimanalo plantation. After retiring from active service, he was executive secretary of the Hawaiian Agricultural Advisory Committee and a member of the Civil Service Commission and other civic bodies, the Hawaiian Sugar Technologists' Association, and various clubs.

MEMBERSHIP

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Kepner, Richard D.
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Kirch, William
Klinkman, M. Helena
Kirschman, H. D.
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Krauss, F. G.
Krauss, N. L. H.
Kunesh, J. F.

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Lam, Robert L.
Lamb, Alvin R.
Larrabee, L. M.
Larsen, Nils P.
Larsen, Norma
Larson, Harry W.
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Levine, Max
Lind, Andrew W.
Livesay, T. M.
Lohman, Marion L.
Look, William C.
Lord, Edith
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Loucks, Ruth B.
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Louis, Lucille
Lum, C. K.
Lyon, Harold L.
Lyon, Mrs. H. L.

McCarthy, Harold
McCleery, Walter L.
McGuire, Thos. R. L.
McMorrow, Bernard J.
Macdonald, Gordon A.
Magistad, O. C.
Manchester, C. A., Jr.
Mangelsdorf, A. J.
Maroney, Verna B.
Martin, Joseph P.
Mason, Leonard
Matthews, Donald C.
Mau, Kong Tong
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Miller, Carey D.
Miller, Robert C.
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Mitchell, Wallace C.
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Moir, William W. G.
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Mottl, Joseph R.
Moulton, Margaret

Naiditch, Sam
Nakamoto, Goichi
Nakamura, W. T.
Nakeo, Harry
Natsui, Dorothy
Naughton, John J.
Neal, Marie C.
Newell, Irwin
Nickerson, Thomas
Nightingale, Gordon T.
Nishida, Toshiyuki
Nishimura, Earl
Nitta, Doris
Nordfeldt, Sam
Nutting, Lewis M.

Okimoto, Marion C.
Okubo, Shigeo
Orr, Kathryn J.

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Puth, Mabelle J.

Rhead, Clifton C.
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Rosenberg, Morton M.
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St. John, Harold
Sakimura, Kay
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Schmidt, Carl T.
Schmidt, Helen D.
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Scott, Arlen M.
Seeley, Delos A.
Sekiguchi, Nao
Sette, Oscar E.
Sherk, Kenneth W.
Sherman, G. Donald
Sherman, Martin
Shigeura, Gordon T.
Sideris, C. P.
Sidwell, A. P.
Simpson, Robert H.
Sinclair, Gregg M.
Slattery, Mabel
Smith, Elbert G.
Smith, Madorah
Smith, R. Q.
Spalding, P. E.
Spiegelberg, Carl H.
Spitzer, Blanch H.
Springer, Doris
Sterns, Marjorie
Stewart, William S.
Stidd, C. K.
Stokes, J. F. G.
Storey, William B.
Suehiro, Amy
Suzuki, F. T.
Swezey, O. H.
Sykes, Walter E.

Takahashi, David
Takahashi, Makoto
Takazawa, Futoshi
Tanimoto, Ralph H.
Tanimoto, Tyrus T.
Taylor, A. R.
Taylor, Keith L.
Tester, Albert L.
Thorne, M. D.
Titcomb, Margaret
Tucker, Leo W.
Tuthill, Leonard

Umeda, Rose M.
Urata, Rokuro

Vaksvik, K. N.
Van den Bosch, Robert
van Weel, Pieter
Van Zwaluwenburg, R. H.
Vernon, Mabel D.
Vinacke, W. Edgar
Vinacke, Winifred R.
Voorhees, George

Wadsworth, Harold A.
Wakai, Ted Y.
Walder, Leopold
Wallace, George C.
Wallace, Keith K.
Warner, H. H.
Watson, Leslie J.
Weatherbee, Carl
Wedge, Bryant
Weller, D. M.
Wentworth, Chester K.
Wentworth, Juliette
White, J. Warren
Wilbar, Chas. L.
Wismer, Chester A.
Withington, Paul
Wolford, J. J.
Wong, Arthur G. H.

Yamanaga, George
Yanagihara, Iichi
Yee, Phillip K. H.
Yoshioka, Tad T.
Young, Hong Yap

Zeitlin, Harry
Zimmerman, E. C.
Zoebisch, Oscar C.

HAWAII SYMPOSIUM ON SCIENTIFIC RESEARCH IN THE PACIFIC

Honolulu, Hawaii . . . . March 9–10, 1951

Sponsored by THE HAWAIIAN ACADEMY OF SCIENCE
Assisted by THE PACIFIC SCIENCE COUNCIL SECRETARIAT

INTRODUCTION

Invitations were sent out by President E. C. Auchter (and, after his departure for the mainland United States, by the Secretary of the Academy) to about 90 persons living in the Hawaiian Islands, interested in applied science, to take part in the proposed symposium. A chairman was selected and appointed for each of 11 committees into which the applied sciences were divided. Additional invitations were sent, at the suggestion of these chairmen and others, until a total of nearly 150 persons had been invited to participate. These invitations were not confined to members of the Academy and, in a few instances, went to persons outside the Territory of Hawaii, who were expected to be in Honolulu at about the time of the meetings.

Mimeographed summaries of background data were prepared by the Pacific Science Council Secretariat and distributed to those invited to participate. These summaries included specific recommendations of the seven Pacific Science Congresses, the Bishop Museum, the South Pacific Commission, and the Pacific Science Conference sponsored by the National Research Council and held in Washington, D.C., June 6–8, 1946. An agenda was prepared by the chairman of each of the 11 committees, and copies of these, together with the program of the opening meeting and a list of 137 participants, were distributed.

The program was presented as scheduled, with a few changes, made necessary by the absence of two of the speakers and the addition of another. Dr. L. D. Baver, vice-president of the Academy, presided. The opening session was held in the seminar room of the Pineapple Research Institute. Summaries of the addresses and reports presented at this opening session are printed herein.

The committees met Friday afternoon and Saturday morning in various rooms on or near the University of Hawaii campus. Summaries of their deliberations are given below.

The group as a whole reassembled in the seminar room of the Pineapple Research Institute at 3:00 P.M., Saturday, May 10, to hear the reports of the committees. Copies of most of these reports were mimeographed, through the help of volunteer workers, and distributed prior to their presentation. These recommendations, as adopted, with slight editorial changes made in the interests of uniformity, are printed below.

Verbatim recordings of the Friday morning and Saturday afternoon meetings were made with Gray Autograph Sound Writing equipment on Flexograph discs, through the courtesy of Fisher Corporation, Ltd., of Honolulu. Photographs of the opening session and of some of the committee groups were made by the University of Hawaii.

The Academy is grateful to the Pineapple Research Institute, the University of Hawaii, the Pacific Oceanic Fishery Investigations, and the Institute of Pacific Relations for providing meeting places and other facilities.

The help of Loring G. Hudson, executive secretary, and Miss Brenda Bishop, of the Pacific Science Council Secretariat, is gratefully acknowledged. They carried out their objective of co-operating with other scientific groups seeking to advance knowledge concerning the Pacific area, in a most efficient and helpful manner.

EDWIN H. BRYAN, JR.,
Secretary-Treasurer.

Program

FRIDAY, MARCH 9, 9:00 A.M. Opening meeting, Seminar Room, Pineapple Research Institute.

ADDRESSES

L. D. Baver, Chairman.

Peter H. Buck, Director, Bernice P. Bishop Museum.

K. C. Leebrick, Vice-President, University of Hawaii and Alternate Commissioner for the United States for the South Pacific Commission.

Harold J. Coolidge, Executive Secretary, Pacific Science Board.

Loring G. Hudson, Executive Secretary, Pacific Science Board Secretariat.

MESSAGE

From B. M. Gonzalez, President, Eighth Pacific Science Congress.

RESEARCH REPORTS

C. A. Manchester, Jr., Chairman, Research Committee, University of Hawaii.

H. A. Wadsworth, Dean, College of Agriculture and Director, University of Hawaii Agricultural Experiment Station.

J. L. Collins, Pineapple Research Institute.

Colin G. Lennox, President, Territory of Hawaii Board of Agriculture and Forestry.

Walter Sykes, Soil Conservation Service, U.S. Department of Agriculture.

Otto L. Burton, Captain, Medical Corps, U.S. Navy.

O. E. Sette, Director, Pacific Oceanic Fishery Investigations, Fish and Wildlife Service, U.S. Department of the Interior.

Max H. Carson, Chief Hydrographer, Territory of Hawaii Division of Hydrography and U.S. Geological Survey.

R. H. Simpson, Officer in Charge, U.S. Weather Bureau, Pacific Projects. (Presented by Charles Woffinden.)

H. M. Mayo, Staff Agriculturist, Trust Territory, Pacific Islands.

L. D. Baver, Director, Experiment Station, Hawaiian Sugar Planters' Association.

Frank R. Oberhansley, Superintendent, Hawaii National Park.

FRIDAY, MARCH 9, 1:30 P.M. Committee meetings.

SATURDAY, MARCH 10, 9:00 A.M. Committee meetings.

SATURDAY, MARCH 10, 3:00 P.M. Combined committees' co-ordinating session to receive committee reports and recommendations and to adopt symposium resolutions; L. D. Baver, presiding.

ABSTRACTS

Addresses

ADDRESS OF WELCOME

In welcoming the delegates to the symposium, Dr. Baver said that the symposium program will deal with research phases in the islands which have implications throughout the Pacific.

We regret that Dr. E. C. Auchter, President of the Academy, who has been so active in planning the symposium, is unable to be present and to preside.

Research is that tool by which we find the facts of the case. Nearly every problem of any area, to be solved, needs basic information. For example, we need a better picture of the original culture of peoples in the Pacific area and of methods by which this culture may be preserved. We need basic data that can guide us in the conservation of the resources we have, both natural and human, in order to build a modern economy. We need to gather sociological facts to improve the standards of living of these peoples.

The world moves as a result of conflict between man and nature. This conflict is necessary if we are to have any kind of sociological environment in which people can carry on even the most primitive type of life. Man wants food, shelter, wealth, recreation. In order to obtain these, he takes or destroys natural resources. We must help man to conserve as well as to take. Natural resources also include climate, soil, and life in the sea.

The job of this symposium is to establish facts which will help man to satisfy his needs, develop areas, and at the same time preserve what is worth preserving. In building up a modern economy in the Pacific, we should not destroy either the culture or the resources that have come to us from the past.

Man's livelihood on the earth is influenced by the evolution of his ideas and by his ability to make progress. All progress is based upon facts. We will become stalemated if we have no new information on which to build an economy. We hope that the various committees that have been appointed as a part of the symposium will incorporate this idea in their considerations.

L. D. BAVER

BERNICE P. BISHOP MUSEUM

What we need today is more co-operation between the sciences, so they can come together in a symposium such as this, to add to the general building up of science and knowledge. During the coral atoll symposium we gathered a wealth of information from a number of people who one might think would have little or no interest in coral atolls.

Natural science and anthropology were not built up by abstract thought. They were built upon the study of material things. It is impossible for an individual to make all the needed collections. This has to be done by a number of people, and there must exist museums and other institutions which will bring together and care for these material things.

Scientific progress has been made possible in Hawaii by various institutions—university, museum, experiment stations, research organizations—which are established here.

Pacific investigations can be achieved best through co-operation between students of the different sciences. The Bishop Museum is able and willing to care for collections which are assembled. It is open to you all. We are happy to help you, and you can help us by telling us what we lack and by helping us to fill the gaps.

In New Zealand, spring planting was a co-operative undertaking; everybody helped—commoners, warriors, chiefs, women, even the children. Theirs was a form of symposium. The coming of spring was announced by the Song of the Cuckoo which ended with the command, "Koia (dig)!"

PETER H. BUCK

SOUTH PACIFIC COMMISSION

The South Pacific Commission is an advisory and consultative body set up by the six governments which administer non-self-governing territories in the South Pacific region. Its purpose is to advise the member governments on means of promoting the well-being of the peoples of these territories—their social and economic development and their health. The expenses are borne by the six governments according to fixed proportions.

The Commission seeks, as far as possible, to carry out its purposes, aims, and functions by advising and encouraging activities of the local administrations rather than by doing for these territories what they can do more directly for themselves. It deals chiefly with problems of common interest which can be undertaken better by regional co-operation. It has concentrated upon a number of clearly defined problems that show promise of early results, and it will use its international character to spread knowledge of the results achieved by other institutions.

The following are fields for co-operative effort through the Commission: (1) Partnership enterprises, such as epidemiological information, advice on vocational training, plant introduction projects, and quarantine measures, between territories that otherwise would be separated by national boundaries; (2) interchange of information; (3) projects, such as illiteracy, marketing problems, and help to atoll dwellers, so area-wide and so far from solution that effort on a common basis is justified; and (4) pilot or experimental projects, such as community development.

The Research Council meets yearly to draw up a work program. This is approved and financed by the 12 Commissioners. Projects in operation or to be undertaken during 1951 are: 9 on health, 13 on economic development, and 13 on social development.

K. C. LEEBRICK

PACIFIC SCIENCE BOARD

The Pacific Science Board is a regional committee of the National Research Council, with 11 members, a number of consultants, and 6 standing committees. It was established, as a result of the Pacific Science Conference held in Washington, D.C., in 1946, to aid scientists of America who wish to engage in scientific investigations for which there is a need in the Pacific area, to advise governmental and other agencies on scientific matters pertaining to the Pacific, and to further international co-operation in the field of Pacific science.

These objectives have been carried out during the past 4 years. The principal activities have been: (1) co-operation with the Department of the Navy, with the help of funds granted by the Office of Naval Research, in carrying out scientific investigations primarily in the islands of the Trust Territory. These have included CIMA, SIM, and ICCM, which last has become ICCP (Invertebrate Consultants Committee for the Pacific) which has advised on problems of pest control and quarantine, and sponsored an insect survey of Micronesia; (2) organization of United States participation in the Seventh Pacific Science Congress, New Zealand, 1949; (3) organization of an Alaskan Science Conference; (4) participation in five international conferences; (5) establishment of co-operation with foreign scientists; (6) advising the Department of the Army on problems in the Ryukyus; (7) co-operation with international agencies; and (8) development of a 5-year program of fundamental ecological research on coral atolls, commencing work on Arno Atoll, Marshall Islands. In many of these activities the Board has received valuable and welcome help from scientists in Hawaii.

The future of scientific work in the Pacific will depend upon: (1) the development of increasingly active international co-operation in research, aided greatly by the Pacific Science Congresses and the Secretariat which has been established in Honolulu; (2) an ever-increasing flow of American scientists and research funds into Pacific areas; and (3) aiding these by the establishment in Honolulu of a center for Pacific scientific research, and supporting the great and widely respected scientific institutions of Hawaii.

HAROLD J. COOLIDGE

SECRETARIAT, PACIFIC SCIENCE COUNCIL

One of the instructions laid down by the Seventh Pacific Science Congress in establishing this international Secretariat was that it assists scientists. This symposium provides an excellent opportunity for just such assistance. Bringing together scientific workers in various fields and facilitating free flow of scientific information among workers are services that come well within the terms of reference of the Secretariat.

The permanent Secretariat was opened in March, 1950, with offices at the Bishop Museum, which is the Pacific Science Association's representative institution for Hawaii. There are two officials, Miss Brenda Bishop and myself. Financial support for 2 years has come from UNESCO, the Rockefeller Foundation, the Coolidge Foundation, the Government of France, and Hawaii's own McInerny Foundation.

The Secretariat is established to: (1) assist governments, institutions, and individuals, as well as standing committees of the Pacific Science Association, in the implementation of resolutions and recommendations adopted by Pacific Science Congresses; (2) serve as a central office for the Pacific Science Council, especially during the intervening periods between Congresses; (3) serve as an information dissemination center in Pacific science matters; (4) assist in maintaining a continuity in the relationship between the Pacific Science Association and such international bodies as the specialized agencies of the United Nations and the South Pacific Commission.

Carrying out plans and instructions of the Seventh Pacific Science Congress, the Secretariat has: (1) inspired the formation of the Conservation Council for Hawaii; (2) laid plans for establishing a Public Health Information Center; (3) arranged with UNESCO Field Science Cooperation office to assist scientists passing through Honolulu on their way from one country to another; (4) undertaken to produce nine information bulletins a year; (5) commenced a file on current research in the Pacific; and (6) summarized data on expeditions in the Pacific since 1900, with maps.

Through the Pacific Science Association's established channels, the Secretariat is in a position to act as a means of liaison for furthering co-operation among scientists in different disciplines and in different territories.

LORING G. HUDSON

MESSAGE TO HAWAIIAN ACADEMY OF SCIENCE

(Published in full.)

In the name of the National Research Council of the Philippines and the organizers of the Eighth Pacific Science Congress, I send greetings to the Hawaiian Academy of Science on the occasion of its symposium on scientific research in the Pacific.

The example set by Hawaii in promoting general community welfare has set a pace for other nations to emulate. It is indicative of a commonly observable fact that leadership does not necessarily lie in size or in numbers. The broad outlook and the friendly attitude toward other nations, which dominate Hawaiian thought, have influenced the life of other nations of the Pacific. Examples of this are the Pacific Science Congresses which Hawaii started modestly in August, 1920, and which, through the last three decades, have become a potent influence for healthy growth and development in the material and the scientific, through the altruistic, constructive, and friendly approach to national problems among the countries bordering the Pacific. We recognize the contagious example set by Hawaii.

We, the organizers of the Eighth Pacific Science Congress, which we hope to convene in Manila and Quezon City in the Philippines during the months of October and November, 1953, extend our hearty congratulations to the Hawaiian Academy of Science for demonstrating once more its active interest in promoting scientific research in the Pacific and wish it every success in its endeavors. We also hope that in its deliberations it will have in mind the larger scope and interests of the Eighth Pacific Science Congress and will pass on to us, by way of suggestions, any significant ideas or plans that might develop in the course of the discussions in the present symposium.

B. M. GONZALEZ

Research Reports

UNIVERSITY OF HAWAII RESEARCH

In order to encourage faculty research, the University of Hawaii grants reductions of one-quarter to three-quarter time from the normal teaching load of 12 hours and allots funds for research. Two members of the Stenographic Pool devote full time to research typing. Research is especially encouraged in the area of Pacific studies.

To further the program, a Research Committee has been appointed which has the duties and responsibilities of (1) advising the Dean of Faculties regarding teaching-load reductions and the allotment of funds; (2) advising the Publications Office regarding research studies proposed for publication; (3) maintaining a file of faculty research projects completed; (4) making available to the faculty information regarding fellowships and financial aids to research; and (5) advising the President and University Senate of the general research policies of the University.

The committee recommended reductions in teaching load for 18 faculty members for the academic year 1949–50 and for 24 in 1950–51. Twenty-eight members of the faculty reported the completion of one or more research projects during the academic year 1949–50. This report was not entirely complete, so was not included in the total completed.

During the same year the Stenographic Pool typed all or parts of 8 books and 35 papers.

During 1949–50, the Research Committee approved the expenditure of $2,156. The bulk of this was for the Arno Atoll Research Project in which five members of the University participated.

The departments reported research projects completed as follows:

Art, 6	Geography, 3	English, 1
Zoology, 6	Bacteriology, 2	Chemistry, 1
Anthropology, 4	Mathematics, 1	Geology, 1
Botany, 4	Sociology, 1	

C. A. MANCHESTER

HAWAII AGRICULTURAL EXPERIMENT STATION

The College of Agriculture, with a program of teaching, extension, and research, enjoys one-third of the appropriations made to the University of Hawaii and lists among its personnel one-third of the University's employees.

Lately, our teaching program has been directed toward training in tropical crop production, the better to fit young people for jobs in the tropics of the Pacific area.

In the Extension Service, we have nine island sections manned by Extension Agents and Home Demonstration Agents. These people are drawn upon frequently for temporary service in other parts of the Pacific area, such as the Philippines, Okinawa, and the Trust Territory.

In the Agricultural Experiment Station, we have 13 departments, ranging from agricultural economics to vegetable crop production. In addition we have experimental stations and substations, one on the islands of Hawaii and Maui and two on Oahu.

A program is being started to analyze in our nutrition laboratory food samples collected by a qualified nutritionist in Pacific islands under American administration. We are also doing what we can to bolster the single exportable crop—copra—of the Trust Territory.

H. A. WADSWORTH

PINEAPPLE RESEARCH INSTITUTE

The commercial growing and canning of pineapples in Hawaii started in the early days of this century. Expansion of the industry made experimental studies necessary. The present Pineapple Research Institute, supported co-operatively by the pineapple companies of Hawaii, is the product of this growth and evolution. The headquarters, comprising administrative offices, research laboratories, and a specialized library are located adjacent to the University of Hawaii. Part of the field experimentation is conducted on a 90-acre farm at Wahiawa, equipped with offices, laboratories, glass and lath houses, and farming machinery. Other experimental studies are carried out in plantation fields in co-operation with the companies.

Both applied and basic research is performed. Basic research in the biology of the pineapple is necessary and important as without it the applied function eventually would become sterile and stagnant. For most mainland agricultural crops there are a number of state and federal institutions throughout the country where fundamental research studies are conducted. Pineapples do not share this source of basic research.

Some of the problems now under study concern (1) the control of diseases and pests which adversely influence production or quality, (2) the regulation of plant and fruit growth through the use of plant-growth hormones, (3) more efficient and economical control of weeds through the use of specially adapted chemical herbicides, (4) crop improvement through plant selection or roguing, and (5) the development of new varieties having resistance to major diseases through crossbreeding with wild resistant species and with other varieties.

Other studies include the improvement of soil management, development of new and more efficient farm machinery, the relation of meteorological conditions to plant growth, and the development of new and more efficient means of soil fumigation. Basic studies are continuing on these subjects in order to improve methods of crop production. These researches are directed by a staff of 30 scientists in the departments of Agricultural Engineering, Entomology, Genetics, Plant Chemistry, Plant Physiology, Plant Pathology, Soils, and Meteorology. Frequently two or more of these eight departments work together on a single problem.

The results of applied studies are made available to the Hawaiian pineapple industry in the form of special reports. Results of fundamental or basic studies which are of general scientific interest are published in appropriate technical journals.

J. L. COLLINS

TERRITORIAL BOARD OF AGRICULTURE AND FORESTRY

The work of the Board of Agriculture and Forestry is primarily one of managing and protecting certain of the resources of the Territory, as it is authorized to do by law. Research is incidental to these activities. Some of it is fundamental, but most of it is applied. The Board is supported by territorial appropriations augmented by federal funds.

The work of the Board is done through a number of independent divisions: (1) Animal Industry seeks to safeguard the animal health of the Territory and to supervise sanitary work as it relates to animals. A bacteriological pathology laboratory is maintained for research on animal diseases, but in the main the findings of national and international research are applied to the local situation. (2) Entomology is set up primarily to control pests that enter the Islands and to guard against further introductions through an inspection service. Natural enemies are introduced and some fundamental research performed. (3) Fish and Game administers the fish and game laws and advises on matters of conservation and utilization. A fair amount of fundamental research is carried on, but research is mainly applied. One objective is the production of a better huntable surplus of birds and animals. To do this, fundamental research in better management is necessary, largely supported by federal appropriations. (4) The primary job of the Forestry division is the proper management and protection of the forest reserve system that has been set up to safeguard the water supply of the Territory. Studies are made of exotic trees in relation to Hawaiian environments (particularly cover for watersheds), but little work is done in actual use of forest products other than water. (5) A division concerned with the marketing of agricultural crops does applied research in establishing standards on which to enforce laws relating to the protection of agricultural crops.

COLIN G. LENNOX

SOIL CONSERVATION SERVICE, U.S. DEPARTMENT OF AGRICULTURE

"The use of every acre of agricultural land in accordance with its capabilities, and the treatment of every acre in accordance with its needs" are the basic objectives of the Soil Conservation Service.

This requires a soil survey. To make this survey we must send soil scientists into the field to map the nature and depth of the soil, its texture and permeability, underlying materials, slope, degree of erosion, and possibly such other factors as wetness, salinity, and frequency of overflow. From this survey we prepare technical recommendations which we call the conservation farm plan. We look to the Hawaii Agricultural Experiment Station for assistance in research.

The work of the Soil Conservation Service is done almost entirely in co-operation with soil conservation districts, which are set up by state or territorial law. Those of the Territory of Hawaii were set up in 1947. The Hawaii soil conservation committee is composed of the president of the Board of Agriculture and Forestry (chairman), the director of the Agricultural Experiment Station, and the director of the Extension Service. In Hawaii there are eight soil conservation districts; one on Maui, one on Molokai, three on Oahu, and three on Hawaii. There is none at present on Kauai. Any agreements with farmers concerning work which is voluntary on their part are entirely between the District governing body—a board of five directors—and the individual farmer. The District determines priority of work. The Honolulu office passes on the technical soundness of the job to be done on the individual farms and provides technicians for the surveys. A fine degree of co-operation between agencies and scientists exists in the Territory of Hawaii.

WALTER SYKES

MEDICAL PROGRAM IN THE TRUST TERRITORY

The Navy's Health Service policy for the Trust Territory, as originally conceived, embraced four programs: (1) Preventive medicine and public health, (2) medical and dental care, (3) native training, and (4) stimulation of research.

Before an effective long-range public health program could be established, it was necessary to conduct a health and sanitation survey of the Trust Territory. Such a survey has been conducted by the ship *Whidbey* for 2½ years and should be completed this June (1951). Appropriate health and vital statistics are being collected. There are some 50,000 natives; approximately 30,000 had been examined by the end of 1950. Most of them have been immunized for smallpox, typhoid, and tetanus. The principal existing diseases appear to be tuberculosis, yaws, intestinal parasites, filariasis, and leprosy.

Provisions have been made for the reporting of preventable diseases.

Medical and dental care and hospital facilities are available at dispensaries at Koror, Saipan, Truk, Ponape, and Majuro, and a subdispensary at Yap. Outlying islands have small dispensaries manned by health aides or nurse's aides, who are capable of giving simple medical care. Medical field teams from the district dispensaries, designated to act on the findings of the *Whidbey,* spend 2 to 3 weeks on visits to outer islands. Patients requiring hospital care are sent back to district dispensaries.

Health aides and nurse's aides are given 3 to 9 months training in sanitation and first aid at the dispensaries. Three professional training schools were in operation by the Navy on Guam: School for Medical Assistants (38 students, December 1, 1950), School for Dental Assistants (28 students), both offering a 4-year course, and School for Nursing (43 students), a 3-year course. The first two were deactivated February 15, 1951, the students being transferred to Suva, Fiji.

Research programs are in the making as more medical statistics become available. Special studies are being made in the treatment of filariasis with hetrozan, and a research project on the use of streptomycin in the treatment of leprosy has been in progress since November, 1949.

Dental examinations show fairly good dental conditions among younger natives; older natives show evidence of poor mouth hygiene.

OTTO L. BURTON

PACIFIC OCEANIC FISHERY INVESTIGATIONS

Interest in the research and development of the central Pacific Ocean, generated in Hawaii and on the West Coast, led to passage in 1947 by the Congress of the United States of Public Law 329, "The Farrington Act." Under this Act, implemented by necessary appropriations, the mission of the Pacific Oceanic Fishery Investigations of the United States Fish and Wildlife Service is to explore and investigate the potentialities for large-scale commercial high-seas fisheries in the Hawaiian Islands, Samoa, Guam and the Trust Territory, and intervening waters.

Not all this vast area nor all the fishes can be studied at once. Initially we are concentrating on the yellowfin tuna or *ahi* and the skipjack or *aku* in the area directly south of the Hawaiian archipelago to about 5 degrees south of the equator. Our problem is to determine areas of concentration and seasonal or other shifts and fluctuations. These probably are governed by the system of ocean currents, so our research must include oceanography. The habits and reactions of tunas are bound up with peculiarities of life histories and feeding requirements. Our work also includes exploratory and experimental fishing on a semi-commercial scale.

Equipment for performing our mission includes a newly built laboratory on the University of Hawaii campus, a vessel docking site at Pearl Harbor, one combination oceanographic and fishing research vessel, and two exploratory and experimental fishing vessels. Our staff, including the crews of the vessels, currently numbers 90 persons.

During our first year of operations we have found that the productivity of the sea and the abundance of tuna is greatest in the zone lying between 1 and 7 degrees north latitude where a current system of some complexity exists and draws to the surface from underlying reservoirs nutrient salts which in turn give rise to plankton growth on which small fishes and invertebrates can subsist and in turn furnish fodder for the tunas. Similar updrafts of nutrient materials appear to occur near islands, atolls, and reefs. The habits and reactions of tuna in the area differ sufficiently from those along the American coast so that new methods of taking these fish in commercial quantities must be developed.

It is planned to survey the more westerly areas, out through the Trust Territory, before engaging intensively on gear-developing phases of the problem.

OSCAR E. SETTE

U. S. GEOLOGICAL SURVEY

The Geological Survey came to Hawaii in 1909 and started a program of measuring surface waters and streams of the Territory and of getting records of artesian wells. At about the same time, the Survey started mapping the Islands. Topographic maps, with contours, of all the Hawaiian Islands were completed in 1930. Last year a revision of the topographic maps by photogrammetric processes was commenced.

A survey of the general areal geology with respect to ground water of the entire Territory is nearly completed. Another activity of the Geological Survey in Hawaii has been volcanology, continuing the work started by Dr. T. A. Jaggar.

In the Pacific, outside the Territory of Hawaii, very little has been done by regular branches of the Geological Survey. During the war the necessities of the military resulted in the organization of a Section of Military Geology. At present they are co-operating with the Far East Command Headquarters at Tokyo, and a general and rather detailed survey of the islands of the Trust Territory and Guam is being undertaken. Some of the islands have been fairly well covered. The ground-water branch of the Survey has placed a geologist on Guam to study the ground water there, and another is starting to make a ground-water survey of the Trust Territory. Surface-water work has not been done outside the Hawaiian Islands, except for a few attempts to make estimates on very inadequate data. The Survey is doing geophysical work in the Marshall Islands, which is now classified.

MAX H. CARSON

U. S. WEATHER BUREAU

Research in the Pacific area by the Weather Bureau is and will continue to be directed primarily toward problems in general meteorology. In the Hawaiian area, research is carried on in co-operation with the Pineapple Research Institute and the Hawaiian Sugar Planters' Association.

While the principal focus of attention has been on rainfall distribution and forecasting, research efforts have been directed more recently toward the general circulation of the atmosphere. Special attention is being given to circulations in the upper troposphere, with broad application to tropical meteorology in general.

Studies are being planned for forecast improvement which will attempt to develop successful methods of 5-day trend forecasts for Hawaii. Special projects include the installation of (1) an automatic radio weather station at the Pali (Oahu) for use in studying the relation between variation in the trade-wind inversion and rainfall on the Koolaus, (2) automatic weather stations at the summit of Mauna Loa (Hawaii), including instrumentation for studying wind gustiness, microstructure of pressure waves, and atmospheric radiations, and (3) an automatic radio weather station at Mt. Waialeale (Kauai) in co-operation with the U. S. Geological Survey.

R. H. SIMPSON

TRUST TERRITORY OF THE PACIFIC ISLANDS

A comprehensive program planned for agriculture in the Trust Territory has been handicapped by lack of personnel and finances. With the co-operation of the Navy, we are carrying on the program originally instituted in these islands by the Foreign Economic Administration in 1944 and 1945 and continued by the U. S. Commercial Company. A growing program is progressing satisfactorily, and, with the transfer from the Navy to the Department of Interior, we hope to continue all these projects and others still in the planning stage. The latter include a ramie project on Saipan and one on abaca on Ponape. The cacao project is as yet not really underway but is being investigated with the help of Dr. George Bowman from Costa Rica, who is enthusiastic about the possibilities for cacao production in the Trust Territory. There are no visible signs of serious diseases or pests of this crop in the Ponape area where a start will be made, beneath the Metalanum coconut groves. Ramie and abaca are products that will stand shipping and long-period storage. Processing the product must be kept comparatively simple and within the range of ability of the native people.

A poultry project is fairly well underway at Truk, where selected varieties and strains of chickens are being bred to help rehabilitate the poultry industry.

The co-ordination of agriculture and education is being planned in conjunction with Commander Taylor and the educational group. Unless these are co-ordinated, agriculture will be bound by customs and traditions of the native people. The co-operation between these two groups has been excellent and we are also most appreciative of help received from the University of Hawaii, the Hawaiian Sugar Planters' Experiment Station, and other institutions here in Hawaii.

H. M. MAYO

HAWAIIAN SUGAR PLANTERS' EXPERIMENT STATION

Our organization was set up in 1895. Since the cessation of fundamental work of the Java station at Pasuruan, we are probably the only sugar research station in the world doing fundamental research in conjunction with applied research.

This experiment station has the following departments: (1) Agricultural Engineering, concerned with mechanical harvesting of cane and fertilization and tillage practices, at the Agricultural Engineering Institute maintained jointly with the University of Hawaii and Pineapple Research Institute; (2) Agronomy, concerned with such projects as irrigation, fertilization, rat control, control of weeds by chemicals, and soil improvement and conservation; (3) Chemistry, primarily concerned with chemicals to control weeds and with soil and plant analysis preparatory to making fertilizer recommendations; (4) Climatology, concerned with means for measuring radiation and with the relationship of other climatological factors to sugar-cane growth; (5) Entomology, interested in the control of insect pests, chiefly through biological control; (6) Experimental Statistics, handling the planning and analyzing of our experimental work; (7) Genetics, responsible for cane breeding and the development of new varieties of sugar cane; (8) Geology, responsible for locating water for cane irrigation; (9) Meteorology, concerned with research leading to better short-time forecasts that can be used in plantation operations, in co-operation with the Pineapple Research Institute; (10) Pathology, responsible for the control of sugar-cane diseases, at present by developing disease-resistant varieties, in co-operation with the Department of Genetics; (11) Physiology and Biochemistry, concerned with such fundamental work as control of tasseling, use of radioactive isotopes in the nutrition of the cane plant, and the effect of temperature on cane physiology; (12) Sugar Technology, concerned with milling problems, such as those of molasses and the clarification of cane juices; (13) Personnel Training, in both agriculture and factory engineering, giving young college graduates a 2-year program to prepare them for plantation operation.

The Station has representatives and substations on each sugar-cane-producing island. A library of over 30,000 volumes is open to researchers. The staff at the main Experiment Station numbers over 100 persons.

Much public service is done. A spectroscope, set up for the chemistry and agronomy departments, is widely used for such work as determining the amount of sodium in poi. A weekly tour and discussion of research activities is given for tourists and other visitors.

L. D. BAVER

NATIONAL PARK SERVICE

Objectives of this Service are: (1) to preserve, or restore as far as possible, the flora and fauna in their natural and undisturbed state in all park areas, and (2) to provide opportunities for the people to understand and enjoy the higher values of the plant and animal life of the park areas. This implies (3) the major objective, which is to secure a thorough knowledge of the flora and fauna of national parks and monuments through research.

With reference to non-native plants and animals, it is the policy of this Service to eliminate or hold to a minimum any exotic species, provided complete eradication is impossible. Furthermore, every possible measure shall be employed to prevent the invasion of parks by non-native plants or animals. This explains why our biologists are concerned with the proposal to bring axis deer to Hawaii and why this Service does not confine its interest in wildlife problems to the Park but extends them to the island as a whole. There is every possibility that if deer were introduced to Hawaii they would eventually move into the Park forests where rapid impoverishment and irreparable loss of native plants would result. We are attempting to restore the numbers of endangered plant species to a point of safety, and even though it is granted that hunting pressure might control deer numbers, one animal could exterminate an entire species from Hawaii National Park in a matter of a few hours' time.

F. R. OBERHANSLEY

COMMITTEE ACTION

Recognizing the importance of noting the action taken upon suggested recommendations by a committee of specialists in a given field, the sponsors of the symposium requested that a record of such considered action be made. A brief report on such action, including the general trend of committee discussions, is recorded in the following section. Text of the resolutions, as adopted, is given at the end of these proceedings.

COMMITTEES	CHAIRMEN	RECORDERS
1. Geology, geophysics, and hydrology	Doak C. Cox	Max Carson H. S. Palmer
2. Meteorology	R. H. Simpson* W. A. Mordy	W. A. Mordy
3. Oceanography and zoology	A. D. Tester	A. H. Banner
4. Entomology	C. E. Pemberton	H. A. Bess
5. Conservation	L. D. Baver	Marlowe Thorne
6. Museums in Pacific research	E. H. Bryan, Jr.	W. S. Thomas
7. Soil survey and land classification	Zera C. Foster	J. C. Kingsbury
8. Crop improvement and soil management	J. L. Collins J. H. Beaumont	W. B. Storey
9. Animal improvement	Sam B. Nordfeldt	M. M. Rosenberg
10. Anthropology and social sciences	Leonard C. Mason	S. H. Riesenberg
11. Health and nutrition	C. L. Wilbar	D. D. Bonnet

* Prepared agenda, but was unable to be present at sessions.

Committee 1

GEOLOGY, GEOPHYSICS, AND HYDROLOGY

I. The Pacific Basin and Its Floor
  A. Hydrology (C. A. George)
    Discussion of charts of the Pacific Area.
  B. Geodesy (Doak C. Cox)
    Discussion of gravity anomalies along the Hawaiian chain.
  C. Seismology (Roland F. White)
    Magnetic observations have been made on Oahu since 1901.
  D. Geomagnetism (Roland F. White)
    The U. S. Coast and Geodetic Station at Barbers Point, Oahu, keeps continuous records of magnetic-field intensities and direction.
  E. Other geophysical techniques (Doak C. Cox)

II. High Simatic Islands
  A. Geology and geophysics
    1. Topography and hydrography (C. A. George)
    2. Areal geology coverage (Dan A. Davis)
      All Hawaiian islands have been mapped for ground-water studies by the U. S. Geological Survey and the Territorial Bureau of Hydrography.
    3. Volcanology (Gordon A. Macdonald, presented by Doak C. Cox)
    4. Petrology (Gordon A. Macdonald, presented by Doak C. Cox)
    5. Tectonics, not directly volcanic (Harold S. Palmer)
    6. Erosion and sedimentation (Chester K. Wentworth)
    7. Age (Dan A. Davis)
      Topographic features and oldest fossils are Pleistocene.

B. Hydrology
  1. Surface water (Max H. Carson)
     More stream-gauging stations are needed.
  2. Ground water
     a. Course of ground water (Harold S. Palmer)
     b. Dike compartment hydraulics (Chester K. Wentworth)
     c. Ghyben-Herzberg ground-water hydraulics (Chester K. Wentworth)
     d. Areal distribution and inventory (Dan A. Davis)
  3. Evapotranspiration (Max H. Carson)

III. High Sialic Islands
  A. Geology (Dan A. Davis)
     The U. S. Geological Survey has made a rather thorough study of Saipan, Tinian, and Yap.
  B. Hydrology
     1. Surface water (Max H. Carson)
     2. Ground water (Dan A. Davis)

IV. Coral Atolls
  A. Geology and geophysics (Doak C. Cox)
  B. Hydrology (Doak C. Cox)

Committee 2

METEOROLOGY

1. General circulation of the atmosphere (Leon Sherman)
   No adequate description of circulation in tropical regions can be given because of the sparseness of meteorological stations and observations.
2. Exchange of radiation energy
   Present stations furnishing radiation measurements include Canton Island, Wake Island, and various stations in the Hawaiian Islands.
3. Upper tropospheric cyclones (C. K. Stidel)
4. Cloud physics and artificial nucleation (W. A. Mordy)
5. Energy exchange between wind and sea
6. Weather forecast improvement (E. M. Vernon)
   Either more use of available data or more observations are needed.
7. Synoptic observation networks in the Pacific (C. M. Woffinden)
8. Depository for Pacific weather information
   A subcommittee consisting of Lt. Col. Jones, Dr. Sherman, Mr. Mordy, and Mr. Woffinden was appointed to draft recommendations.

Committee 3

OCEANOGRAPHY AND ZOOLOGY

I. Scope and Organization
   The committee divided this combined field into three categories: (1) physical and chemical oceanography—as it influences life in the sea; (2) biological oceanography — marine zoology and marine botany in all their aspects; and (3) terrestrial zoology — excluding entomology (Committee 4).
   Dr. M. S. Doty was named chairman of a subcommittee to consider and present recommendations.

II. Summary of Projects
  A. Bernice P. Bishop Museum (C. H. Edmondson)
     1. Marine wood borers and their control
  B. Division of Fish and Game (Vernon E. Brock)
     1. Terrestrial game birds and animals
     2. Fisheries investigations
     3. Pollution studies
        a. Hilo Harbor (completed)
        b. Honolulu Harbor
     4. Livebait project
     5. Artificial key for identification of fishes of Hawaii
     6. Statistical summary of fishes of Hawaii
     7. Minor projects
        Studies of marlin, akule (*Selar crumenopthalmus*), large tuna, trolling lures used in Hawaiian waters, and Hawaiian trap fishing.
  C. Pacific Oceanic Fishery Investigations (O. E. Sette)
     1. Compilation and analysis of information and literature on tunas from Japanese and other sources
     2. Problem of races and geographic limits of tuna stocks
     3. Physical and chemical oceanography of the tropical and subtropical Pacific
     4. Distribution and abundance of tunas in relation to environmental factors, and potential productivity of various areas of the sea
     5. Food and feeding habits of tunas
     6. Study of maturation and spawning of tunas and of the distribution of eggs, larvae, and juveniles
     7. Age and growth of tunas
     8. Studies of bait fishes
     9. Experimental fishing and gear development
     10. Exploration of fishing activities
     11. Reaction of tuna to various physical and chemical stimuli
  D. Hawaii Marine Laboratory (R. W. Hiatt)
     1. Marine projects
        a. Taxonomy and distribution (12 completed, 6 active)
        b. Physiology and ecology (3 completed, 10 active)
        c. Productivity (5 completed, 10 active)
        d. Hydrography (2 completed, 1 active)
     2. Non-marine studies
        a. Evolution of terrestrial invertebrates
        b. Ecology and physiology of marine birds

Committee 4

ENTOMOLOGY

1. Brief review of literature
2. Consideration of submitted recommendations
3. Insect surveys and taxonomic work on collections
4. Centralization of collections
5. Appropriation for publication
6. Geographical distribution of species, especially economic pests, their hosts, and their importance
7. Biological control of insect pests
8. Artificial control of insect pests
9. Quarantine
10. Biological control of pest plants
11. Relation of insecticides to biological control
12. Termite distribution in Hawaii

Committee 5

CONSERVATION

This committee divided its agenda into two symposia:

1. Preservation of ecological areas
   a. Ecological changes in the Pacific area as affected by man (H. L. Lyon)
   b. Preservation of vegetation types in the Hawaiian Islands (F. R. Oberhansley)
   c. Control of exotic animals (Colin G. Lennox)
2. Preservation of beaches
   a. Mechanics of beach erosion (Chester K. Wentworth)
   b. The problem of the Waianae beaches
      (1) From the point of view of the Corps of Engineers (F. H. Falkner)
      (2) From the point of view of the City Engineer (Karl Sinclair)
   c. The problem of the Black Sands of Hawaii (F. R. Oberhansley)

In addition to the foregoing, two papers were submitted by F. R. Fosberg: "Thoughts on the Axis Deer Problem" and "Wilderness Areas as Research Tools."

Committee 6

MUSEUMS IN PACIFIC RESEARCH

1. Relations between museums, taxonomy, and biogeography
2. International co-operation in Pacific research
3. Botanical and zoological surveys
   a. Known distribution of plants and animals in the Pacific
   b. How surveys can be made to fill gaps in this knowledge
   c. Need for trained personnel and adequate finances

The committee agreed with, and indorsed in principle, most of the numerous recommendations of other scientific groups regarding the need for botanical and zoological surveys, ecological studies, preparation of bibliographies, check lists, regional studies and handbooks, training of taxonomists and museum personnel, and wide distribution of specimens and data. However, it saw no value in repeating such recommendations, except as ways and means could be suggested for implementing them.

Committee 7

SOIL SURVEY AND LAND CLASSIFICATION

This committee (1) considered the types of surveys needed for studies of soil, land capabilities and land use, data needed, and personnel recommended; (2) agreed with the many recommendations made by the seven Pacific Science Congresses, 1920–49, and by the National Research Council in 1946; and (3) was gravely concerned because so very little seems to have been done in accordance with these recommendations.

Committee 8

CROP IMPROVEMENT AND SOIL MANAGEMENT

This committee found its problems and discussions so broad and general that, to cover adequately the subjects assigned, it divided into two groups: (1) crop improvement (J. L. Collins, chairman, W. B. Storey, recorder), and (2) soil management (J. H. Beaumont, chairman, J. C. Ripperton, recorder). A joint report was submitted.

In considering the agricultural problems of the tropics and subtropics to which research might be directed, the committee was guided by (1) statements and actions already taken by the seven Congresses of the Pacific Science Association, the Pacific Science Conference of the National Research Council, and the South Pacific Commission; (2) the fact that since representatives of foreign countries were not present, the problems discussed should be those confronting agriculture in Hawaii, but of such fundamental character as to have possible general application; and (3) the fact that problems of the Trust Territory of the Pacific could be considered specifically, in that this area is the direct responsibility of the United States and, therefore, of Hawaii.

The subcommittee on crop improvement considered crops which might be of value in the Pacific region, either as subsistence crops or as potential commercial crops. These included pineapple production (J. L. Collins), sugar cane (A. J. Mangelsdorf), corn (John Warner), tomatoes, leafy crops such as Chinese cabbage and mustards, and other vegetable crops (D. C. McGuire), sweet potatoes (C. F. Poole), forage crops and legumes (O. C. Zoebisch), and miscellaneous tree fruit, spice, drug, and fiber crops (W. B. Storey).

From a round-table discussion of the Pacific area, principally the Trust Territory, led by Harold Mayo, it was brought out that the greatest immediate need is improvement of subsistence crops rather than of the existing or potential export crops. The important subsistence crops of the area, more or less in order of importance, are breadfruit, sweet potato, banana, yam, cassava, taro and yautia, *Pandanus,* Tacca arrowroot, papaya, and Polynesian chestnut.

Committee 9

ANIMAL IMPROVEMENT

1. Considerations
   a. Present status of animal industry in the Pacific
   b. Consideration of previous recommendations
   c. Other eventual considerations
2. Discussions
   a. Animal industry areas in the Pacific
   b. Vacuum in animal industry in certain areas due to World War II; how to restore the industry to normal
   c. Breeds and breeding
   d. Feeds and feeding
   e. Animal diseases
   f. Improving animal industry by market regulations
   g. Other problems of importance

Committee 10

ANTHROPOLOGY AND SOCIAL SCIENCES

The work of this committee was divided between five major subjects — anthropology, geography, sociology, linguistics, and education. Its recommendations were concerned primarily with Oceania (Polynesia, Micronesia, and Melanesia). In addition to the five major subjects, it was agreed that studies in psychology, political science, and economics should be included in any well-rounded program of Pacific research.

1. Anthropology (Katharine Luomala)

Surveys of research in Polynesia have appeared in two Bishop Museum bulletins. No comparable statements on the status of research in Micronesia exist as yet. Projects have been co-ordinated by the Pacific Science Board. Melanesia lacks a general ethnographic statement as well as surveys of research. The South Pacific Commission has been energetic in applied research. In Polynesia, acculturation studies have been made in New Zealand, Tonga, the Cook Islands, and the Tuamotus. Little is known of the Polynesian outliers in Melanesia.

2. Geography (Neal Bowers)

Geographic research in the Pacific has been limited, although much basic source material has been gathered by other disciplines.

3. Sociology (C. E. Glick)

The Pacific is an area of increasing culture contact between immigrant peoples and the indigenes, with major political and economic decisions being made in metropolitan centers of the world. The special task of the sociologist is to trace the gradual absorption of the various parts of the Pacific within the emerging "Great Society."

4. Linguistics (Sam Elbert)

In Melanesia, Capell has produced most of the reliable work in language study. Other parts of Melanesia, particularly New Guinea and the Solomons, need study. In Micronesia, one of the first problems is orthography as no standards exist. Phonemic analysis and grammars are available for Truk and Ponape and will be completed for Yap. Few satisfactory grammars of Polynesian languages have been produced.

5. Education (J. L. Taylor)

Except for isolated chapters and fragmentary comments on the broader phases of education, little research has been done in this field. Even in the case of mission groups, which initiated formal schooling and which still bear the responsibility for much of the formal educational activity in the islands, there are no exhaustive or comprehensive studies.

RESOLUTIONS

GENERAL

1. *Resolved,* That governmental agencies having data of value concerning the Pacific area be encouraged to publish these data or make them available to science whenever security regulations permit.

2. *Resolved,* That the Secretariat of the Pacific Science Council be requested to compile a register of institutions and individuals (particularly scientists) actively interested in the natural history (geology, botany, zoology, anthropology, and related subjects) of the Pacific area, as a basis for mutual co-operation and the interchange of information and specimens. This might lead to the "clearing house" which has been recommended.

3. *Resolved,* That for Micronesia, there remains the important task of an intensive search by properly qualified personnel for published Japanese material in Japan. Japanese scientists who have worked in Micronesia should be contacted and encouraged to publish studies based on prewar research.

4. *Resolved,* That translation of significant documents from Japanese, German, and other languages is desired, especially where such translations can be annotated by scientists familiar with the present-day situation in the area.

5. *Resolved,* That the symposium, noting with satisfaction the establishment of the Pacific Science Council Secretariat in Honolulu, Hawaii, and recognizing the need for such an organization, recommends that the Secretariat be continued on a permanent basis to further international action and co-operation in Pacific science.

6. *Resolved,* That the Hawaiian Academy of Science express its gratitude for and appreciation of the establishment of a branch office of the Pacific Science Board of the National Research Council in Hawaii and the Academy notes with satisfaction that the field work of the Board has involved, to date, the participation of scientists from the Hawaiian Islands; and that the Hawaiian Academy of Science go on record as offering full co-operation in furtherance of the activities of the Pacific Science Board.

7. *Resolved,* That the Hawaiian Academy of Science make available information on the different agencies which might make possible the extension of research by local scientists to the Trust Territory and other Pacific countries.

8. *Resolved,* That, in general, bibliographic studies of Pacific literature and cartography be required as an aid to researchers.

GEOLOGY, GEOPHYSICS, AND HYDROLOGY

1. *Resolved,* That recent expeditions attempting deep-sea exploration by geophysical, bathymetric, and sampling techniques be commended, and that similar and related work be prosecuted as rapidly as possible, with financial assistance from the Federal government.

2. *Resolved,* That the work of the Coast and Geodetic Survey and other agencies in the Seismic Sea Wave Warning System be commended, and that improvement in communications be sought to permit addition of a South American and a Tahitian station to the tidal stations reporting to the System.

3. *Resolved,* That the geologic bulletins of the Hawaii Division of Hydrography and the accompanying geologic maps, now largely out of print, be kept in print with revision as required.

4. *Resolved,* That the establishment of a joint observatory in volcanology and meteorology on Mauna Loa be encouraged.

5. *Resolved,* That it be recommended that a geophysical institute be established at the University of Hawaii.

6. *Resolved,* That efforts be made to establish a volcanological laboratory on Niuafoou with the co-operation of the Tongan government.

7. *Resolved,* That surface-water, ground-water, and evapotranspiration studies be prosecuted with the aim of developing quantitative inventories of water supplies in the Hawaiian Islands.

8. *Resolved,* That modern hydrographic surveys of Hawaiian waters be made as soon as possible; and until such surveys can be made, that utilization of hydrographic data that are now being collected or that might easily be collected by ships other than regular survey ships be investigated as a possible means of improving local hydrographic charts. (Made jointly with Oceanography and Zoology Committee.)

9. (See Meteorology Resolution 11.)

10. (See Oceanography and Zoology Resolution 9 and Conservation Resolutions 2, 3, and 4.)

METEOROLOGY

1. *Resolved,* That the further study of large-scale circulation patterns including intertropical air movements be encouraged with emphasis on: (1) obtaining sufficient data to enable adequate description of weather processes; (2) developing adequate models for weather disturbances through tropical regions; (3) interrelationships between tropical and extratropical disturbances. In this respect a recommendation of the Seventh Pacific Science Congress (New Zealand, 1949) is endorsed: "In climatological measurements an almost complete lack of operative radiation stations is noted. Radiation measurements, in addition to being of direct use in the agricultural meteorology of the Pacific, are essential to the solution of the basic problem of energy exchange between sea and air."

2. *Resolved,* That an integrated, planned program of radiation measurements be expanded in the Pacific area (see previous resolution).

3. *Resolved,* That every encouragement be given for further research in cloud physics and the theory of rainfall formation. Because of the controversy over the effectiveness of cloud seeding, special attention should be given to the means of evaluating these experiments.

4. *Resolved,* That the recommendation of the Seventh Pacific Science Congress concerning the exchange of energy between the sea and atmosphere by wind moisture and heat be endorsed: "In order to follow the cycle of transfer of energy to the sea in low latitudes, transport by surface currents through middle latitudes and dissipation into the atmosphere in high latitudes, considerable study of the fundamentals of this energy exchange across the interface is required with particular attention to radiation, wind and water transport. This involves studies of wave generation, wind driven current, convection cells, radiation balance, evaporation and rainfall over the sea, and should include comparison methods of investigation."

5. *Resolved,* That, recognizing a need for greater emphasis on applied research, the following be recommended:

   1. That such synoptic data, records, etc., as are required for research in local forecasting problems, be made easily available to workers in the Pacific through a planned program for the collection and reproduction of such data.
   2. That investigation of the dynamics of the trade-wind inversion be encouraged.
   3. That investigation of high-level influences on developments in the lower atmosphere be encouraged. In this connection note is taken of the recommendation of the Committee on Meteorology of the National Research Council Pacific Science Conference (1946) and it is suggested that the emphasis be extended to levels as high as 200 mb: "Study of medium and high altitude meteorology (above 5,000 feet), particularly of the northern and western Pacific areas, basic theoretical work on the cause and mechanism of fog and a synoptic and geographic study of the distribution of fog in the north Pacific. Study of the thermal, moisture, and wind micro-structure of the lower layer of atmosphere (less than 5,000 feet). Research in formation, structure, and motion of typhoons. Study of meteorological conditions, causing anomalous propagation of ultra-high-frequency radio and radar in the western Pacific area."
   4. That investigation of the life history of "cold lows" in tropical latitudes and the relationships between such disturbances and the general hemisphere circulation be encouraged.
   5. That a problem of primary importance in the tropical and subtropical atmosphere of the Pacific is an understanding of the structure and life history of warm-core tropical storms, including those which do not reach typhoon intensity.

6. *Resolved,* That the following resolution of the Seventh Pacific Science Congress (New Zealand, 1949) be endorsed: "The weather reporting network in the Western Pacific is not considered adequate; it is strongly urged that additional stations be established immediately in the outlying islands of the occupied territory and the islands of the Trust Territory," and that a network of stations in the Trust Territory at least as dense as the pre-war Japanese network be established. In this connection an emphasis on upper-winds observations is favored.

7. *Resolved,* That it be recommended that additional weather ships be assigned to the Pacific and that the meteorologists have a greater part in their placement. The important contribution made by weather reconnaissance flights is noted and the extension of this program encouraged.

8. *Resolved,* That the recommendation of the Seventh Pacific Science Congress concerning the need for additional upper-air stations to complete an upper-meridian cross section from Pole to Pole be endorsed: "Attention is drawn to the need for establishment of upper air stations and the desirability of a complete upper air meteorological section from Pole to Pole. Such an upper air section would provide valuable observation data for the much needed attack on the problem of the general circulation."

9. *Resolved,* That, noting the importance of weather observations from transient aircraft, recommendations be made for improvement in instrumentation to improve the accuracy of these weather observations and the Seventh Pacific Science Congress resolution on this program be endorsed: "The importance of observations from ships in the Pacific cannot be overstressed. With the large oceanic area, surfaces of which are unbroken by islands, it is necessary to devise means of taking and utilizing not only the weather observations commonly made from vessels at sea, but also measurements of radiation, rainfall and sea surface

temperature. It is also recommended that attention be paid to the problem of obtaining accurate and representative air temperature measurements from ships at sea. This particular element is currently the most poorly observed. The use of aspirated thermometers is believed necessary."

10. *Resolved,* That, noting the plan of the Weather Bureau to install automatic reporting equipment in mountain areas in the Hawaiian Islands, encouragement be given to this proposal.

11. *Resolved,* That steps be taken by appropriate agencies for the establishment of a depository for original and summarized meteorological observations in the Pacific area for the purpose of co-ordinating local research. It is suggested that this depository might be located in the Secretariat of the Pacific Science Council of the Pacific Science Association. (Joint Resolution of Meteorology with Geology, Geophysics, and Hydrology.)

12. (See Oceanography and Zoology Resolution 8.)

OCEANOGRAPHY AND ZOOLOGY

1. WHEREAS, The logical avenue of approach to a scientifically derived understanding is in general from the observational aspects (taxonomy to morphology, distribution, and ecology) to the experimental aspects; and

WHEREAS, The observational aspects are only in the initial stages in this area; therefore be it

Resolved, That investigations designed to assemble and complete the initial steps in this logical approach be encouraged in particular.

2. WHEREAS, It is essential to consider the dominating practical aspects as well as the purely scientific problems; therefore be it

Resolved, That studies be encouraged in the fields of phylogeny and ecology as well as productivity.

3. WHEREAS, It is inefficient and impractical to investigate the entire Pacific as a unit; therefore be it

Resolved, That encouragement be given to intensive studies in selected areas.

4. WHEREAS, In the Tropical and Central Pacific one of the principal barriers to scientific endeavor is transportation; therefore be it

Resolved, That the Pacific Science Council Secretariat be requested to investigate the problem of transportation of scientific personnel by military and nonmilitary agencies.

5. WHEREAS, The ocean is an area of relatively unknown potential; and

WHEREAS, The resources of the ocean are great; and

WHEREAS, The location of Hawaii is peculiarly favorable for the study of the tropical ocean; therefore be it

Resolved, That a major portion of efforts in oceanographic investigation be directed along lines devised to elucidate the chemical, physical, and biological nature of the Central Pacific.

6. WHEREAS, The time and space variations of the general circulation are little known; and

WHEREAS, The dynamic aspects of physical oceanography are believed to be of basic importance to organic production in the ocean; therefore be it

Resolved, That studies of circulation and related factors be intensified.

7. WHEREAS, A more complete knowledge of the distribution, variations, and fluctuations of the chemical constituents of sea water is necessary for an understanding of productivity; therefore be it

Resolved, That studies of nutrient salts and oxygen concentrations be recommended in particular.

8. WHEREAS, The major ocean currents are maintained by the stress of the wind; and

WHEREAS, The variations of these currents are related to the time and space variations of the wind; therefore be it

Resolved, That combined oceanography-meteorology programs to clarify this relationship be initiated.

This type of investigation of the important North Equatorial and Counterequatorial Current region is recommended in particular.

9. WHEREAS, Information as to the physical nature of the environment is essential to biological investigations; and

WHEREAS, Such information is widely scattered; therefore be it

Resolved, That encouragement be given the establishment of a recognized repository for information, particularly concerning the more physical and economic aspects of oceanography of the area; and

Be it further resolved, That the publication of a periodical containing the materials in such a repository be encouraged.

It is suggested that the depository be located in the Secretariat of the Pacific Science Council of the Pacific Science Association. (Resolution made jointly with Geology, Geophysics, and Hydrology Committee.)

10. WHEREAS, Analysis of tidal records does give valuable information on oceanic currents; and

WHEREAS, These motions are primary factors in distribution and productivity of marine forms; therefore be it

Resolved, That it be recommended that additional tide gauge stations be established and maintained where feasible in the tropical and subtropical Pacific.

11. WHEREAS, It is essential for the continuing intensive studies in Kaneohe Bay, Oahu, that correctly evaluated empirical data on distribution of nutrients, fish eggs, fish larvae, and growth of all organisms be available; therefore be it

Resolved, That support be given to a detailed hydrographic study of the Bay and related inshore waters.

12. WHEREAS, All phases of the biology of the Central Pacific are inadequately known; and

WHEREAS, The knowledge of taxonomy, distribution, and ecology is essential to an understanding of the biota and its productivity; therefore be it

Resolved, That investigations so directed be encouraged.

13. WHEREAS, There is at present an almost complete lack of information as to algal forms in the area; and

WHEREAS, These forms are responsible essentially for the energy available to biological processes in the Pacific Ocean; therefore be it

Resolved, That the collection and identification of both the sessile neritic forms and planktonic forms be encouraged.

14. WHEREAS, It is recognized that the rich Indo-Pacific biotic region is attenuated toward Hawaii; therefore be it

Resolved, That studies of the nature, relationships, and derivation of the marine fauna and flora be intensified.

It is felt that investigations of certain forms, e.g., flukes, plankton, and certain groups of invertebrates which exhibit particular advantages for the study of the problem, are most necessary.

15. WHEREAS, It is essential for workers in nontaxonomic fields of biology to be able to name that with which they are working; therefore be it

Resolved, That encouragement be given and funds provided for the preparation of faunal and floral handbooks on marine life.

16. WHEREAS, There are a great many species of reef and inshore fish that apparently range over a large portion of the tropical Pacific; therefore be it

Resolved, That morphometric studies be made of selected populations of some of the species better to determine the real status of and relationship among these populations.

17. WHEREAS, Detailed information on the egg and larval period of bait fish is important toward understanding the effect of natural factors on survival and growth; therefore be it

Resolved, That studies be intensified on the development of larvae of the anchovy, ***Stolephorus purpureus,*** and the atherinid, ***Pranesus insularum,*** under controlled variations in temperature, salinity, water movement, and food supply.

18. WHEREAS, There is virtually no information on developmental growth rates of economically important fish and invertebrate species; and

WHEREAS, Such information is necessary for the evaluation of important aspects of productivity; therefore be it

Resolved, That studies be conducted on the life history of such species.

19. WHEREAS, Hawaii contains shores ranging from those recently formed by lava flows into the sea through all stages of the development and degeneration of coral reefs; and

WHEREAS, These reefs are so immensely important to the tropical and Central Pacific; and

WHEREAS, Hawaii is one of the few places where such studies can be carried on efficiently; therefore be it

Resolved, That studies of the ecological successions on such reefs be intensified and supported.

20. WHEREAS, The reef community can be considered as a superorganism; therefore be it

Resolved, That its physiology as a superorganism be studied.

21. WHEREAS, Holothurians have long been suspected of being obstructive to coral reefs; and

WHEREAS, Such reefs are such important and conspicuous elements of the tropical and Central Pacific; therefore be it

Resolved, That support be given to a study of the anatomy and histology of the digestive system of some abundant type, such as *Holothuria atra,* to provide a basis for physiological studies directed toward an evaluation of their triturating effect on coral fragments.

22. WHEREAS, Recent studies have shown that close relationships between animals probably result from a chemical dependence between them; and

WHEREAS, Commensal associations are numerous on Hawaiian reefs; and

WHEREAS, Laboratory facilities are available for such experimentation; therefore be it

Resolved, That studies be recommended on the nature of the attraction of hosts for their commensals.

23. WHEREAS, The sensory responses of fish and invertebrates are basic in their behavior patterns; and

WHEREAS, Such responses may be utilized to design more effective catch methods; therefore be it

Resolved, That studies be further supported on responses of marine animals to electrical, sonic, chemical, and visual stimuli.

24. WHEREAS, A thorough understanding of the physiology and dynamics of digestion of marine animals is basic to an evaluation of area productivity; therefore be it

Resolved, That such studies be encouraged.

25. WHEREAS, The marine wood borers cause great economic loss, especially in the tropics; and

WHEREAS, None of the current methods of treating wooden structures is adequate; therefore be it

Resolved, That the following investigations be recommended: (a) a taxonomic study of the wood borers obtained through Naval surveys in the Pacific; (b) an investigation of the chemical treatment of wood with a view to increasing its resistance to attack by borers; (c) detailed studies on the embryology, metamorphosis, and later developmental anatomy of the several major species of marine boring organisms; (d) a study of the effect of parasitic copepods upon their teredo hosts; and (e) an investigation of methods of controlling *Limnoria* chemically, since this genus is resistant to present methods effective in other marine borers.

26. WHEREAS, Bait fish are essential for present-day methods of catching tuna and because the bait fish supply in the Central Pacific is not extensive; therefore be it

Resolved, That current studies on Hawaiian bait fish be further encouraged and supported to determine the maximum sustained productivity in Hawaiian waters in particular and in tropical waters in general.

27. WHEREAS, The available nitrogen is nearly always a limiting factor in oceanic productivity; and

WHEREAS, The Myxophyta, or blue-green algae, are known in many cases to fix nitrogen; therefore be it

Resolved, That a study of those of the oceanic area be initiated.

28. WHEREAS, Enrichment culture studies in relatively enclosed shallow waters in temperate regions have proved promising in increasing the total productivity; therefore be it

Resolved, That similar studies in appropriate areas of Kaneohe Bay, Oahu, be undertaken.

29. WHEREAS, Productivity in tropical waters is significant for evaluating resources in tropical seas; and

WHEREAS, The productivity in tropical waters has been little studied; therefore be it

Resolved, That detailed studies of plankton productivity in inshore, neritic, and oceanic waters, correlated with physical and chemical hydrographic features, be undertaken in Hawaii.

30. WHEREAS, Oceanic islands are classically recognized as providing unique opportunities for the study of adaptation and speciation; and

WHEREAS, The Hawaiian Islands are exceptionally favorable for observations of the adjustments of exotic species to new environments; therefore be it

Resolved, That studies of evolutionary processes in both indigenous and exotic species be emphasized.

31. WHEREAS, The endemic fauna is rapidly being destroyed along with the indigenous forests on the Pacific islands; therefore be it

Resolved, That an active program of faunistic and floristic surveys be initiated and continued on these islands.

32. WHEREAS, Guano deposits in the Pacific islands are of economic and biological interest; and

WHEREAS, A thorough survey of literature bearing upon guano has been made; and

WHEREAS, The lacunae in knowledge of the genesis of guano deposits in the past and possibilities for the future can be gleaned; therefore be it

Resolved, That mineralogical surveys of guano deposits and biological studies of guano birds, such as their populations and the environmental factors influencing these populations, be encouraged.

33. WHEREAS, The Hawaiian archipelago, especially the leeward Hawaiian Islands, has long been known as one of the finest rookeries for oceanic birds; and

WHEREAS, Virtually nothing is known about these species except taxonomy and distribution; and

WHEREAS, Man-induced environmental changes are known to affect adversely some species; therefore be it

Resolved; That studies on life history and ecology of oceanic birds be undertaken.

34. WHEREAS, The opportunities in Hawaii are unique for a study of those factors basic to evolution, as exemplified by speciation and dispersal of endemic species on an oceanic island; therefore be it

Resolved, That advantage be taken of the phenomenal speciation of appropriate organisms, such as *Drosophila, Oechalia,* and land snails, for morphological and cytogenetic studies.

35. WHEREAS, Resolution 31 is of critical interest to the sections on Entomology, Conservation, and Museums in Pacific Research, as it bears upon plant and animal distribution; therefore be it

Resolved, That this resolution be referred to those sections.

36. (See Geology, Geophysics, and Hydrology Resolution 8.)

ENTOMOLOGY

1. *Resolved,* That the activities of the Bishop Museum in compiling a complete bibliography of Pacific entomology be commended and their continuation approved.

2. *Resolved,* That the recommendations of the Pacific Science Conference of the National Research Council (1946) and the Second and Seventh Congresses of the Pacific Science Association be endorsed insofar as they apply to entomology.

3. *Resolved,* That more collecting should be done in the Pacific area. There are many opportunities and an urgent need for taxonomic work and further monographic studies.

4. *Resolved,* That, as far as possible, it is urged that Pacific island insect collections be deposited in the Bishop Museum, and that strong representations be made for increasing the Bishop Museum facilities for handling them.

5. *Resolved,* That, inasmuch as the publication of results is essential to adequate use of accumulated scientific data, financial provision be strongly recommended for such publication.

6. *Resolved,* That the development of economic entomology in the Pacific be urged as essential to the economic well-being of the peoples of the Pacific, and that this development proceed along the following lines:

(a) Information be obtained and made available concerning the origin, distribution, and importance of agricultural insect pests.

(b) Measures be devised for control of these pests by agronomic, biological, chemical, or other means.

(c) The basis for these control measures be adequate ecological studies of the species concerned.

7. *Resolved,* That, in view of the entirely inadequate status of plant quarantine in much of the Pacific area, the whole question of these quarantines be reviewed by competent authority, and adequate procedures be established and maintained.

The Hawaiian Academy of Science recommends that the South Pacific Commission convene a conference on quarantine regulations covering pests and plant and animal diseases and weeds, this conference to be held in April, 1951.

8. (See Oceanography and Zoology Resolution 31.)

CONSERVATION

1. WHEREAS, The soil, water, flora, fauna—archaeological and aesthetic resources with which we have been entrusted—are inextricably interwoven with the health and welfare of the people of this Territory; and

WHEREAS, The conservation and restoration of these resources is a duty of all citizens for the benefit of our descendants; and

WHEREAS, The expansion of the population and the economy of this Territory has presented problems in conservation of these resources not hitherto confronting the people; and

WHEREAS, There has been formed in the Territory of Hawaii a body known as the Conservation Council for Hawaii, consisting of conservationists, naturalists, scientists, and other persons representing various organizations, both public and private, which are vitally interested in the conservation of our resources; therefore be it

Resolved, That the Hawaiian Academy of Science recommend to His Excellency the Governor and to the Legislature of the Territory of Hawaii that the aforesaid Conservation Council for Hawaii be named an official advisory body for conservation for the Territory, and that the fullest use be made of its services in research and in the solution of such problems as may arise; and

Be it further resolved, That the Hawaiian Academy of Science tender its support to the Conservation Council for Hawaii in its actions to protect and preserve the resources of Hawaii.

2. WHEREAS, The conservation of Hawaiian beaches involves the need for flood control and the use of sand for commercial purposes as well as recreational aspects; therefore be it

Resolved, That the Territory of Hawaii immediately set up a commission to initiate studies on the over-all problem of the conservation of beaches, with particular attention to (a) evaluating the annual damage caused by floods in relation to the damage that would occur by removing sand bars from mouths of streams; (b) evaluating area and number of people affected by flood problems; (c) evaluating annual costs of clearing channels without selling the sand; (d) developing alternate plans for flood control compatible with beach maintenance at a reasonable cost; (e) evaluating need for and value of beaches as relating to tourist trade, population centers, accessibility to bathers, and availability to other beaches; (f) determining the volume of littoral drift which moves along the beaches in order to obtain information on the receding and building up of beaches; (g) determining the needs of commercial sand for construction purposes and the sources of such sand, such as studying the cost of trading dune sand for beach sand, crushed lava as substitute for sand, etc.; and

Be it further resolved, That this Commission on the conservation of beaches chart the critical beaches of the Territory for preservation in order of priority; and

Be it further resolved, That a special study be made of the Black Sands of Hawaii for preserving the scenic and recreational values of this irreplaceable resource; and

Be it further resolved, That, until a long-term program for conservation of beaches is developed by the aforementioned Commission, the present method of removal of sand from mouths of streams for flood control be continued under strictest policing to make sure that sand is removed according to specifications presented; that the Hawaiian Academy of Science concur in the recommendations of the City Engineer that the responsibility for keeping the streams open shall be vested in the Territory of Hawaii; that the Academy strongly urge the Territory provide the police protection essential to causing minimum damage to the beaches in such removal of sand.

3. WHEREAS, The conservation of native species is highly desirable for educational, scientific, and cultural purposes of any area; therefore be it

Resolved, That appropriate agencies catalogue areas of primeval vegetation for purposes of conservation; that the Kipahulu Valley on Maui and a suitable section of the upper Olaa or Waiakea Forest area on Hawaii be included in the National Park system; that the appropriate federal and territorial agencies make a study of the plant successions, native and introduced, on volcanic flows.

4. *Resolved,* That, in light of the controversial aspects of the importation of axis deer to the island of Hawaii, it be recommended that (1) a national authority on wildlife management be brought to the Islands to prepare a complete brochure on the behavior of axis deer in other world habitats, to make a thorough analysis of the behavior of axis deer on Molokai in relation to their probable behavior on Hawaii, and to advise on whether the deer should be extended to other islands; (2) all groups interested in the transfer of axis deer to other islands hold these interests in abeyance until the aforementioned study has been made; (3) legislation be enacted making it illegal to transport deer from one island to another until the aforementioned study has been completed; and (4) the present bill before the Legislature of Hawaii to appropriate $20,000 for transporting axis deer to Hawaii be reconsidered in the light of subsections (1), (2), and (3).

5. (See Oceanography and Zoology Resolution 31.)

MUSEUMS IN PACIFIC RESEARCH

1. *Resolved,* That Bernice P. Bishop Museum be commended for the extensive scientific work which it has done in the Pacific with very limited means, and that ways be sought to expand its finances so that its work can be increased in the future, including the expansion of its storage and research facilities, its library, and its work for the public.

2. *Resolved,* That the Bishop Museum be requested to compile and maintain a file of scientific projects which should be undertaken and kinds of specimens which should be sought in different areas of the Pacific, particularly in Polynesia and Micronesia, such a file to be used by persons planning to visit particular areas and by those preparing field programs.

Wide co-operation is urged in compiling the aforementioned file.

3. *Resolved,* That the scientists of Hawaii co-operate in the preparation of a guide for collecting different kinds of natural-history specimens, stressing the need for adequate field data and including sample field label blanks; that the Bishop Museum be asked to co-ordinate the preparation of such a field guide, said guide to be used to encourage amateur collectors to obtain specimens of scientific value and to assist scientists in handling specimens in other than their own field.

4. (See Oceanography and Zoology Resolution 31.)

SOIL SURVEY AND LAND CLASSIFICATION

1. WHEREAS, Soil and water are basic to the health, wealth, and happiness of the population; therefore be it

Resolved, That a systematic and comprehensive survey of land and water in the Pacific, along the lines of the Food and Agriculture Organization of the United Nations' program, be given high priority.

2. *Resolved,* That surveys relating to soil and land factors be in sufficient detail to determine land-use capability classes.

3. *Resolved,* That steps be taken to expedite the publication of the soil survey of the Hawaiian Islands. The necessary information for this report has been in the office of the U. S. Department of Agriculture.

4. *Resolved,* That a committee be appointed to work in co-operation with the Pacific Science Association Standing Committee on Soil and Land Classification and the Pacific Science Council Secretariat in collecting such information on soil and land classification as applies to the Pacific area.

CROP IMPROVEMENT AND SOIL MANAGEMENT

1. WHEREAS, The greatest immediate need in the Trust Territory, Central and South Pacific, is improvement of subsistence crops rather than of existing or potential export crops; therefore be it

Resolved, That, in order to implement a program of crop improvement with particular attention to subsistence crops in the Trust Territory, the area under the jurisdiction of the South Pacific Commission and adjacent and similar areas, the following be recommended: (1) establishment and maintenance of experiment stations and/or experimental gardens, staffed by competent personnel in representative locations; (2) introduction of new plants and reintroduction of improved varieties of the more important subsistence crops, with adequate quarantine measures to guard against the introduction of pests and diseases; (3) exchange of information relating to varietal performance and to acceptance by native peoples; and (4) utilization of the services of scientists in Hawaii and other tropical and subtropical areas in attacking specific problems and in promoting a program for the exchange of plant materials.

2. *Resolved,* That research in the exchange, adaptation, and culture of native food crops of the Trust Territory be emphasized.

3. *Resolved,* That, to prevent erosion and to conserve soil fertility in cultivated tropical soils, it be recommended that emphasis be placed on proper use of grass and legume mulches, green manures, crop residues, and rotation, as basic practices in tropical agriculture.

4. *Resolved,* That, to prevent erosion on nonarable lands in tropical areas, it be recommended that emphasis be placed upon the development of permanent vegetative covers and the use of economic plants where possible.

5. *Resolved,* That research into the development and use of legumes, especially perennial legumes suitable for food, feed, and soil conserving uses, be greatly enhanced.

6. *Resolved,* That research on range and pasture improvement in Hawaii and other tropical areas be directed especially to the control of pasture pests, to the development of improved grasses and legumes, and to improved management.

7. *Resolved,* That development and utilization of local agricultural crops and by-products, which would contribute to a more adequate animal production, be encouraged.

8. *Resolved,* That intensive research and effort be directed to the culture and adaptation of fruits, nuts, and forest trees which are likely to yield greater self-sufficiency and economic returns than pasture or other crops grown on the same land.

9. *Resolved,* That intensive research be directed to comparative crop ecology in order to define better those factors which determine the present and potential distribution of economic plants.

10. *Resolved,* That, in the development of a permanent agriculture in a well-organized society, a national consciousness of the importance of farming be developed, and an appreciation of the dignity of his profession be engendered in the farmer.

(See also Health and Nutrition Resolution 3.)

ANIMAL IMPROVEMENT

1. *Resolved,* That, before introducing livestock for meat, milk, eggs, or wool, a careful investigation be undertaken of local needs for these products and the feasibility of producing them at prices within the means of consumers.

2. *Resolved,* That local stocks be evaluated and maximum use made of adapted stocks in any improvement plan.

3. *Resolved,* That large-scale introductions of animals be avoided until their adaptability has been clearly demonstrated by adequate experimental introductions. Unless animal introductions, either experimental or on a commercial scale, are under the supervision of trained personnel with adequate facilities for taking care of them, a fair estimate of their potential value is unlikely.

4. *Resolved,* That an animal-improvement program through breeding be accompanied by equal or greater improvement in nutrition, sanitation, and general management practices.

5. *Resolved,* That, before introducing livestock, the availability and value of local forage, other crops, and by-products that may have value in animal nutrition, and the interaction of soil, climate, and plants with regard to their effects on animals be investigated.

6. *Resolved,* That, in adapting animals to a new environment, selection pressure be exerted toward function rather than form.
Such characteristics as milk and butter-fat production, efficiency of feed utilization, etc., are of greater economic importance than show-ring standards alone.

7. *Resolved,* That the knowledge of Mendelian inheritance and the mechanics of pedigree breeding be more widely disseminated and the establishment of local breeding farms encouraged.

8. *Resolved,* That the need for greater knowledge of characteristics determining climatic tolerance of livestock and techniques for evaluating such characteristics be acknowledged.
Investigators should be trained in climatic physiology and genetics to undertake more effectively such studies.

9. *Resolved,* That the importance of the development and improvement of grasses which cure well on the ground without undue loss of feeding value, in areas where long, dry spells occur, be recognized.
Studies should also be undertaken in the harvesting and dehydration of forage crops during long, wet spells.

10. *Resolved,* That co-ordinated, standard, experimental procedures be adopted to enhance the interchange of information between investigators who are studying the same problems.

11. *Resolved,* That increased attention be given to the determination of cost per unit T.D.N. of each crop when grazed, cured as hay, ensiled, etc.

12. *Resolved,* That a study be undertaken of infectious and parasitic diseases of animals in the Pacific area so control measures can be formulated and recommended. To that end it would be desirable to collect and evaluate such information at a central agency.

13. *Resolved,* That further investigations be undertaken to determine the causes of sterility in cattle.

14. *Resolved,* That flocks of sheep, in which multiple twinning is frequent, be collected in order to increase the frequency of genetic factors influencing that characteristic.

15. *Resolved,* That studies be undertaken to determine the causes of small litters in swine.

16. *Resolved,* That strains of chickens adapted to Pacific conditions be developed.
It is deemed advisable that selection pressure be exerted against certain economic characters with specific emphasis on resistance to disease (i.e., avian leucosis complex and perosis), tolerance to seasonal changes in climate, increased egg-shell strength, higher albumen index, and decreased frequency of eggs containing meat and blood spots.

17. *Resolved,* That studies be undertaken on the correct use of carbohydrates in ruminant feeding, with particular emphasis upon the microflora of the intestinal tract.

18. *Resolved,* That increased animal production be sought through better pasture-management practices.

19. *Resolved,* That the use of rotational pastures be developed so forage may be grazed under more optimum conditions.

20. *Resolved,* That further studies be undertaken to determine the optimum period for harvesting animal

feed with regard to the interaction between available T.D.N. and time.

21. *Resolved,* That routine screening of local and introduced forage crops be established for the elimination of poisonous crops.

22. *Resolved,* That further studies be undertaken concerning the toxic effect of insecticide and weed-killing sprays.

23. *Resolved,* That studies be undertaken on the application of nutrients to lactating and nonlactating ruminants and other animals, with specific attention to the dry period prior to parturition.

24. *Resolved,* That emphasis be placed upon the interrelationship between antibiotics and microorganisms in the intestinal tracts of animals.

25. *Resolved,* That further studies be encouraged toward the evaluation and utilization of locally produced ingredients in poultry feeding.
It is recommended that greater use be made of by-products from the sugar, pineapple, fish, and meat packing industries.

26. *Resolved,* That a study be undertaken of the problem of piroplasmosis (Texas fever) in the Pacific area.
It is recommended that control measures be instituted previous to introducing livestock into areas known to be infested.

27. *Resolved,* That a study be undertaken of liver flukes and the feasibility of eradicating fresh-water snails through biological control.

28. *Resolved,* That an investigation be made of the distribution of kidney worms in swine with further studies on prevention and treatment.

29. *Resolved,* That basic information is needed on the distribution of infectious and parasitic diseases of poultry before specific recommendations can be made.

ANTHROPOLOGY AND SOCIAL SCIENCES

1. *Resolved,* That emphasis be given to team research and co-operation of scientists within the social sciences and also between the social and natural sciences.
In this connection, attention is directed to the team projects successfully completed, under the Pacific Science Board, such as the Coordinated Investigation of Micronesian Anthropology in 1947 and the Arno Atoll Ecological Study in 1950. The Moturiki community development project in Fiji, under the South Pacific Commission, is a further example of the team approach.

2. *Resolved,* That emphasis be placed on the need for more standardized methods in field and library research in the social sciences.
Closer co-ordination of scientific activities would avoid needless duplication of effort. The value of Human Relations Area Files (Yale University) is particularly noted as a guide to standard classification and filing of accumulated data.

3. *Resolved,* That, although field researches and publications on aboriginal cultures in Polynesia (except for archaeological investigations) are nearly done, further work be undertaken in the Ellice Islands among the Polynesian outliers of Micronesia and, especially, Melanesia.

4. *Resolved,* That studies of acculturation and culture change be undertaken in Polynesian communities for which the basic anthropological research has been completed.

5. *Resolved,* That reviews be made of the status of field research and literature concerning Micronesia and Melanesia, along the lines of the Bishop Museum's "Specialized Studies in Polynesia" and "Introduction to Polynesian Anthropology."

6. *Resolved,* That a comprehensive bibliography of Micronesian anthropology, comparable to those undertaken by Keesing (Polynesia) and Elkin (Melanesia) for the South Pacific Commission, be undertaken.
Such a bibliography should include a summary of postwar field work and publication, work now in progress, and unpublished materials otherwise available.

7. *Resolved,* That a more intensive study be made of Fiji, as an important link between the culture areas of Melanesia, Polynesia, and Micronesia.

8. *Resolved,* That syntheses of ethnographic studies of isolated Micronesian and Melanesian communities be undertaken along the lines of the Polynesian research done by Bishop Museum.

9. *Resolved,* That additional studies of Oceanic somatology and serology supplement the present data, for a better understanding of racial trends and intermixtures in Oceanic history.

10. *Resolved,* That, as approximate dates of archaeological sites through the radioactive carbon technique may possibly be attained, systematic archaeological excavations throughout Oceania be undertaken to establish the movement of peoples and cultures.

11. *Resolved,* That land inventory be undertaken of island areas, with consideration of land types, land utilization, and possible improvement of land use in type areas, with attention to needed conservation measures.
Such an inventory would facilitate land-planning projects and the settlement of native peoples on now-unoccupied islands.

12. *Resolved,* That study be undertaken of the extent of the agricultural land supporting the present population, the possibility of extension of farm land under present production techniques, and the determination of total supporting capacity of the land.

13. *Resolved,* That study be undertaken of the edaphic, climatic, and labor requirements of commercial crops suitable for introduction into the agricultural pattern of the Trust Territory.

14. *Resolved,* That study be undertaken of native settlement patterns—advantages and disadvantages, possible modifications, and extension into now-unoccupied areas.

15. *Resolved,* That, for geography of Pacific island handicrafts, study be undertaken of distribution and nature of raw materials, products, and techniques of production, cost of production, and possible markets.

16. *Resolved,* That survey and evaluation be undertaken of American efforts in Guam to increase the development of local resources and the self-sufficiency of the island. Comparisons with Japanese methods of increasing native production in the former mandated area are recommended.

17. *Resolved,* That study be undertaken of the influence of demographic loss and displacement resulting from World War II upon the production and trade of the former Japanese Mandated Islands.

18. *Resolved,* That study be undertaken of relationships between vegetation, soil, land utilization, and microclimates on the high islands, and that possible

use of microareas for commercial agricultural production be considered.

19. *Resolved,* That the Division of Geography of the Department of the Interior be encouraged to participate in furthering field studies in the Pacific.

Considering the facilities of the Board on Geographic Names and the important role of place-name terminology in the work of Pacific scientists, it is urged that work in the production of atlases and gazetteers be promoted.

20. *Resolved,* That airphoto coverage and mapping of areas in the Pacific, especially in Micronesia, as being carried out by various government agencies for restricted use, be made available to scientists and scientific institutions as soon as possible for non-government use.

Involved in this is the problem of declassification of materials and co-ordination of distribution through a proper government agency or a professional geographic organization.

21. *Resolved,* That more attention be given to studies of island communities from the point of view of their incorporation in the developing world society.

Among other things, this means increased emphasis upon the study of the cultural and social relations between Europeans, Orientals, and indigenous populations, if and as these develop in island communities of the Pacific.

22. *Resolved,* That attention be given to the value of the application of research studies on relations between European and Oriental peoples in areas bordering the insular Pacific to research problems along lines suggested in the preceding resolution.

23. *Resolved,* That co-operation between sociologists and anthropologists be augmented, especially in those island communities where acculturation has progressed to the point that the specialized techniques and conceptual approaches of anthropology and sociology are both needed for proper analysis of the cultural situation.

24. *Resolved,* That a series of island communities falling along a continuum from the aboriginal state to one of Western orientation be studied to determine principles and processes involved in the progressive incorporation of communities into the developing world society.

25. *Resolved,* That attention be given to the need for further empirical studies on a wide variety of subjects concerned with problems of race and culture contacts in the Pacific. Among the studies needed are the following: demography; race mixture; situations of dual and plural economies; occupational succession; labor movements; political administration in multicultural situations; nativistic movements; nationalistic movements; political integration of Caucasian, Oriental, and indigenous peoples into unified political units; cultural assimilation of persons and ethnic groups in heterogeneous cultural situations; emergence of "neo-Pacific" cultures; social and racial movements; personality in relation to heterogeneous cultural situations; personality of mixed bloods and of second and third generation offspring of Oriental immigrants; social types in intercultural situations.

26. *Resolved,* That the need, throughout the Pacific, for intensive studies of indigenous languages by trained personnel be recognized.

Much of the older missionary work in languages needs revision. Scattered manuscript materials need collocation and annotation.

27. *Resolved,* That the need for orthographies based upon scientific analysis of the phonemics of native vernaculars be considered.

Linguists should co-operate with anthropologists and educators for popular acceptance of these orthographies.

28. *Resolved,* That grammars and dictionaries be written for laymen—educators and administrators who have to deal with linguistic problems.

Many scientific studies have no utility for the non-linguist in the Pacific because of their problems of technical terminology.

29. *Resolved,* That, with the production of more field studies by trained linguists, attention be given to comparative research in pure linguistics with special regard for historical relationships of Oceanic languages.

30. WHEREAS, The function to be served by the school (whether government or mission), the formulation of educational aims, the provision of educational materials, and the adoption of methods of instruction are matters which can be determined effectively only in the light of more accurate and exact knowledge than is now available of the traditional educational arrangements of the island peoples concerned; therefore be it

Resolved, That intensive studies be undertaken by anthropologists (with educators participating at least in the planning phases of the research) to determine what the traditional arrangements were in the various island societies, the extent to which these arrangements are still utilized, the degree of their effectiveness, and trends toward persistence, change, disintegration, or abandonment.

31. WHEREAS, Although educational activity conducted or influenced by Europeans and Americans has been carried on in the various island groups for periods ranging from one to three centuries, the lack of dependable historical accounts is surprising; therefore be it

Resolved, That historical research be undertaken which would contribute toward an understanding of the role which has been served by:

(1) Mission schools. The problem of tracing the development and role of missionary schools as a whole is dependent upon preliminary research on the role of such groups as the American Board of Commissioners for Foreign Missions, the Jesuits, the London Missionary Society, the Society for the Propagation of the Faith, and other religious orders, societies, and sects which have initiated and operated schools of various sorts. Studies may range from the history of a specific school (e.g., the "Protestant School" on Kusaie) to broad integrated studies.

(2) Government schools. A number of studies are needed which will trace not only the history but the implied philosophy (administrative, as well as educational) of government schools in areas which have been under Dutch, German, French, British, Australian, Japanese, and American domination. Ideally, this large project would be one to be undertaken by a team of scholars working under a generous subvention.

(3) Evaluation of educational programs now in operation. Research is needed to assess the effectiveness of varying kinds of education now operating, both with respect to the ends toward which such activities are professedly directed and with reference to the effect upon the persistence or abandonment of native institutions and practices, the maintenance of stability in transition to new cultural patterns and values, and the personality organization of the individuals affected.

An interesting research undertaking would be a comparison of educational practices and outcomes considered in relation to the guiding philosophy of administration in two or more areas, e.g., the Trust Territory on the one hand, British Borneo or Dutch New Guinea on the other.

HEALTH AND NUTRITION

1. *Resolved,* That adequate nutrition occupy a major position and be a consideration in all studies concerned with health, since it is a problem of world-wide significance and is of primary importance in the preservation and maintenance of health.

2. *Resolved,* That support be given to the immediate completion of the compilation of an annotated bibliography on nutrition and related matters in the Pacific in order that knowledge of previous research, now scattered, can be assembled, and that this information be published and widely disseminated to all workers in the field of health in the Pacific.

When the bibliographical data are collected, a systematic program of food analysis and diet study in those areas where this information is not available will then be needed.

3. *Resolved,* That it be requested that agricultural committees give adequate consideration to the nutritive qualities of the food plants which may be introduced into Pacific island economies.

4. *Resolved,* That facilities be provided for the collection of data on the incidence and nature of the etiological agents associated with intestinal diseases of the inhabitants of the Pacific islands.

5. *Resolved,* That, since the poisonous fish of the Pacific constitute a serious health problem to the Hawaiian Islands and to other islands of the Pacific where fish constitute a significant part of the diet, and since much additional work in the study of this problem is needed, the present investigations by Dr. Bruce Halstead (School of Tropical and Preventive Medicine, Loma Linda, California) and others be encouraged and receive adequate financial support.

6. *Resolved,* That the Symposium, recognizing the need for timely reporting of the prevalence of communicable diseases in the Pacific, endorse in principle the recommendations made at the Seventh Pacific Science Congress held in 1949 in New Zealand concerning the formation of a center to correlate such information.

It is recommended that: (1) A Communicable Disease Information Center for the Pacific be established in Hawaii; (2) the five pestilential diseases (yellow fever, plague, typhus, cholera, and smallpox), presently being reported by the World Health Organization, be excluded; (3) the Secretariat of the Pacific Science Council, with the aid of the Department of Health, Territory of Hawaii, proceed to develop a program with a view to establishing a permanent Communicable Disease Information Center in conformity with the resolution of the Executive Board of the World Health Organization, February 3, 1951; and (4) this Communicable Disease Information Center not duplicate present functions of the Epidemiological Section of the World Health Organization, but rather serve to complement its present work in the Pacific.

7. *Resolved,* That education of medical, dental, and other assistants in health professions and crafts be continued and augmented in the Pacific islands wherever these services are needed, and that concentrated efforts be made to have basic, accurate public health and nutrition information incorporated into the primary education of the population of these islands.

To implement this recommendation, the Symposium recommends that a Standing Committee on Health and Nutrition be established by the Eighth Pacific Science Congress of the Pacific Science Association.

8. *Resolved,* That the Symposium recommend that, in view of the large number of mosquitoes and mosquito-borne diseases in the Pacific, necessary steps be taken to determine the types of species and subspecies which act as vectors for disease in each of the island areas of the Pacific.

PARTICIPANTS

The number in parentheses indicates the committee; see list, page 18. An asterisk (*) precedes the names of those who participated in the planning but were unable to attend the sessions. A double asterisk (**) precedes the names of those who submitted papers *in absentia*.

Abel, Mrs. Marjorie, Territorial Department of Health (11)
Akamine, E. K., Hawaii Agricultural Experiment Station (8)
Akers, Ernestine, Pacific Science Board
Alexander, W. P., Lihue, Kauai
Alicata, J. E., Agricultural Experiment Station (9)
Appleton, Vivia B.
Arnow, Ted, U. S. Geological Survey
*Auchter, E. C., Pineapple Research Institute
Ayres, Arthur S., Experiment Station, H.S.P.A. (7)
Banner, A. H., University of Hawaii (3)
Bartling, Wray B., 31st Weather Squadron (2)
Baver, L. D., Experiment Station, H.S.P.A. (5)
Beatty, Marguerite, Territorial Department of Health
Beaumont, J. H., Hawaii Agricultural Experiment Station (8)
Belt, Robert, Territorial Department of Public Works (5)
Bess, H. A., Hawaii Agricultural Experiment Station (4)
Bice, C. M., University of Hawaii (9)
Bishop, Brenda, Pacific Science Council Secretariat
Bonnet, D. S., Territorial Department of Health (11)

Borden, R. J., Experiment Station, H.S.P.A. (8)
Bowers, Neal, University of Hawaii (10)
Brock, Vernon E., Territorial Board of Agriculture and Forestry (3)
Bryan, E. H., Jr., Bishop Museum (6)
Buck, Peter H., Bishop Museum
Burton, Otto L., U. S. Navy (11)
Bushnell, O. A., University of Hawaii (3)
Carson, Max H., U. S. Geological Survey (1)
Carter, Walter, Pineapple Research Institute (4)
Ching, George, Territorial Department of Health (11)
Chu, George W., University of Hawaii (3)
Clopton, R. W., University of Hawaii (10)
Collins, J. L., Pineapple Research Institute (8)
Coolidge, Harold J., Pacific Science Board
Cox, Doak C., Experiment Station, H.S.P.A. (1)
Cromwell, T., Pacific Oceanic Fishery Investigations (3)
Crosby, William, Territorial Board of Agriculture and Forestry (8)
Cross, R. F., Territorial Board of Agriculture and Forestry (9)
Davis, Dan A., U. S. Geological Survey (1)
Degener, Otto, Bishop Museum (3)
Doty, Maxwell S., University of Hawaii (3)
Edmondson, C. H., Bishop Museum (3)
Elbert, Sam H., University of Hawaii (10)
Emory, K. P., Bishop Museum (10)
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Falkner, F. H., Area Engineer, U. S. Army (5)
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**Fosberg, F. Raymond, Pacific Science Board
Foster, Z. C., University of Hawaii (7)
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Gaskell, T. H., H.M.S. *Challenger*
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Gilbert, J. C., Hawaii Agricultural Experiment Station (8)
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Greenwell, J. M., Hawaii Meat Company (9)
Gulick, J. R., U. S. Weather Bureau (2)
Hanson, Noel, Experiment Station, H.S.P.A.
Hardy, D. Elmo, Hawaii Agricultural Experiment Station (4)
Hartt, Constance E., Experiment Station, H.S.P.A. (6)
Hendrix, Walter, Hawaii Agricultural Experiment Station
Henke, L. A., Hawaii Agricultural Experiment Station (9)
Hiatt, Robert W., University of Hawaii (3)
Hormann, Bernard L., University of Hawaii (10)
Hosaka, E. Y., Hawaii Agricultural Experiment Station (9)
Hoven, E. E., Pacific Oceanic Fishery Investigations
Hsiao, Sidney C., University of Hawaii (3)
Hu, Stephen M. K., Territorial Department of Health
Hudson, Loring G., Pacific Science Council Secretariat
Humbert, R. P., Experiment Station, H.S.P.A.
Iwanaga, Isaac I., Hawaii Agricultural Experiment Station
Jacobson, Wilson N., California Packing Corporation
Jaggar, T. A., University of Hawaii (1)
Jermann, Fred, Hawaiian Tuna Packers, Ltd. (9)
Jones, J. J., Air Weather Service, Western Pacific, Tokyo (2)
Kalstrom, George W., U. S. Weather Bureau, Los Angeles (2)
Kask, John L., Pacific Oceanic Fishery Investigations (3)
Kearns, Kenneth R., Pineapple Research Institute (8)
King, W. Norman, Agricultural Adjustment Administration
Kingsbury, J. C., U. S. Soil Conservation Service (7)
Kondo, Yoshio, Bishop Museum (3)
Krauss, Frederick G., University of Hawaii (8)
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Lennox, Colin G., Territorial Board of Agriculture and Forestry (5)
Levine, Max, Territorial Department of Health (11)
Lind, Andrew W., University of Hawaii (10)
Loomis, Charles H., Institute of Pacific Relations
Luomala, Katharine, University of Hawaii (10)
**Lyon, H. L., Experiment Station, H.S.P.A.
McGowan, D. C., Magnetic Observatory, Oahu
Magistad, O. C., Libby, McNeill and Libby (8)
Manchester, C. A., Jr., University of Hawaii
Mangelsdorf, A. J., Experiment Station, H.S.P.A. (8)
Marshall, H. L., Trust Territory of the Pacific Islands
Mason, Leonard E., University of Hawaii (10)
Mayo, Harold M., Trust Territory of the Pacific Islands (8)
McGuire, D. C., Hawaii Agricultural Experiment Station (8)
*Midkiff, Frank E., B. P. Bishop Estate (6)
Miller, Carey D., University of Hawaii (11)
Moir, Wm. W. G., American Factors, Ltd. (8)
Mordy, W. A., Pineapple Research Institute (2)
Neal, Marie C., Bishop Museum (6)
Nordfeldt, Sam B., Hawaii Agricultural Experiment Station (9)
Oberhansley, F. R., Superintendent, Hawaii National Park (5)
Orr, Kathryn, Hawaii Agricultural Experiment Station (11)
Palafox, A. L., Hawaii Agricultural Experiment Station (9)
Palmer, H. S., University of Hawaii (1)
Payne, J. H., Experiment Station, H.S.P.A. (9)
Pemberton, C. E., Experiment Station, H.S.P.A. (4)
Pen, Florence, Hawaii Agricultural Experiment Station (11)
Poole, Charles F., Hawaii Agricultural Experiment Station (8)
Porter, H. Paul, Hawaii Audubon Society (5)
Ripperton, J. C., Hawaii Agricultural Experiment Station (8)
Rice, Kenneth A., U. S. Weather Bureau, Wake Island (2)
Riesenberg, Saul, University of Hawaii (10)
Ritchie, G. S., H.M.S. *Challenger*
Rosenberg, Morton M., Hawaii Agricultural Experiment Station (9)
St. John, Harold, University of Hawaii (5)
Schmidt, Carl T., Pineapple Research Institute (4)
Sekiguchi, Nao, Hawaii Agricultural Experiment Station (11)
Serebrini, Sydney, Pan American World Airways, San Francisco
Sette, O. E., Pacific Oceanic Fishery Investigations (3)

Sherman, Leon, University of California, Los Angeles (2)
*Simpson, R. H., U. S. Weather Bureau (2)
Sinclair, Karl, Honolulu City Engineer (5)
Springer, Donald R., Northwest Airlines, Seattle (2)
Sterns, Marjorie, Bishop Museum (6)
Stidd, C. K., U. S. Weather Bureau (2)
Stiefelmeir, C. E., Pan American World Airways, San Francisco (2)
Storey, W. B., University of Hawaii (8)
Straub, Robert E., Pan American World Airways (2)
Suehiro, Amy, Bishop Museum (4)
Sykes, Walter E., U. S. Soil Conservation Service (7)
Taff, Melville A., Territorial Department of Health (11)
Takahashi, Makoto, Hawaii Agricultural Experiment Station (8)
Taylor, J. L., Trust Territory of the Pacific Islands (10)
Tester, A. L., University of Hawaii (3)
Thomas, W. S., U. S. Navy (6)
Thorne, Marlowe D., Pineapple Research Institute
Tucker, L. W., U. S. Public Health Service (11)
van Weel, Pieter B., University of Hawaii (3)
Van Zwaluwenburg, R. H., Experiment Station, H.S.P.A. (4)
Vernon, E. M., U. S. Weather Bureau, San Francisco (2)
Vollrath, Harvey M., University of Hawaii (9)
Wadsworth, H. A., University of Hawaii
Walker, H. H., Leahi Hospital (11)
Warner, John, Experiment Station, H.S.P.A. (8)
Wentworth, Chester K., Honolulu Board of Water Supply (1)
White, Roland F., Magnetic Observatory, Barbers Point, Oahu (1)
Wilbar, C. L., Territorial Department of Health (11)
Willers, Ernest, Territorial Board of Agriculture and Forestry
Woffinden, Charles M., U. S. Weather Bureau (2)
Younge, Otto R., Hawaii Agricultural Experiment Station (7)
Zoebisch, O. C., Hawaii Agricultural Experiment Station (8)

PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

TWENTY-SEVENTH ANNUAL MEETING 1951–1952

Published by the University of Hawaii Honolulu, Hawaii, 1952

FOREWORD

In May, 1951, the Academy had a membership of 322. Forty new members were elected during the year, 26 in November, 1951, and 14 in May, 1952. Fourteen members resigned or were dropped from the rolls and five were lost through death: Dr. Peter H. Buck, Dr. Arthur L. Dean, Dr. Charles J. Engard, Dr. Herbert E. Gregory, and Mrs. Maude Fletcher Lyon. The present membership of 343 is the largest in the history of the Academy.

A total of 19 scientific papers were presented at five meetings: November 29 and 30, 1951, and May 8, 9, and 10, 1952. At the November meeting it was voted unanimously to adopt the report of the Special Committee appointed to investigate the possible affiliation of the Academy with the American Association for the Advancement of Science; this committee recommended that the Academy take immediate steps to affiliate formally with this Association. Final acceptance has not as yet been received.

The Proceedings of the Hawaii Symposium on Scientific Research in the Pacific were published with the Proceedings of the 26th Annual Meeting of the Academy.

OFFICERS

1951–1952

President, L. D. Baver
Vice-President, Harry L. Arnold, Jr.
Secretary-Treasurer, E. H. Bryan, Jr.
Councilor (2 years), J. H. Beaumont
Councilor (1 year), Andrew W. Lind
Councilor (1 year), E. C. Auchter (ex officio)

1952–1953

President, Harry L. Arnold, Jr.
Vice-President, William B. Storey
Secretary-Treasurer, Doak C. Cox
Councilor (2 years), Donald Mitchell
Councilor (1 year), J. H. Beaumont
Councilor (1 year), L. D. Baver (ex officio)

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925, FOR "THE PROMOTION OF RESEARCH AND THE DIFFUSION OF KNOWLEDGE."

THE 27th ANNUAL MEETING 1951-52

Program

NOVEMBER 29, 1951

Albert L. Tester: The Establishment of Tuna in Captivity.
Chester K. Wentworth and Gordon A. Macdonald: Earthquake of August 21, 1951, at Kona, Hawaii.
Wendell A. Mordy: A Study of Cloud Formation in Hawaii.
Harry L. Arnold, Jr.: *Alopecia areata* (Spontaneous Patchy Baldness): Racial Incidence and Prognosis without Treatment.
Charles E. Snow: Restoring the Palestinian Giant of Mt. Carmel. [Guest paper.]

NOVEMBER 30, 1951

Chester A. Wismer: Controlling Pineapple Disease of Sugar Cane.
P. B. van Weel: Respiration of Marine Crustacea.
R. H. Simpson: The New Geophysical Observatory on Mauna Loa's Summit.
M. M. Rosenberg, O. A. Bushnell, and William Morikawa: The Effect of Graded Concentrations of Terramycin on the Growth and Intestinal Microflora of Chicks.

MAY 8, 1952

P. B. van Weel: Reactions of Tuna to Chemical Stimuli.
K. R. Kerns and J. L. Collins: Variability in Quantitative Characters of the Cayenne Pineapple.
Albert H. Banner: The Coral Atoll Project for 1951: Onotoa, Gilbert Islands.
Donald C. Matthews: The Development of the Pedunculate Spermatophore of the Hermit Crab, *Dardanus asper* (De Haan).

MAY 9, 1952

Maxwell S. Doty: The Hypothetical Role of Algae in Atoll Structure.
Willis A. Gortner and Martha Kent: Indoleacetic-acid Oxidase and an Inhibitor in Pineapple Tissue.
R. M. Heinicke: A Theory for the Structure and Action of Enzymes.
G. Y. Kikudome and M. L. Lohman: The Drumstick Puff-ball (*Battarrea stevenii*) of Maui.
Kenneth P. Emory: Advances in Hawaiian Archaeology.

MAY 10, 1952

Annual Luncheon
Business Meeting and Election of Officers
Address of the Retiring President, L. D. Baver: The Rise and Fall of Peruvian Culture.

Abstracts

THE ESTABLISHMENT OF TUNA IN CAPTIVITY

During 1951, under contract between the University of Hawaii and the U.S. Fish and Wildlife Service, Pacific Oceanic Fishery Investigations, efforts were made to catch, transport, and hold in captivity various species of tuna and other pelagic fish. The object was to study the reactions of tuna to various types of stimuli under controlled, experimental conditions. It was hoped that this type of information might lead to suggestions for improving present commercial fishing gear or devising new gear for catching tuna more efficiently.

Over 60 trolling trips were made off Kaneohe Bay with the University's research vessel, *Salpa,* during which about 400 fish were caught including skipjack (*aku*), frigate mackerel, little tunny (*kawakawa*), yellowfin (*ahi*), and dolphin (*mahimahi*). Uninjured fish were placed in the ship's livewell and transported to shore. No great difficulty was experienced in bringing back small tunny, yellowfin, and dolphin. However, a large percentage of the frigate mackerel and large tunny and practically all the skipjack died either on capture or during transportation.

On arrival at the Hawaii Marine Laboratory, Coconut Island, the fish were transferred to ponds and tanks. All tuna which were placed in a pond 50 feet wide, 100 feet long, and about 6 feet deep, died within a short time. They swam very rapidly and cut themselves on the rough coral sides. Dolphin, on the other hand, swam slowly, and several of them became established in the pond. Next, an attempt was made to keep tuna in a concrete tank 11 feet wide, 35 feet long, and 4 feet deep, with a water flow of 25 gallons per minute. After many unsuccessful trials, two yellowfin and five small tunny eventually were established; they started feeding on fish flesh and gradually became quite tame. They were subjected to a series of stimuli-reaction experiments by co-workers with results which will be reported elsewhere. Finally, an attempt was made to maintain a stock of tuna in a large pond 65 feet wide, 350 feet long, and about 2 to 10 feet deep, with smooth concrete walls. In this large pond 2 yellowfin and about 30 small tunny were successfully established. Unfortunately, most of the tunny died during early November, after a period of cold, wet weather. However, two yellowfin and three *kawakawa* are still alive (Dec. 1, 1951), and it is hoped that they will live over the winter. During their period of confinement, these fish have more than doubled their weight.

ALBERT L. TESTER

EARTHQUAKE OF AUGUST 21, 1951, AT KONA, HAWAII

The earthquake at 00:57, August 21, 1951, at Kona, Hawaii, was the most severe of any felt on that island since 1868. It had an intensity of 6.5 on the modified Mercalli scale and was felt generally and strongly by people all over the island of Hawaii and weakly by many people in Honolulu, 200 miles away. The Kona seismograph was seriously damaged by the first shock and was only put back in operating condition 2 days later. The Hawaiian Volcano Observatory seismographs at Uwekahuna and at 6,700 feet on Mauna Loa were dismantled by the first waves and provided no useful records. The seismograph at the Volcano House recorded the preliminary waves of the quake but was dismantled by the first surface waves. All instruments were restored as soon as possible after the main quake and have provided a rich collection of nearly 1,000 seismograms of aftershocks, some of which also dismantled one or both components of certain instruments.

Damage to structures and roads in the Kona district was extensive and severe, including demolition of several churches, a considerable number of houses, and an estimated 150 water tanks. A large number of houses suffered material and costly damage, the total of which will probably never be known. In a few cemeteries containing scores of headstones, almost every headstone was overthrown, with some breakage. In every cemetery for some 20 to 25 miles, there was some derangement of headstones, and nearly every cemetery suffered extensive breakage of cement grave caps and derangement of base plates. The damage is not minimized by recognition of the fact that much of the construction was old, in poor condition, and in many instances of inadequate design. Stone walls parallel to the coast were much more damaged than those at right angles to it. The commonest direction of overturning or fall of objects was toward the sea, the next commonest away from the sea. These facts suggest that the epicenter was offshore, as also does the generation of a small tsunami. A count of about 700 items of damage in a north-south direction along the highway for 40 miles showed a sharp and symmetrical peak in the frequency distribution about 3 miles north of Keokea, or 3 miles southeast of Captain Cook. This point is close to the line of the mapped fault that extends southeastward from the bluff facing the north shore of Kealakekua Bay. Estimates of damage to major buildings would place the position of the epicenter 2 or 3 miles farther southward. It is thought that, because of the different terranes and types of damage considered in the two estimates, the difference may not be truly discrepant.

Determinations of location are available from seismograms of numerous aftershocks. The majority of the shocks centered on the Napoopoo fault line for 2 or 3 miles inland from Kealakekua Bay. The duration of the preliminary waves indicated that the major earthquake originated 47 miles from the Volcano House seismograph. Uniformity of effects over fairly broad areas indicated that the focus was fairly deep, perhaps in the vicinity of 12 to 15 miles. From this assumed depth and the known distance from the Volcano House instrument, the focus is placed 3 or 4 miles west of the Kona shoreline. Its position in a north-south azimuth cannot be closely determined from the instrumental records of the earthquake, but, judging from the area of maximum damage and the locations of most of the aftershocks, it probably was on the Napoopoo fault nearly west of Kealakekua Bay.

CHESTER K. WENTWORTH AND
GORDON A. MACDONALD

A STUDY OF CLOUD FORMATION IN HAWAII

Because of the rugged Hawaiian terrain and persistent, even trade-wind flow, there are characteristic cloud patterns on each of the islands. A study of the air motions which produce these clouds and the normal cloud extent is of value. Lapse-time motion pictures have provided a good technique for making this study. Photographs have been collected of characteristic clouds on each of the islands. [Illustrated with diagrams, slides, and motion pictures.]

WENDELL A. MORDY

ALOPECIA AREATA: RACIAL INCIDENCE AND PROGNOSIS WITHOUT TREATMENT

Alopecia areata is a form of baldness the cause of which is unknown but which is characterized by the sudden appearance of one or several oval, coin-sized bald spots on the scalp or beard, and by—in most cases—eventual regrowth of hair. Local irritative measures have been used for centuries in its treatment and are still widely used despite a growing belief that the cause is primarily emotional and recovery is spontaneous or the result of subsidence of the emotional disturbance.

Reassurance alone, without any actual treatment, was employed in the management of 135 consecutive cases of this disorder seen in my office in a 6 year period; 84 of these (62 per cent) were followed by a questionnaire, and it was learned that: (1) the disease is disproportionately frequent among Japanese in Honolulu and apparently disproportionately infrequent among Filipinos and Hawaiians; (2) only five patients had failed to regain all their hair after 1 year; (3) the age distribution among stubborn cases was about the same as that for the group as a whole, not confirming the long-held view that older patients do less well or a recently reported one that the youngest ones do least well; and (4) no correlation could be found between duration of symptoms when first seen and length of time required for regrowth of hair.

It is concluded that the outlook for spontaneous recovery in *Alopecia areata* is good and is probably not materially enhanced by the usual methods of treatment; reassurance alone seems at least as effective as the latter, and perhaps it is more effective.

HARRY L. ARNOLD, JR.

RESTORING THE PALESTINIAN GIANT OF MT. CARMEL

Among the ancient group of interesting individuals buried in the caves of Mt. Carmel, Israel, was one of great size, a giant among the Palaeolithic men of the Pleistocene. The geological date is established as third interglacial or early fourth glacial (50–100,000 years).

Skhul V (burial No. 5 from cave Mugharet es Skhul), as the tall one is designated, has survived the London blitz and the Atlantic crossing to Boston. His bones now form one of the interesting exhibits on the top floor of Harvard's Peabody Museum.

During July and August, 1951, additional restoration as well as repair of shipping damages was accomplished upon the well-preserved skeleton of this remarkable, long-limbed man of 30–35 years. Most of the bones had been fractured after burial and recemented along the break-joints by travertine. This bonding material filled the long bone shafts and composed the protective stony cover from which the burials were excavated.

The skull, noteworthy for its combination of features characteristic of both Modern and Neanderthal Men, was refitted so that the vault fragments formed the smooth dome-shape of the original. From the limiting anatomical boundaries of nasion, both malar bones, and the occluded, articulating jaws, the nasal region was restored with plasticine. After final, repeated comparison with the corresponding parts of other individuals of the group as well as with other Palaeolithic skulls proved satisfactory, alabstone plaster was modeled in conformity with the temporary oiled clay. The restored parts were tinted a red-brown shade for visual distinctness.

The long bones, which appear modern in virtually all respects, presented an interesting challenge in restoring missing parts. The head and neck and the right hip region with the upper fourth of the thigh bone firmly cemented in the hip socket were removed from the cave excavations. By means of small-diameter dental and standard steel drills, an electric circular saw, and emory wheels this perfectly preserved joint was separated. This important bone section provided the model by which the corresponding missing part of the left member was restored. In the same way, the preserved lower shaft section of the left femur supplied the knee-joint restoration for the missing parts of the right bone. Similarly the left shin bone and the members of both arms were restored.

Here and there, the travertine deposits were hardened with silica. Such layers dulled the usual drill points; successful penetration was achieved only by means of carbide-tipped or diamond-pointed drills.

Thus, by patient, painstaking care, much stony cover and cemented fillings of fractured contacts were removed and the original bony pieces rejoined with alvar glue in thin acetone solution (vinyl-acetate, Shawinigan Products Ltd.). Alabstone restorations proved very satisfactory due to the hard, smooth, workable texture of the medium and its unusual property of expansion upon setting.

Squatting facets at the ankle joints indicate that this long-shanked fellow habitually sat with his haunches on his heels and his feet flat on the ground. This same functional organic response may be found today among the world's chairless people who likewise squat to sit.

In striking contrast to the long lower-limb bones, the arm segments (upper-lower arm ratios) are disproportionately small. The forearm bones are very short compared with the long slender upper arm members.

It is significant to note that another remarkable skull was found near Nazareth (reported by R. Neuville) which likewise has the same amazing combination of archaic and Modern features. These forms mark a most important place in the realm of human origins.

CHARLES E. SNOW

CONTROLLING PINEAPPLE DISEASE OF SUGAR CANE

Ceratostomella paradoxa, the cause of pineapple disease of sugar cane, is responsible for most of the rotting of sugar-cane cuttings in Hawaii. This organism causes most damage to cuttings when field planting is done during periods unfavorable for germination of the buds (eyes) due to low soil temperatures in the winter months, wet or dry soil conditions, dormant buds, and too deep covering.

Treatment of cuttings with Ceresan has been practiced by plantations in Hawaii for many years; this treatment has not always given satisfactory protection from *C. paradoxa.*

In 1949, work on the evaluation of fungicides was begun for the purpose of finding a chemical more satisfactory than Ceresan. Some 65 fungicides were tested by laboratory methods. The thread technique proposed by Forsberg and a technique in which one-eye sugar-cane cuttings were treated with different concentrations of the fungicides and incubated in a soil-sand-cornmeal medium inoculated with *C. paradoxa* proved to be satisfactory for evaluating these fungicides. A good correlation was obtained from the results of evaluating fungicides by the two laboratory methods and tests with some of the same fungicides in field experiments.

It was demonstrated that, to evaluate fungicides under field conditions, it is necessary to have the fungus present before determining the fungicidal or fungistatic properties of any fungicide.

In general, the organic mercurials were found to be the most effective of the fungicides tested for the protection of sugar-cane cuttings from rotting by *C. paradoxa.*

Phenyl mercuric acetate (10 per cent aqueous solution) at a concentration of 1 quart per 100 gallons of water was found equal to other fungicides in protecting sugar-cane cuttings from rotting and at a lower cost. It is efficient, economical, easy to apply, and is as permanent as any other fungicide tested. It does not injure the cuttings at the concentration recommended for the treatment of cuttings. Furthermore the aqueous solution is readily soluble and does not contain any inert material.

It was shown in laboratory and field studies that phenyl mercuric acetate was not as effective when used after the hot-water treatment (52°C., 20 min.). However, laboratory tests with phenyl mercuric acetate at a concentration of ½ pint per 100 gallons of water, placed in the water during the hot-water treatment, showed this treatment to be as effective in preventing rotting with *C. paradoxa* as cuttings without the hot-water treatment dipped in phenyl mercuric acetate at a concentration of 1 quart per 100 gallons of water.

Phenyl mercuric acetate is recommended for the treatment of sugar-cane cuttings at a concentration of 1 quart per 100 gallons of water for dipping or spraying of cuttings or at ½ pint per 100 gallons of water where the fungicide is added in the hot-water treatment.

CHESTER A. WISMER

RESPIRATION OF MARINE CRUSTACEANS

The consumption of oxygen from running sea water containing different percentages of oxygen was studied in the crabs *Metopograpsus messor* (Forskål) (shore crab, more or less "terrestrial"), *Pseudozius caystrus* (Adams and White) (living in well-aerated shore waters), *Phymodius ungulatus* (Milne-Edwards) and *P. laysani* (Rathbun) (coral-reef dwellers), *Calappa hepatica* (Linn.) (sandy flats), *Podophthalmus vigil* (Fabricius) (mud dweller), *Platypodia granulosa* (Rüppel) (swimming crab), and the stomatopod *Pseudosquilla ciliata* (Miers) (sandy flats). All animals except *Platypodia* show a type of adaptive respiration, which is more or less adjustable when the oxygen tension of the water does not get too low. Characteristic differences in utilization of oxygen (percentage oxygen consumed from the oxygen available) were found which agree very well with the adaptation to the characteristic habitats of the animals. The following series of sequence with respect to this utilization of oxygen was apparent: mud dwellers > sand dwellers > coral-reef dwellers > swimming crabs > shore crabs.

P. B. VAN WEEL

THE NEW GEOPHYSICAL OBSERVATORY ON MAUNA LOA'S SUMMIT

A new geophysical observatory has been opened recently at the summit of Mauna Loa, on the Island of Hawaii. This observatory, one of the highest of its kind in the world, is located at an elevation of 13,453 feet.

At present, the facilities include ordinary weather-observing equipment geared to recorders which may operate continuously for as long as 3 months without attention. Records of wind speed and direction, sunshine, rain- or snowfall, pressure, temperature, and humidity are collected. In the future, the Weather Bureau expects to install more specialized equipment, including a water vapor absorption spectrometer, a Dobson ozone recorder, and special equipment to measure intensity of light of the night sky.

Because of the strategic location and ideal exposure of the observatory, it is expected that scientific organizations the world over will plan to make use of the observatory for projects that cannot be carried out under conditions less ideal.

R. H. SIMPSON

THE EFFECT OF GRADED CONCENTRATIONS OF TERRAMYCIN ON THE GROWTH AND INTESTINAL MICROFLORA OF CHICKS

Terramycin introduced into chicks' diets in the form of Bi-Con-TM-5 (Pfizer) was fed at five progressively doubled concentrations, in two trials, to determine its effect upon the intestinal microflora of chicks. The concentrations of the antibiotic ranged from 0.0 to 10.57 grams per 100 pounds of feed. Straight-run New Hampshire chicks were fed these rations from 1 day after hatching to 28 days of age. Counts of microorganisms present in ½-gram samples of natural feces were made every third day using the following media: thioglycollate broth (for total counts), tryptose-glucose-yeast extract agar (for "aerobes"), carrot-liver agar (for "lactic acid-producing bacteria"), SF broth (for enterococci), Difco's modification of eosin-methylene blue agar (for coliform bacteria), and potato-glucose (for yeasts). Data were collected concomitantly on growth rate, economy of feed utilization, and livability of the experimental chicks.

Although terramycin significantly stimulated the growth rate of chicks during the two 28-day studies and increased the efficiency of feed utilization, the microorganisms detectable by the techniques used were not eliminated or even significantly reduced in number. In both trials the counts for enterococci were significantly greater among the groups receiving the higher concentrations of terramycin.

M. M. ROSENBERG, O. A. BUSHNELL,
AND WILLIAM MORIKAWA

REACTIONS OF TUNA TO CHEMICAL STIMULI

The tunas were kept in a large concrete tank measuring 34 feet by 11 feet by 4 feet. The animals used in these experiments were yellowfin tuna (*Neothunnus macropterus* Temminck and Schlegel) and *kawakawa* (*Euthunnus yaito* Kishinouye). Although the tunas, being fishes of prey, are probably guided in their actions in the first place by visual stimuli, it was considered worthwhile to study their behavior when chemical substances were added to the water. Attraction by smell and/or taste could not be excluded without definitive proof.

The following substances were used: (1) "conditioned water" (water in which *iao* [the Hawaiian silverside, *Hepsetia insularum* (Jordan and Evermann)] had lived for a period of time); (2) *iao* extract; (3) squid extract; (4) tuna extract (mostly of skipjack); and (5) marlin extract. As it has been claimed that asparagine would be attractive to fish, asparagine and d-l-asparagine were also tried (6). Finally, the reactions to copper acetate (7) were studied. *Iao* can be used as a livebait fish and is readily accepted as a food by tuna. Squid is an important part of the normal food of tunas. In captivity the tunas were fed on skipjack flesh, much later also on marlin flesh. The former was readily accepted, the latter did not seem to suit their taste as well although it was eaten.

The extracts were siphoned into the tank so the fishes were not attracted by sound. In order to exclude any visual attraction, the extracts were centrifuged, and both parts, the clear supernatant fluid and the débris, were given after being diluted with sea water. It turned out that, when an attractive factor is present, *it is present in the clear extract,* not in the débris. "Conditioned water" had no attraction whatever to the fishes. The *iao* extract usually showed negative results; it was found that the fish noticed its presence only a few times. Squid extract was always negative, even when either Octopus ink or Indian ink were added as a possible visual stimulus. The tuna extract proved to be extremely attractive, marlin extract less so. Asparagine was not noticed at all by the fishes, whereas copper acetate, a well-known shark repellent, in concentrations varying between 0.1 and 1 per cent, proved to be also a tuna repellent. The tunas seemed to be less sensitive to it than other fishes present in the tank (*iao, manini,* puffer).

Finally, an attempt was made to determine in what fraction of the clear extract the attractive factor is present. For that purpose the tuna extract was shaken with petrol ether. After fractioning the extract in this way, the petrol ether was allowed to evaporate, and the residue was dispersed in sea water. We have, therefore, two fractions: (1) a "fat" fraction and (2) a "protein" fraction. The former had a typical fishy smell, the latter was practically odorless. It was found that the attractive factor is localized in the protein fraction. The fat fraction did not induce any response at all.

P. B. VAN WEEL

VARIABILITY IN QUANTITATIVE CHARACTERS OF THE CAYENNE PINEAPPLE

A clone is a group of plants derived by vegetative reproduction from a single plant, the members of which are alike in their hereditary characters. Environmental changes will cause variations between plants of a clone. These, however, are not permanent changes. Mutations in the chromosomes, on the other hand, cause permanent variations in hereditary characters.

The rate of mutation is known to be very low generally, and this is true for the Cayenne pineapple, which was originally a clone. A variety which has been propagated vegetatively on a large scale for a very long period of time will have had opportunity to accumulate a number of somatic mutations. The Cayenne pineapple is known to have existed for more than 100 years and has, therefore, satisfied these requirements.

Mutations causing changes in the physical appearance of the plant are easily recognized. Less easily recognized are mutations altering quantitative characters such as fruit yield, slip number, resistance to disease, time of maturity, etc. We assume that there are at least as many of these less obvious mutations changing physiological and quantitative characters as there are those causing changes in the physical characters of a plant.

Two Cayenne clones, previously shown to be resistant to mealybug wilt, were planted with other Cayenne clones in three replicated experiments and harvested in 1947, 1949, and 1951. With three crops of the same experiment it is possible to evaluate the percentage of variability due to hereditary and environmental influences.

It would appear that mutations have occurred in some of these clones changing fruit yield, slip number, and time of maturity. These less obvious types of mutations can only be isolated from environmental variations by adequate replicated tests, carried over several crop years.

K. R. KERNS AND
J. L. COLLINS

THE CORAL ATOLL PROJECT FOR 1951: ONOTOA, GILBERT ISLANDS

The purpose of the Coral Atoll Project of the Pacific Science Board is to study the "total ecology" of a series of contrasting atolls. The program for 1951 was to study a dry and overpopulated atoll; Onotoa, in the Gilbert Islands, was selected for this study.

The personnel of the scientific party were: Dr. Preston E. Cloud, Jr., geologist, U. S. Geological Survey; Dr. Edwin T. Moul, terrestrial biologist, Rutgers University; Dr. Ward H. Goodenough, anthropologist, University of Pennsylvania; Dr. Albert H. Banner, marine biologist, University of Hawaii; and two assistants from the University of Hawaii, John E. Randall, Jr., ichthyologist, and Donald W. Strasburg, who assisted Dr. Cloud.

Transportation was provided by the U. S. Coast Guard, which assigned the supply ship *Nettle* to transport the party and its supplies between Kwajalein and Onotoa.

Onotoa, one of the southern Gilbert Islands, is located at 1°50'S and 175°35'E. It is 12 miles long, with the two major islands lying to the east of the small lagoon. The islands proper vary in width from 1/4 to 1/2 mile; their maximum elevation is about 15 feet. The lagoon is shallow, reaching a maximum depth of about 8 fathoms and containing many sand bars.

The geologist found the island to be based on old, elevated coral reef; submarine wave-cut benches were found which indicated varying heights of the water upon the island in the past. Dr. Cloud is of the opinion that the lagoon will eventually fill should the present sea level be continued.

The flora of the island is meager and limited to such plants as are characteristic of the strand flora throughout the central Pacific. The native flora has been largely replaced by the cultivated coconut and pandanus of the Gilbertese. Because of the general aridity of the islands and especially because of the periods of intense drought, the undercover of the islands is very sparse.

The marine animals were those typical of the central Pacific islands, somewhat like those of Hawaii but much more extensive in both number of individuals and species. Two of the more conspicuous invertebrates not found in Hawaii are the two corals, *Heliopora* or the Blue Coral and *Acropora,* a stag horn coral.

The population is about 1,500 persons, making the atoll definitely crowded. The economy of the atoll is self sufficient. Copra is the only trade crop; tobacco, cloth, and a few metal articles such as knives and fish hooks are the only things imported to any extent. Onotoan food is largely coconut and pandanus, extensively supplemented by fish and invertebrates caught in the adjacent waters. The land resources of the islands would better supply the populace were the land more evenly divided.

ALBERT H. BANNER

THE DEVELOPMENT OF THE PEDUNCULATE SPERMATOPHORE OF THE HERMIT CRAB, *DARDANUS ASPER* (DE HAAN)

The vas deferens of the hermit crab *Dardanus asper* (De Haan) is studied *in toto* and in serial section to determine the origin and development of its pedunculate spermatophore. The morphology of the vas deferens is figured and the physiology of its epithelial cells described.

The continuous sperm-mass, which emanates from the testis, is enveloped in a sheath and, by muscular contractions of the wall of the vas deferens, undulates into continuous sinusoidal curves.

From the deepened groove of the pear-shaped lumen, epithelial cells produce a secretion which, accumulating between the closing half-arches, forms the precursors of the upright stalks.

The muscular activity which closes the half-arches to form the ampullae of sperm is found to be co-ordinated with the muscular activity which lengthens these precursors to form the upright stalks.

As the upright stalks continue to lengthen, the epithelial cells, which line the deepened pear-shaped lumen, secrete a new substance, the precursor of the veil.

Cross sections through the enlarged, straight portion of the vas deferens reveal two typhlosole-like folds whose mucus-like secretion encompasses the completed spermatophores.

The muscular contractions of the wall of the vas deferens, which once served to mold the sperm-mass in compliance with the lumen, now serve to expel the completed spermatophore. When first expelled, it is difficult to distinguish the veil from the pedestal. If the spermatophore is allowed to stand in tap water, the veil soon disintegrates, leaving the upright stalks with their ampulla of sperm directly attached to the continuous unsegmented pedestal. The regions responsible for spermatophoric development in *D. asper* are compared with those of other species (*Eupagurus bernhardus, E. prideauxi, E. cuanensis, Anapagurus hyndmanni, Clibanarius misanthropus, Diogenes pugilator,* and *Pagurus arrosor*).

Dardanus asper is the only hermit crab studied so far whose vas deferens possesses the region for the lengthening of the upright stalks but lacks the region for the segmentation of the pedestal.

Further studies of the process in other genera, especially in *Coenobita* and *Birgus,* are suggested.

DONALD C. MATTHEWS

THE HYPOTHETICAL ROLE OF ALGAE IN ATOLL STRUCTURE

Observations in the field followed by taxonomic work in the laboratory have revealed that certain unique groups of algae are conspicuous and probably play important roles in the construction and ecology of an atoll. While not true of all atolls, especially of selected places, it does seem to be the consensus of those who have studied atolls closely that the reef structure is largely the result of the activity of the algal genus *Porolithon.*

Each of several predominant kinds of algae to be found seems to play a different role. The Porolithons and their red algal calcareous relatives seem to be largely responsible for the bulk and consolidation of the outer shell or layers of an atoll. They appear also to provide the larger part of the floor of the reef shelf. Within the lagoon the green algal genus *Halimeda* dominates and seems to be the one most largely responsible for filling in the lagoons.

Algal fragments, coelenterate coral fragments, and foraminifera not only contribute to the lagoon sediments but may, upon occasion, form sand bars that in time extend above high-tide line. Such a habitat can become inhabited only by biotic forms tolerant of the subaerial and often rain-water-dominated calcareous sand. Blue-green algae grow in these sand bars to such an extent that they are probably major factors in their stabilization as islets on the reef flat. With the continued binding of sand particles by the blue-green algae, the islets grow larger and more permanent. Blue-greens may bind the sand so securely that airplanes can use the sandy surface as a landing strip. With a given porosity, after the islets reach a certain size, they come to hold a Ghyben-Herzberg fresh-water lens. It is believed by some that, with the removal of oxygen during the night from the interior of such a sandy islet by respiration and the addition of carbon dioxide, a sufficient saturation of the fresh water (at relatively low *p*H) is attained so that when this water meets the sea water at the edge of the fresh-water lens, the sudden shift in *p*H is sufficient to bring about a precipitation of the calcium salts and the formation of the beach rock which is the solid coral island basis. It has been demonstrated amply that many of these blue-green algae fix nitrogen to a considerable degree. In an ocean, three limiting factors for growth of terrestrial vegetation and the food we eat are: fresh water, nitrogen, and a substratum in which higher plants can become anchored. The algae, as above hypothesized, provide all three.

In an open ocean it is the algae that do the photosynthesizing, the trapping of the sun's energy and the accumulating of it in food. Fish that have grown directly or indirectly on such food derived from algae are, as a protein source, perhaps the final limiting factor to native populations, and, with the arrival of the seeds of flowering plants via birds' feet or rafting, people can live their normal atoll lives.

This hypothetical role of the algae in coral atolls is the basis of the design of current investigations being carried out with the purpose of better revealing the extent to which animal life and the land itself in the central Pacific is dependent upon algae.

MAXWELL S. DOTY

INDOLEACETIC-ACID OXIDASE AND AN INHIBITOR IN PINEAPPLE TISSUE

Pineapple leaf and meristem tissue contains a strong oxidizing enzyme capable of destroying the natural growth regulator or auxin of the pineapple, indoleacetic acid. It also contains a powerful enzyme inhibitor which acts in competition with the auxin. This is shown very strikingly by the fact that 0.5 milliliters of untreated brei shows no enzyme activity in the presence of 200 micrograms of indoleacetic acid substrate, yet 0.1 milliliters of brei will destroy more than three fourths of the substrate in 10 minutes. The smaller amount of brei has less competing inhibitor.

The IAA-oxidase is apparently a heavy metal enzyme and requires M/200 manganese for optimum activity. Pineapple indoleacetic-oxidase differs most strikingly from the indoleacetic-oxidase from peas or beans in having an unusually low *p*H optimum at approximately *p*H 3.5.

The enzyme inhibitor is a heat stable, dialyzable, photosensitive material which is somewhat unstable even at low temperatures in the dark.

The oxidase inhibitor in pineapple tissue may also differ from that in peas in that the former acts competitively, whereas the inhibitor in peas is substrate independent. However, since a strikingly different enzyme protein is involved, it is possible that the difference in inhibitors is not real but can be ascribed to the different enzyme.

The biological significance of these observations remains to be checked but can be speculated upon. Alteration of the dynamic balance between newly formed auxin, the auxin-destroying enzyme, and the enzyme inhibitor in meristem tissue may well be the controlling factor in various growth phenomena in the pineapple.

WILLIS A. GORTNER AND
MARTHA KENT

A THEORY FOR THE STRUCTURE AND ACTION OF ENZYMES

As the basis for a hypothesis of enzyme structure and action, it is assumed that proteins and enzymes may have the spiral arrangement of polypeptide chains postulated by Pauling. In a single protein molecule many polypeptide spirals might be held together in a bundle by van de Waal forces, hydrogen bonding, chemical linkage of certain amino acid R groups, or by a continuity of the polypeptide chain between spirals.

The peculiar property of a protein which might enable it to act as an enzyme may be the possibility of having resonance across hydrogen bonded carbonyl-amide groups of the polypeptide chain and across hydrogen bonded groups between the protein and substrate. (Geissman.)

If a Fisher-Hershfelder model of a polypeptide chain is twisted into a spiral, it can be seen that a wave of hydrogen bonded structures—and thus of electron transport—could be made to pass over the surface of the spiral by slightly twisting the polypeptide chain on its axis. This would have two effects which might be important in enzymatic action: it would displace the end R groups (as well as the surface R groups), thus straining any substrate molecule attached to the end of the spiral; and it would also permit the removal by resonance of electrons from a substrate molecule attached to the end of the spiral.

Since the movement of atoms in the polypeptide chain would be very much influenced by temperature, one would predict that enzymatic reactions would be extremely sensitive to temperature, which they are. If there were a continuous chain of hydrogen bonded structures, one would expect practically no effect of temperature on the rate of reaction.

The complete shielding of the core of the spiral by amino acid R groups would leave only two possible sites of attachment for the substrate molecule, namely, at one or the other end of the spiral. Those enzymes which have a prosthetic group might have this group at the end of the spiral opposite that at which the substrate molecule is attached, and sandwiched in between the polypeptide bundles and substrate or sandwiched in between two bundles of polypeptide spirals.

The prosthetic group may function principally as an electron or proton supply depot. In those enzymes which do not contain a detectable prosthetic group, such as urease and the proteases, a functional electron or proton supply depot might be formed by hydrogen bonding, into the end of the spiral, an amino acid R group which might be capable of receiving or donating electrons. The trace metals which are required by certain enzymes might also be combined with such R groups.

Specificity of enzymes might be determined by the type of R groups which occur at the end of the spiral to which the substrate is joined. In general, at least three points of attachment might be used for each substrate, one of which would be the hydrogen bonding between the polypeptide chain and the substrate, and one of the other either hydrogen bonding or van de Waal attraction to the end R groups.

R. M. HEINICKE

THE DRUMSTICK PUFF-BALL (*BATTARREA STEVENII*) OF MAUI

Various kinds of puff-ball fungi and their close relatives of more bizarre form occur on every continent and are commonly recognized in folklore. Particularly noteworthy because of their remarkable form, rarity, and restricted ecology are the Podaxon, *Podaxis pistillaris* (L. ex Pers.) Fries—which in South Africa is Crow's Snuff ("kraaisnuif")—and the Drumstick Puff-balls (Tulostomataceae). These are stalked forms of striking stature, some attaining a height of 18 inches. They occur sporadically following rains, usually in the open among shrub in fertile, arid, sandy soils such as are found on flood plains or bordering washes on the margins of deserts. Although in Hawaii the drier leeward areas of any of the older islands appear to be possible habitats for *Podaxis* and *Battarrea,* these genera have been found only on Maui with several records of the occurrence of the former near Lahaina and at Kihei and our single gathering of *Battarrea stevenii* (Liboschitz) Fries near Lahaina in Ukumehame Gulch. This is the first record of a *Battarrea* for Hawaii.

Six specimens of the Drumstick were found in December, 1951, in an area about a meter in diameter, among *koa haole* on the floor of the gulch about 1.5 miles from the shore. These are up to 10 inches in height, and, in all characteristics including the dimensions of capillitial elements and elaters, are similar to specimens as described by Cunningham for Australia and therefore differ in one or more respects from those known in California, New Mexico, and Peru. In one mature but unweathered specimen, complete with calyptra and volva, the depressed-globose spore case is 2¼ inches in diameter. The spore masses are rusty-cinnamon in color.

These fungi may be of recent introduction. If not, such likely terminology as might have been applied to them by the early Hawaiians could now be obscured. Species of *Podaxis* and *Battarrea* have not been reported for New Zealand and do not resemble the common Gasteromycete (*Clathrus cibarius*) of that country, known by the Maori as "tutae kehua" or "tutae whetu."

G. Y. KIKUDOME AND
M. L. LOHMAN

ADVANCES IN HAWAIIAN ARCHAEOLOGY

The application of modern techniques in archaeology, particularly the radio-carbon technique of dating, to the problem of when the Hawaiian Islands were first settled and of the character of the first culture has been realized through cooperation between the University of Hawaii and the Bernice P. Bishop Museum. It started in 1950 when the University of Hawaii began offering a course in methods and techniques in archaeology, with Dr. Kenneth P. Emory instructing.

The undisturbed portion of the floor of a bluff shelter at Kuliouou Valley on the island of Oahu, partly excavated by Jack Porteus in 1939 while he was a senior at the University of Hawaii, was systematically excavated in 1950 by the University class in archaeology.

The excavation of this floor revealed continuous occupation from the time of the first camp fires, buried to the depth of some 30 inches, until the coming of Europeans as evidenced by the finding of iron and glass beads. The lowest stratum of occupation showed a diet in which sea birds figured prominently, and the upper strata were heavily laden with sea shells, fish bones, and occasional bones of the dog, pig, and fowl. As sea birds would have been far more abundant and easily obtainable when man first arrived in the area, it was reasoned that the first layer showing human occupation would go back to the beginning of habitation of this part of Oahu.

Charcoal from a hearth in this first occupation level was sent to the Institute of Nuclear Studies, University of Chicago, for the reading of its age. It turned out to be 946 years, plus or minus 180. In other words, the first occupation of the shelter dates back to within 180 years of 1004 A.D.

The stone adzes in the lowest stratum did not differ in type from those found in the highest stratum, indicating no essential change in culture from the beginning. The development of this type of adz can be traced to Tahiti. The fish hooks also showed no marked change and are of the regular Polynesian patterns. No artifacts were found which would have suggested a pre-Hawaiian or pre-Polynesian culture, but the several hundred artifacts which were found all fit into the historic Hawaiian culture.

When all the bone material and the fragments of gourds, coconuts, kukui nuts, pandanus cones, and other foreign material have been carefully analyzed, it will be possible to ascertain whether or not these go back to the period of first occupation.

Familiarizing the public with the nature of this type of archaeological work through Kodachrome slides accompanied by a tape-recorded explanation has been of great help in stirring up interest in this research and in protecting sites from destruction by pot-hunters.

KENNETH P. EMORY

THE RISE AND FALL OF PERUVIAN CULTURE

Presidential Address, 1952.

Cut off by the impressive, towering Andes from the moisture-laden winds from the east, the west coast of Peru is a land of barren, dry slopes separating valleys made fertile by irrigation and stream runoff from the snow-capped mountains.

About 400 miles northwest of Lima, Peru, lies the broad, fertile Chicama Valley. In it are numerous large ranchos, largest of which is the Casa Grande sugar plantation, which with its range land is larger than the country of Belgium. The sugar cane grows chiefly up the valley, toward the Andes. Toward the sea are found numbers of *huacas* or burial mounds. These contain numerous archaeological treasures which give a clue to the past history of the region. It is forbidden to dig into these mounds, but, nevertheless, a certain amateur archaeologist has acquired numerous objects from them and has stimulated much interest in further excavation by his theories regarding the story they tell.

A study of some 40,000 pieces of ceramics and other archaeological specimens in his private museum has led him to describe seven eras of civilization, five of which preceded the period of the Incas. These people left no written language. They communicated with correspondents at a distance by means of combinations of knots in strings and dots inscribed on lima beans. Parts of messages were entrusted to two or three messengers, so the communication could be read only after all had arrived. Later, drawings of the beans with their dots were placed upon ceramics; and still later, the dots and other symbols were shown without the lima beans.

The earliest of the seven periods was known as the Pre-Ceramic Era. It was the stone age of old Peru, the remains consisting of lance points, rasps, knives, and picks finished by percussion from reddish-yellow jasper.

Following this was the Initial Era of Ceramics. This period produced simple ware, without definite form, made from wet clay, baked or not. Later in the era the artisans began to make clay copies of objects such as men, animals, and fruits. Then more useful objects were made, but without decoration.

The third period followed, the Era of Evolution, featuring the beginning of sculptured art in ceramics. Spherical, large-mouthed pitchers and geometrical shapes such as cylinders predominated. Decorations were influenced by religious art. Toward the middle of this era, agriculture began to develop in the valleys through irrigation. Vases took the form of effigies and religious scenes, and stirup-shaped handles were added to pitchers. Toward the end of this era, changes in form indicated the beginnings of outside influences.

The fourth era was that of Maturity. It has been divided into five different phases of Mochica civilization. The first innovation was to cover vases with a layer of white clay which served as a background for pictorial motifs. Then objects of gold, silver, and copper began to appear in the tombs. Industrial as well as religious motifs indicated the development in the valleys of plantations with extensive irrigation works.

By "Mochica III" there was evidence of the high development of technical methods in agriculture: great temples and palaces in central communities; gold, silver, and copper used in the construction of beadwork, utensils, and arms. Decorations on ceramics showed war scenes, hunting parties, birds, fishing, but also a benevolent divinity.

During "Mochica IV" the religion was one of purified monotheism. The art of the goldsmith and silversmith reached a high development. Ceramic ware showed the customs and institutions of the people and also that they were seeking to impart their creeds and social organization to other valleys.

By the final "Mochica V" period of this fourth era, lust of conquest reached its peak, and the decadence of the Mochica civilization began. Large cities with their comforts and industry led to ease, sexual perversion, and lowering of moral standards, along with artistic refinement of the people. The civilization became the victim of invasion from the outside.

Thus developed the fifth era, known as the Era of Fusion. Invasion, largely from the north, brought new peoples into the area, bringing new elements to enrich the culture. Initially came the Huari, or northern plains, culture. Ceramics show that these people came in as conquerors. Cloth was introduced, some dyed a beautiful turquoise color with veins of white. The two cultures, Mochica and Huari, hybridized. Then came the Lambayeque, a large people, greatest clay sculptors of them all. The Huari culture became decadent in the face of such highly developed art work in silver and gold. Although the sculptures were Lambayeque, the decoration of the religious motifs were Huari. Then came the nomadic Cajamarca, first to decorate both the inside and outside of containers.

The Era of Imperialism followed. It opened with a Chimu period, the forging together of people inured to war, less spiritual, and eager for conquest. They constructed great cities. Ceramics lost its art and became purely utilitarian. Plans were developed for a great empire covering vast sections of Peru. But then came the Incas, and the influence of the north disappeared. These people worshipped the sun, moon, and stars, and their art showed strongly the influence of the Andes. Vases represented the wearing apparel of women and objects of nature—corn plants with leaves and ears—in natural form.

This civilization was cut short by the Era of Conquest. Spanish influence showed itself in new textiles and in crosses of shell and bone, the last remains found in the tombs. Now a complete decadence of culture set in; the dead no longer were reverenced, so nothing more was placed in the tombs. Pottery was made for use only and was not decorated.

The story told by archaeological remains in Chicama Valley gives us something to ponder. We see there the growth, evolution, conquest, decadence, and, finally, complete overthrow of a great civilization. Conquest followed the period of ease, sexual perversion, and immorality. Is there evident some moral lesson which we ourselves might learn?

L. D. BAVER

NECROLOGY

PETER H. BUCK

Peter Henry Buck was born at Urenui, Taranaki, New Zealand, August 15, 1880. He died in Honolulu, December 1, 1951.

Physician, soldier, scholar, teacher, museum director, and outstanding authority on Polynesian anthropology, he brought honor and credit alike to the Maori ancestors of his mother and the Irish forebears of his father.

Graduating from Te Aute College, New Zealand, in 1898, he studied medicine at New Zealand University, receiving degrees of M.B. and Ch.B. in 1904 and M.D. in 1910. Setting out upon a career devoted to health and public service, he was medical officer of health from 1905 to 1909 and Maori member of Parliament from 1909 to 1914. In World War I, as captain in the New Zealand Medical Corps and major and second in command of the New Zealand Pioneer Battalion, he saw service in Egypt, Gallipoli, France, and Belgium and received awards for distinguished service.

Returning to New Zealand, he was director of Maori hygiene from 1917 to 1927. He found that a detailed knowledge of Maori culture aided his medical work. This led to his becoming an authority on the Maoris and other Polynesians and to his affiliation with the Bernice P. Bishop Museum as ethnologist from 1927 to 1936 and director from 1936 to the time of his death.

During this time, he was the Museum's visiting professor in anthropology at Yale University from 1932 to 1934, professor of anthropology at Yale University from 1936 to 1949, and professor emeritus from 1949 until his death. He also was a research associate of the University of Hawaii from 1946 to 1951 and president of the board of trustees of the Bishop Museum from 1948 to 1951.

Because of his wide knowledge of the Polynesians, he was asked to serve on numerous committees: chairman of the Frederic Duclos Barstow Foundation for American Samoa; chairman of the Honolulu Committee, Pacific Science Board, National Research Council; member of the Advisory Committee on Educational Affairs on Guam; honorary consultant to the South Pacific Commission.

He served as councilor (1941–44), vice-president (1944–45), and president (1945–46) of the Hawaiian Academy of Science and was also a member of several other learned societies.

Dr. Buck's list of publications is a long one. Most of the larger works have to do with the material culture of Polynesians of various island groups: New Zealand, Cook Islands, Samoa, Tongareva, Manahiki, Rakahanga, Mangaia, Mangareva, Kapingamarangi, and (yet to be published) Hawaii. More popular, but nonetheless scholarly and authoritative, books are *Vikings of the Sunrise* and *The Coming of the Maori.* A complete list appears in Bishop Museum Bulletin 208, 1952.

Many well-deserved honors were showered upon Dr. Buck: from Great Britain, the Distinguished Service Order (1918), Knight Commander of St. Michael and St. George (1946); from Sweden, Royal Order of the North Star (1949). The Hector medal and prize was given him by the New Zealand Institute (1936); the Rivers Memorial Medal by the Royal Anthropological Institute of London (1936); the S. Percy Smith Medal by the University of Otago (1951). He received honorary degrees from New Zealand University (D.Sc., 1937), Yale University (M.A., 1936, and D.Sc., 1951), the University of Rochester (D.Sc., 1939), and the University of Hawaii (D.Litt., 1948).

ARTHUR L. DEAN

Arthur Lyman Dean, a charter member and past president of the Hawaiian Academy of Science, was born in Southwick, Massachusetts, in October, 1878, the son of William Kendrick and Nellie May Rogers Dean. His death in Honolulu on March 1, 1952, ended a career marked in rare manner by success in the diverse fields of science, education, and business.

Dr. Dean graduated from Harvard in 1900 and received the degree of Doctor of Philosophy from Yale in 1902. That same year he married Leona Parmelee. The Deans had three children. Except for 1 year while he was in charge of the laboratory for the A. D. Little & Co. in Boston, Dr. Dean was associated with the Sheffield Scientific School at Yale for 12 years after he was granted his doctorate, first as a plant physiologist and later as an industrial chemist. For various periods during this time he was also a Carnegie research assistant and chief of the section of wood chemistry for the United States Forest Service.

In 1914 Dr. Dean came to Hawaii as president of the College of Hawaii. Under his administration the college became the University of Hawaii in 1920. In 1924 Dr. Dean was made director of the experiment station of the Association of Hawaiian Pineapple Canners, and in 1927 he resigned as president of the University to devote full time to the direction of the pineapple experiment station. In 1930 he left the experiment station to become vice-president and director of Alexander and Baldwin, positions which he held until his death.

The adoption of new careers did not mean the relinquishment of old interests. Dr. Dean's interest in education was continued by his service at various times as a regent of the University of Hawaii, as chairman of the Board of Commissioners for Public Instruction, and as trustee of Punahou School. The chemical work for which he probably was most widely known, the identification and refinement of the principle in chaulmoogra oil used as a specific in the treatment of leprosy, was done while Dr. Dean was president of the university. His interest in science was later shown by service as vice-president of the Pineapple Producers Cooperative Association which continued the work of the pineapple experiment station, as a member of the experiment station committee of the Hawaiian Sugar Planters' Association, and by active membership in the American Association for the Advancement of Science, the American Chemical Society, the American Geographical Society, the Social Science Association, the Hawaiian Botanical Society, the Hawaiian Volcano Research Association of which he served as vice-president, and the Hawaiian Academy of Science of which he was a charter member and the second president.

Dr. Dean's influence in the community was not restricted to matters in which he had a professional interest. He served on a number of important governmental and civic commissions where his excellent judgment was much appreciated. Dr. Dean's first rank among those engaged in furthering the aims of the Academy, in the promotion of research, and in the diffusion of knowledge was very likely not realized by many who found him a reserved gentleman, interested in and showing a surprising insight into their technical problems but not given to discussing his own successes.

CHARLES J. ENGARD

Charles Joseph Engard, botanist and plant physiologist at the University of Hawaii, was born in Philadelphia in September, 1912, and died in Hawaii on August 22, 1951. He is survived by his wife (née Dorothy Doneen), whom he married in 1935, and by two small children. Dr. Engard received his Bachelor of Science and Master of Science degrees from Washington State College in 1936 and 1937, respectively, and in 1938 he was granted the degree of Doctor of Philosophy from the University of Chicago. In September, 1938, he came to Hawaii as instructor in botany. At the time of his death he was associate professor of botany and also associate plant physiologist and chairman of the department of plant physiology of the Hawaii Agricultural Experiment Station. He served on the University Press Committee and on the Experiment Station publications committee. Dr. Engard was active in promoting student welfare and development in numerous ways and was a popular member of the faculty. He was a member of the Society of the Sigma Xi, the American Society of Plant Physiologists, the American Association for the Advancement of Science, the Hawaiian Botanical Society, the Botanical Society of America, and the American Society of Lymnology and Oceanography. Dr. Engard's most important single contribution was ***Organogenesis in*** Rubus, in which he applied to plant ontogeny the concept of "field" influences developed by animal morphologists. At the time of his death he was preparing an introduction to a translation of Goethe's *Morphologie,* undertaken by Dr. Bertha Mueller at his suggestion. His death cut short a career of great promise.

HERBERT E. GREGORY

Herbert Ernest Gregory, geologist, geographer, teacher, scientific organizer, and museum director, was born in Middleville, Michigan, October 15, 1869. He died in Honolulu, Hawaii, January 23, 1952.

Graduating from Yale University (A.B. 1896, Ph.D. in geology, 1899), he served his alma mater as assistant in the botany department (1896–98), instructor in physical geology (1899–1901), assistant professor of physiography (1901–04), and Silliman professor of geology from 1904 to 1936, when he became emeritus professor.

He also served the United States Geological Survey in the southwestern United States as assistant geologist (1900–09) and geologist (1909–52), as he liked to put it, "finding water for the poor Indians" in Arizona, New Mexico, and Utah, and doing extensive geologic mapping near Zion National Park and the adjacent Colorado Plateau. From 1916 to 1920 he was superintendent of the Connecticut Geological and Natural History Survey.

He made a geological expedition to Peru (1912–13) and a trip to Australia in 1916 during which he first visited Hawaii. Work during World War I for the War Department again brought him to Hawaii in 1918.

In May, 1919, he was appointed acting director of the Bernice P. Bishop Museum upon the retirement of Dr. William T. Brigham, and he served as director from 1920 to 1936, when he became director emeritus. Through arrangements between Yale and the Museum he continued to teach part time at Yale, which paid his salary as museum director. This arrangement continued with Dr. Peter H. Buck, who succeeded him as director in 1936.

A member of the Division of Geology and Geography of the National Research Council (1918–21), Dr. Gregory served as chairman of its Committee on Pacific Investigation from 1920 to 1946, when he was made the United States member of the Pacific Science Council. In 1920 he took a leading part in organizing the First Pan-Pacific Scientific Conference, held in Honolulu, and was its chairman. He also attended subsequent Pacific Science Congresses and helped to organize their permanent research group, the Pacific Science Association, in 1926.

Dr. Gregory accepted the charge of the First Conference that the Bishop Museum should take a leading part in the scientific exploration of Polynesia. With funds made available by Yale and from national and local foundations, organizations, and individuals, expeditions were sent to many Pacific Island groups and the results published by Bishop Museum under Dr. Gregory's direction.

He was a member of numerous scientific organizations, including the Geological Society of America (councilor 1907–09, 1937–42, president 1919), Association of American Geographers (councilor 1911–13, vice-president 1919, president 1920), American Academy of Arts and Sciences, and American Philosophical Society. He was associate editor of the *American Journal of Science* (1904–28), chairman of the committee on schools, New Haven, Connecticut (1908–18), chairman of the Board of Regents of the University of Hawaii (1937–40), and member of the Honolulu Board of Water Supply (1928–36).

In addition to all these teaching, planning, and administrative duties, Dr. Gregory found time for considerable research and writing on geological and geographical subjects. The list of his publications is a long one, dealing especially with the Pacific and southwestern United States. He was always willing to give help to others and aid to scientific research.

MAUDE FLETCHER LYON

Maude Fletcher Lyon, a charter member of the Hawaiian Academy of Science, came to Hawaii in September, 1907, when her husband, Dr. Harold L. Lyon, later director of the Experiment Station of the Hawaiian Sugar Planters' Association, became assistant pathologist at the Station. Mrs. Lyon's scientific interests paralleled those of Dr. Lyon, and together they were active in the promotion of a number of scientific organizations. A charter member of the Hawaiian Botanical Society, she was one of the first group of honorary members elected by that society in 1949, and the 25th anniversary booklet of the society was dedicated to her and Dr. Lyon. An authority on the botany of ferns, Mrs. Lyon's interests spread beyond the strictly scientific, as evidenced by her activity in such organizations as the Honolulu Garden Club, the Pacific Orchid Society, and the Outdoor Circle. Her influence was felt also in a number of cultural and service organizations. Her death on June 18, 1951, deprived members of the Academy, of other scientific organizations, and of the community of a warm friendship that will be greatly missed.

MEMBERSHIP

MAY 1952

Abel, Marjorie
Akamine, Ernest K.
Akana, Theodore K.
Akers, Ernestine
Alicata, J. E.
Anderson, Earl J.
Appleton, Vivia B.
Arkoff, Abe
Arnold, Harry L.
Arnold, Harry L., Jr.
Atherton, Ballard
Auchter, E. C.
Aust, Ruth
Ayers, Arthur S.

Baker, R. J.
Ballard, Stanley S.
Balock, J. W.
Banner, Albert H.
Bartling, Wray B.
Bartz, Ellwood L.
Baver, L. D.
Beaumont, J. H.
Beebe, James
Berk, Morton
Bess, Henry A.
Bianchi, Fred A.
Bice, Charles M.
Bilger, Earl M.
Bilger, Leonora N.
Bishop, Brenda
Bitner, Harold M.
Bolles, Elmer Richard
Bonk, William J.
Bonnet, David D.
Borden, Ralph J.
Bowers, Neal M.
Bowers, Mrs. Neal M.
Bowles, Herbert E.
Briggs, Leslie J.
Britton, John R.
Branthoover, Barbara Jean
Brock Vernon E.
Brown, Elizabeth D. W.
Brown, Forest B. H.
Bryan, Edwin H., Jr.
Bryan, L. W.
Bryson, L. T.
Burr, George O.
Burr, Mildred
Burton, Otto L.
Bush, Wm. M.
Bushnell, O. A.

Carson, Max H.
Carter, Walter
Caum, Edward L.
Chang, Nora
Ching, Stevenson
Chong, Mabel
Christian, Eloise
Chu, George W.
Chun, Edwin Y.
Clay, Horace F.
Clements, Harry F.
Clopton, Robert W.
Collins, J. L.
Connor, Mary R.
Cooil, Bruce J.
Corboy, Philip M.
Cox, Doak C.
Cox, Joel B.
Crosby, William
Cross, Robert F.
Crowell, David
Cushing, Robert L.

Davis, Clifton J.
Davis, Dan A.
Defibaugh, Betty Lou
Degener, Otto
Deibert, Austin
Deming, Horace G.
Denison, Harry L.
Digman, John
Dillingham, Frank T.

Doi, Mitsugi
Doty, Maxwell S.
Doty, R. E.
Duncan, Richard A.

Eber, Laurence
Edmondson, C. H.
Eguchi, George
Ehret, William F.
Eller, W. H.
Emory, Kenneth P.
Enright, James R.

Feldwish, W. F.
Fennel, E. A.
Finch, Ruy H.
Fong, Francis
Forbes, Theo. W.
Fosberg, F. R.
Foster, Zera C.
Fujimoto, Giichi
Fukuda, Mitsuno
Fullaway, David T.

Geddes, David K.
George, Clarence A.
Giacometti, G.
Gilbert, Fred I.
Gil , Robert F., Jr.
Gladding, Elizabeth
Gortner, Willis A.
Gosline, W. H.
Gowing, Donald P.
Gray, Reed A.
Greenwell, Amy B. H.
Gregory, Christopher

Hagihara, Harold H.
Halperin, Sidney L.
Hamilton, Roland K.
Handy, E. S. C.
Harada, M. B.
Hardy, D. Elmo
Harris, Anna E.
Harris, Wray
Harry, J. V.
Hartt, Constance E.
Hartwell, Alfred S.
Heinicke, Ralph M.
Helmick, John
Henke, Louis A.
Herrick, Colin J.
Hiatt, Robert W.
Holmes, Wilfred J.
Horan, John S.
Hosaka, E. Y.
Hosoi, Kiyoshi
Howe, Guy L., Jr.
Hsiao, Sidney C.
Hu, Stephen M. K.
Hudson, Loring G.
Humbert, Roger P.

Ikeda, Warren
Ito, Kiyoshi

Jackson, Dean C.
Jaggar, T. A.
Jermann, Fred
Johnson, David
Jones, Thomas A.
Jones, Thomas S.
Jorgensen, J. Paul
Jorgensen, Margaret K.

Kamemoto, Haruyuki
Kanehiro, Yoshinori
Kask, John Laurence
Katsuki, I.
Kaulukukui Felice W.
Kawano, Henry
Keller, Arthur R.
Kenda, William
Kepner, Gretel Roth
Kepner, Richard D.
Kerns, Kenneth R.

King, Maurice V.
King, Will Norman
Kingsbury, Joe W.
Kirch, William
Kirschman, H. Darwin
Klinkman, Helena M.
Kondo, Yoshio
Koike, Hideo
Kopf, Kenneth
Kortschak, Hugo P.
Krauss, Beatrice
Krauss, F. G.
Krauss, Noel H.
Kunesh, J. F.
Lam, Margaret M.
Lam, Robert L.
Lamb, Alvin R.
Larrabee, L. M.
Larsen, Nils P.
Larsen, Norma
Larson, Harry W.
Lau, Howard K. S.
Leeper, Robert W.
Lee, Hyun Moo
Lennox, Colin G.
Levine, Max
Lind, Andrew W.
Livesay, T. M.
Lohman, Marion L.
Look, Wm. C.
Lord, Edith
Loucks, Burton J.
Loucks, Ruth Baker
Louis, James L.
Louis, Lucille
Lum, C. K.
Lyon, Harold L.

McCleery, Walter L.
Macdonald, Gordon A.
McGuire, Thos. R. L.
McKernan, David L.
McMorrow, B. J.
Magistad, O. C.
Manchester, Curtis A.
Mangelsdorf, A. J.
Martin, Joseph P.
Maruoka, Rose M.
Mason, Leonard
Matthews, Donald C.
Mau, Kong Tong
Midkiff, Frank E.
Miller, Carey D.
Miller, Robert C.
Mitchell, Donald
Mitchell, Wallace
Moe, Clayton R.
Mordy, Wendell A.
Mottl, Joseph R.
Moir, Wm. W. G.
Murray, Hazel C.

Naiditch, Sam
Nakamoto, Goichi
Nakao, Harry
Natsui, Dorothy
Naughton, John J.
Neal, Marie C.
Newell, Irwin
Nickerson, Thomas
Nightingale, Gordon T.
Nishida, Toshiyuki
Nishimura, Earl
Nordfeldt, Sam
Nutting, Lewis M.

Okimoto, Marion
Okubo, Shigeo
Orr, Kathryn J.

Palafox, A. L.
Palmer, Harold S.
Parks, Lawrence
Payne, John H.
Pemberton, C. E.
Pen, Florence

Pinkerton, F. J.
Poole, Charles F.
Porter, H. Paul
Potter, Colin
Powers, Howard A.
Price, Saul
Puth, Maybelle J.

Rhead, Clifton C.
Riesenberg, Saul
Ripperton, J. C.
Rose, Stanley J.
Rosenberg, Morton M.
Royce, William F.
Rusch, Kenneth H.

St. John, Harold
Sakimura, Kay
Sanford, Wallace G.
Scheuer, Paul J.
Schmidt, Carl T.
Schmidt, Helen D.
Scott, Arlen M.
Seeley, Delos O.
Sekiguchi, Nao
Sette, Oscar E.
Sherk, Kenneth W.
Sherman, G. Donald
Sherman, Martin
Shigeura, Gordon T.
Sideris, C. P.
Simpson, Robert H.
Sinclair, Gregg M.
Slattery, Mabel
Smith, Elbert G.
Smith, Madorah
Smith, R. Q.
Spalding, P. E.
Spiegelberg, Carl H.
Spitzer, Blanche H.
Springer, Doris
Stacey, Mary
Sterns, Marjorie
Stewart, William S.
Stidd, C. K.
Stokes, J. F. G.
Storey, W. B.
Suehiro, Amy
Suzuki, F. T.
Swezey, O. H.
Sykes, Walter E.

Takahashi, David
Takahashi, Makoto
Takasaki, Kiyoshi J.
Takazawa, Futoshi
Tanimoto, Ralph H.
Tanimoto, Tyrus T.
Taylor, A. R.
Taylor, Keith L.
Tester, Albert L.
Thorne, M. D.
Titcomb, Margaret
Trouse, Albert C., Jr.
Tuthill, Leonard D.

Urata, Rokuro

Vaksvik, K. N.
Van den Bosch, Robert
van Weel, Pieter
Van Zwaluwenburg, R. H.
Vernon, Mabel D.
Vinacke, W. Edgar
Vinacke, Winifred R.
Voorhees, George

Wadsworth, Harold A.
Wakai, Ted Y.
Wallace, George C.
Warner, H. H.
Warner, John N.
Watson, Leslie J.
Wayman, Oliver
Weatherbee, Carl
Weller, D. M.
Wentworth, C. K.
Wentworth, Juliette
White, J. Warren
Wilbar, Chas. L.
Wismer, Chester A.
Withington, Paul
Wolford, J. J.
Wong, Arthur G. H.

Yamanaga, George
Yanagihara, Iichi
Yee, Florence
Yee, Phillip K. H.
Yoshioka, Tad T.
Young, Hong Yap
Yuen, Quan Hong

Zeitlin, Harry
Zimmerman, E. C.
Zoebisch, Oscar C.

PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE...

TWENTY-EIGHTH ANNUAL MEETING 1952–1953

Published by the University of Hawaii Honolulu, Hawaii, 1953

FOREWORD

The twenty-eighth year of the Hawaiian Academy of Science was marked by a threefold increase —in its membership, in the breadth of its organization, and in its outside contacts.

In May, 1952, the Academy had a membership of 343. Four old members were reinstated during the year, and 102 new members were elected, 30 in November, 1952, and 72 in April, 1953. Fourteen members resigned during or at the end of the year, 14 were dropped, and 6 were lost through death: E. C. Auchter, E. L. Caum, F. T. Dillingham, Louise S. Jessen, and J. J. Wolford. The membership at the beginning of the twenty-ninth year is 415, the largest in the history of the Academy. Thirty-six of the new members are teachers of science in the high schools of Hawaii, the first respondents to a drive to interest such teachers in the continuing contacts with research and applied science, and with other science teachers, that can be gained through the Academy.

Affiliation of the Academy with the American Association for the Advancement of Science was completed in July, 1952, and the Academy took its place with twenty-eight other state or regional academies in the Association's Academy Conference.

The Constitution of the Academy was revised in April, 1953, to recognize the affiliation with the AAAS, to allow for association of local scientific societies with restricted fields, to extend membership eligibility to nonresidents, to spread the responsibilities of the Academy government among more members, and to improve the method of electing officers.

The Annual Meeting comprised two sessions, totaling five evening meetings, November 13 and 14, 1952, and April 16, 17, and 18, 1953. Twenty-one individual scientific papers, including the presidential address, and a symposium on Hawaii's resources, conducted by a panel of six speakers, were presented at these meetings. The offering of papers was so great that three of these papers could be presented by title only. Attendance at the meetings ranged from 75 to 150, indicating an increased interest in both the membership and the public.

OFFICERS

1952–1953

President, Harry L. Arnold, Jr.
Vice-President, William B. Storey
Secretary-Treasurer, Doak C. Cox
Councilor (2 years), Donald Mitchell
Councilor (1 year), J. H. Beaumont
Councilor (1 year), L. D. Baver (ex officio)

1953–1954

President, William B. Storey
Vice-President, Colin G. Lennox
Secretary, Doak C. Cox
Treasurer, Beatrice Krauss
Councilor (2 years), Kiyoshi Ito
Councilor (1 year), Donald Mitchell
Councilor (1 year), Harry L. Arnold, Jr. (ex officio)

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

THE 28th ANNUAL MEETING 1952-53

Program

NOVEMBER 13, 1952

HAWAII'S RESOURCES—A SYMPOSIUM

Harold S. Palmer: Mineral Resources.
Vernon E. Brock: Marine and Fresh-Water Resources.
C. G. Lennox: Forest Resources.
Harry F. Clements: Prospects for Expansion of Crop Production.
Oliver Wayman: Animal Husbandry Potentials.
James H. Shoemaker, moderator: General Discussion.

NOVEMBER 14, 1952

Business Meeting and Election of New Members
David D. Bonnet: Filariasis in Recent Samoan Immigrants.
Sidney C. Hsiao: Reaction of Tunnies to Visual Stimuli.
Andrew W. Lind: Changing Racial Complexion of Hawaii's Children.
James Milne: Meto—Marshallese Navigation.
W. Edgar Vinacke: Some Factors Affecting Interracial Attitudes.
Robert W. Hiatt, John J. Naughton, and Donald C. Matthews: Effects of Chemicals on a Schooling Fish.
P. B. van Weel: Mechanical Properties of the Resting Holothurian Muscle.

APRIL 16, 1953

Wallace G. Sanford: Effect of Root Temperature and Cation Balance on Snap Beans.
C. E. Palmer: High-Level Tropical Cyclones.
Harvey A. Miller: Moss Societies on Oahu.
Joseph E. Alicata: Control of the Swine Kidney Worm, *Stephanurus dentatus.*
Vernon E. Brock: A Method of Estimating Reef Fish Populations.
John F. Mink and Kiyoshi J. Takasaki: The Tsunami (Tidal Wave) of November 4, 1952.
John S. Horan: A Possible Preventive Treatment for Baldness in Young Men.

APRIL 17, 1953

Leonora Neuffer Bilger, Gustav Ecke, and Claude Horan: A Simple Laboratory Process to Distinguish Genuine from Fake Hui-hsien Ceramic Specimens.
William A. Gosline: The Need for Taxonomic Work on Central Pacific Marine Organisms.
Alexander Spoehr: Oceanic Prehistory.
Robert W. Hiatt: Relation of the Ghyben-Herzberg Lens to Horizontal Zonation on Atoll Coral Reefs.
Grote Reber: Cosmic Static.
M. L. Lohman: A Locally Appearing Poisonous Mushroom, *Lepiota molybdites.*

APRIL 18, 1953

Annual Banquet
Business Meeting and Election of Officers
Address of the Retiring President, Harry L. Arnold, Jr.: Algeomorphic Diseases.

Abstracts

MINERAL RESOURCES

Two categories of mineral resources, metallic ores and mineral fuels, are lacking in Hawaii, but there are a few of the nonmetals other than fuels—water, building materials, and a few others.

That our water is derived from rainfall is shown when floods and rises of water levels follow heavy rains.

On Oahu we have withdrawn more water from underground than rainfall has replaced, as shown by the secular drop of artesian levels, originally 42 feet above sea level in central Honolulu but 9 to 19 feet lower since 1924. A marked rise of sea water, on which floats the lighter fresh water, has caused some wells to yield salty water. We can avoid salting of our water supply by using horizontal tunnels that skim the top of the fresh-water body. We must also avoid waste and low-grade uses of water.

Our narrow, steep valleys are unsuited to storing surface water. Water power has been developed in two situations—where rain falls abundantly all year and where water is dropped from higher to lower ditches of irrigation systems.

Few quarries yield dimension stone, but rock for road metal and concrete aggregate is fairly available. Much of what is quarried is too full of gas pores or too clinkery for such uses, but some is used for walls of dry masonry and some for fill.

Concrete also requires sand and cement. Beach sand varies greatly in abundance from island to island, with Oahu perhaps best supplied. Studies should be prosecuted to learn whether we are harvesting an annual crop of sand or mining an accumulation of the ages. Lava rock can be crushed to small sizes as a substitute for beach sand.

Portland cement is a mixture of silicates and aluminates of calcium. Beach sand and reef rock can supply plenty of calcium, and a few unusual bodies of lava rock have enough silica and alumina for cement making.

Lime is produced in a few plants by calcining beach rock.

Salt has been produced in varying amounts by evaporating sea water.

HAROLD S. PALMER

MARINE AND FRESH-WATER RESOURCES

Only the fishery resources are considered here. They may, for convenience, be considered in the following three categories: fresh-water fishery resources, reef, inshore, and bottom fishery resources, and pelagic fishery resources.

The fresh-water fishery resources are presently of greatest importance as a source of recreation. Aside from several species of native fresh-water gobies, the worth-while species are introductions such as trout, bluegill sunfish, and large-mouth black bass. There are possibilities of profitable rearing of fresh-water pond fishes, but some research and developmental work is necessary, and it may be difficult to get a rapid acceptance of these species as food fishes by the public. The fresh-water fishery resources are, by the limited nature of fresh-water areas in Hawaii, of limited importance.

The reef, inshore, and bottom fish resources of Hawaii depend upon the presence of shallow to moderate depths of water for a suitable environment. Since the Hawaiian Islands are essentially the peaks of great submerged mountain masses, the shallow to moderate water depths represent relatively narrow encircling bands around each of the islands. Therefore, the limited available environment limits the production which may be obtained from this segment of the fishery resources. However, many of the species taken in shoal-water areas are excellent food fishes in substantial local demand and, therefore, command a high price in the markets. Reef fishes and reef areas are important also from a recreational standpoint.

The pelagic fishery resources are composed of relatively few species of active, wide-ranging fishes which are largely confined to the shallow isothermal waters of the open sea. They are not dependent upon the existence of land masses; in fact, recent work by Pacific Oceanic Fishery Investigations indicates that they are abundant in regions about as remote from land as it is possible to be. Also, their relative abundance may be influenced by abundance of food, which in turn is dependent upon the relative enrichment of water within the photosynthetic zone. Any interaction of ocean currents or other hydrographic mechanism which raises water from below into the photosynthetic zone may mark a concentration of pelagic fish.

Some 14 to 17 million pounds of tunas, spearfishes, and other pelagic species are landed annually in Hawaii at the present level of exploitation. Aside from a single species of tuna—the aku—this catch largely goes to the fresh-fish market, a market which, while not saturated, is capable of absorbing only a limited increase in catch. The aku is canned for sale in mainland as well as island markets, and the factors which limit a catch appear to be other than the supply of fish in the sea. An expansion of the local pelagic fisheries would, for species other than aku and moderate to small ahi, involve possibly some technological work and more efficient methods of fishing; for aku, only more efficient methods of fishing are needed.

The Japanese developed a productive offshore albacore tuna fishery to the immediate north of Hawaii (within 500 miles or less of Midway Island), and the investigations of P.O.F.I. have indicated the existence of a large yellowfin tuna resource in the equatorial area directly south of Hawaii. Hawaii is the closest center to both these areas; if certain problems in catching these fish efficiently and processing them economically can be solved, a major fish-processing industry for Hawaii is possible.

VERNON E. BROCK

FOREST RESOURCES

The flora complex of Hawaii, which still dominates the "wet forest" regions, evolved in the absence of influences exerted by man or large animals and consequently died out in many instances where such influences upset the existing delicate ecological balances. Introduced insects, diseases, and plants have also exerted their full influence in hastening the change of the flora complex, so that today is witness to a forest complex which is undergoing constant change. Recognition of the need to maintain a forest complex on a large proportion of the land area in order to prevent serious losses of rainfall from surface runoff dates back to 1876, but not until 1903 were official steps taken to set aside forest areas for forest-cover protection. By 1906, 337,140 acres had been formally set apart as forest reserves. This work progressed with more areas being studied, surveyed, and proclaimed annually until by 1936 more than one million acres had been placed in the category of protected forest reserves.

This is a continuing study with new areas being added where watersheds become increasingly important with shifts of population and water demand. Government lands within forest reserves are placed under the control and custody of the Territorial Board of Agriculture and Forestry in accordance with the Hawaii Organic Act, and privately owned lands are exempt from property taxes if they are maintained as watersheds. There are over 700,000 acres of government lands and 360,000 acres of private lands in forest reserves. All forest reserves are managed as watersheds and are under the supervision of only one agency, the Board of Agriculture and Forestry.

Basic principles followed are the establishment and maintenance of a dense vegetative cover (consisting of an upper story of trees and an under story of ferns, shrubs, grasses, and vines) through exclusion of grazing animals and protection from fire. Such a cover promotes increased moisture from fog drip and decreased losses from runoff by maintaining a surface soil condition conducive to rapid infiltration. Recreation is a forest resource which is encouraged and developed in regions where it will not adversely affect the water resources.

Timber products have played a minor part as a forest resource in Hawaii during the past thirty years. Ohia lehua, *Metrosideros collina,* is in great abundance, and, although a hardwood of high value, it has not been able to compete in price with similar imported timber. Koa, *Acacia koa,* is in limited isolated stands of diminishing size, and there is no prospect of its being increased by replanting. The forestry planting program of the past forty years has utilized timber species from other parts of the world because of their more favorable vigor and growth rates. Many of these stands are reaching maturity for harvesting, and a timber cruise of 800 acres on the Island of Hawaii in 1952 revealed that more than thirty million board feet are now available from twenty-one species.

Stumps of giant tree fern, *Cibotium chamissoi,* is a forest product for which in recent years an export market has been found. A survey to estimate stocks available presented a figure of over three-quarters million cords of merchantable fern stump.

C. G. LENNOX

PROSPECTS FOR EXPANSION OF CROP PRODUCTION

Hawaii is confronted with an unfavorable balance of trade. In general it may be stated that the approach to a solution of the problem includes increasing the efficiency of our established crops, utilizing more of the crops for marketable products, and developing new crops and products not only for export but also for local consumption.

In developing new crops or products, several principles should be considered. First, it is desirable to produce things for which there is a definite local market. Second, new crops should be grown on lands not now used for major crop production. Third, productivity of lands already in use should not only be safeguarded but increased. Fourth, production of new products for the mainland market should meet the standards of highest quality. Fifth, production of new or additional products for the local market should follow normal, efficient methods of production and distribution.

HARRY F. CLEMENTS

ANIMAL HUSBANDRY POTENTIALS

The livestock industry in Hawaii has grown steadily from the time of Vancouver in 1793 until the present. There have been periods of fluctuation in this growth according to varying economic conditions. With the exception of sheep, the number of major farm animals has continued to increase gradually. Sheep reached a numerical peak in 1884 and have decreased continually since then.

Our beef cattle can continue to increase through expansion of pastures in favorable rainfall areas, extension of watering facilities into dry areas not now grazed but producing seasonal forage, more effective use of the by-product feeds now available, improvement of our present range through introduction of more nutritious forages, and improvement of the quality of animals produced by selection for economy and rapidity of gain. Dairy-cattle potential has the same limiting factors as beef, plus dependence upon imported protein feeds and localization in high-cost areas. It may be advisable some time in the future to move dairy cattle to the outlying islands and ship milk to Honolulu by barge. As sheep decrease, they are replaced by cattle. In many areas they can be grazed together to the benefit of the range because of their differential grazing habits. Swine and poultry are in the most precarious position of our livestock, yet they present a broad field for expansion and improvement. Both are dependent on a local preferential market for their continuance. In free competition with mainland supplies, unaided by a market willing to pay a large bonus for immediate freshness or specific product characteristics, both would decrease in importance to a minimum. However, our greatest advances in the use of local by-products for feed are being made with these animals because of their great ability to utilize carbohydrates.

Blackstrap molasses has been used for years in limited quantities in swine and poultry feed. Our recent studies have shown that B-grade molasses can replace barley in the swine ration, pound for pound, up to at least 40 per cent of the ration, with a similar use for poultry. Cane bagasse is an excellent absorbent for use in feeding molasses in a nonliquid form. Pineapple tops and syrup have proved excellent feeds in the past and are again being tested under new conditions. Additional pineapple by-products are being prepared for test. Much of our protein requirements could be met by utilizing fallow lands to raise protein feeds.

Through co-ordination of our industries and optimum utilization of our resources, our livestock industry has room for growth far beyond what it is today.

OLIVER WAYMAN

GENERAL DISCUSSION

An economy is the adaptation of a people to their resources. The man/land ratio, or, expressed another way, the labor/job-opportunity ratio, is the fundamental factor in an economy. Hawaii has had an unusual population history, consisting of a decline from pre-Cook times until 1872 when there was a population of only 56,000 people and, since, an increase to the present population of 465,000. Accompanying the increase, and in large measure causing it, there has been a rise in industry. Now there is a fundamental change. Instead of increasing production rates requiring increasing manpower as in the past, the manpower increase is now calling for increased production. Discussions of the nature, limitations, and potentialities of our resources, like those in this symposium, are basic steps in studying possibilities of expanding our economy.

The service industry, it should be noted, is not based particularly on the resources discussed, but on the geographic position of the Islands. Secondary or derivative industries, also, are not based directly on natural resources. However, an increase in the primary industries is reflected in an increase in the secondary industries and, thus, throughout the whole economy.

Cheaper power would assist the economy in many ways—for example, in the proposed nitrate production. The possibility of utilizing volcanic power is intriguing, but no economic mechanism for developing such power here is known. Gravity power possibilities (dropping cinders or clinkers from high levels to low on a belt) are also intriguing.

Some areas now in forest or grazing could be utilized for agriculture if markets could be developed for the kinds of crops that will grow on them. Orchards are already being developed on some of them. However, much of the land in forest reserves is either too dry or too wet even for cattle. The terms of leases, particularly their length, have an important effect on the amount of capital improvements that can be made and, thus, on the efficient use of the leasehold lands that constitute a large proportion of the total land.

One deterrent to both production and consumption of local minor crops is the large cost of marketing. However, some increases in production seem possible —for example, in tomatoes. For other minor crops, such as taro, a continuance of present production is all that can be expected.

It is conceivable that we can increase beef production to the point of self-sufficiency, or perhaps even to the point of exporting. By-product utilization in the major industries is one of the principal requirements for such an increase. It may some day be more efficient to restrict milk production to the outer islands, where land values are lower, and transport the milk to Oahu by barge. Protection of feed-importation schedules from shipping tie-ups is vital.

JAMES H. SHOEMAKER, MODERATOR,
AND MEMBERS OF THE PANEL

FILARIASIS IN RECENT SAMOAN IMMIGRANTS

On July 28, 1952, a group of 928 individuals arrived at Honolulu by ship from American Samoa. This constituted a mass migration of approximately 6 per cent of the population of Samoa. Through the co-operation of the Navy, blood samples were obtained by venipuncture from 922 of the new arrivals. These samples were examined by the Department of Health, and 160, or 17.3 per cent, were found to be positive for filariasis. This constituted a hazard to the Territory inasmuch as work previously done in Hawaii by the author and by Dr. Stephen M. K. Hu has shown that our local *Culex* mosquito can develop the parasite microfilaria from a Samoan donor to the infectious state. The influx of a large infected reservoir, therefore, produced the possibility of establishing an endemic focus. To forestall such an eventuality, a survey of places of residence was made, *Culex* mosquito control was intensified in those areas, and a three-week course of medication with Hetrazan was initiated by the Health Department.

Repeat blood tests indicated that within a week medication markedly reduced the number of microfilaria. It is believed that as a result of the combined medical treatments and mosquito reduction, the possibility of secondary cases of filariasis occurring in Hawaii as a result of this migration has been eliminated.

DAVID D. BONNET

REACTION OF TUNNIES TO VISUAL STIMULI

The oceanic species of tunnies, *Euthynnus yaito* (Kishinouye), has been subjected to experimentation under controlled conditions for the first time. In this report the apparatus and the experimental methods employed are described, and the results obtained with the use of artificial lures are summarized.

When artificial lures were lowered into the pond, they increased (with one notable exception) the number of times groups of tunnies entered into the field of observation from 150 to 500 per cent that of the control. But, when both aqueous extract of fish meat and artificial lures were used, there was always an increase in the frequency of groups entering the field of observation, ranging from 186 to 572 per cent that of the control, during the first 15-minute observation period immediately after the addition of the fish meat extract. There is a high degree of variation in this increase during successive periods of observation in each day's experiment, as well as between observations made on different days. The swimming rate of the tunnies was doubled when both fish meat extract and lures were employed.

The tunnies reacted positively by either swimming toward the lures with increased speed (making a "pass" at the lure) or by attempting to bite the lure. There is indication that they reacted positively more often at the beginning of this study than they did later (this might be due to learning). Addition of aqueous extract of fish meat also excited the tunnies to run for the lures with a frequency increased by 95 to 500 per cent over that obtained by lowering lures alone. There was no sign of decrease in the number of positive reactions to the lures under the influence of fish meat extract as this study progressed.

For a comparative study of the reaction of tunnies to color, lures of different hues were presented in pairs to the fish. No striking preference was shown by the tunnies toward a particular hue, when the colored lures were lowered into the pond either when fish meat extract was diffusing through the water or when no extract was used. The effect of position of the lures in this type of choice experiment was counterbalanced by interchanging the position of the lures in each pair on consecutive trials. Aqueous extract of fish meat always increased the number of positive reactions of tunnies toward the lures lowered at them.

Further work on the movement of colored objects through the water as lures for tunnies is still in progress.

SIDNEY C. HSIAO

CHANGING RACIAL COMPLEXION OF HAWAII'S CHILDREN

Accepted for publication under the title "A Measure of Miscegenation in Hawaii" in the *American Sociological Review.*

Hawaii's reputation as an observatory of race relations depends largely upon its ability to provide an accurate and dependable record of the interaction between its various ethnic groups. The statistics of a mounting intermarriage rate among these groups have been used and abused as supporting evidence for the rapid amalgamation of racial stocks and of the consequent futility of attempting to keep further population records of the separate racial groups.

Actually, a more accurate index of Hawaii's racial fusion is found in the records of the births of the Territory according to the racial ancestry of the parents. An analysis of these records for the past twenty years provides the basis for judgment as to how and to what extent each of the major ethnic groups is contributing to the future population of Hawaii. In general, these statistics confirm the predictions regarding racial trends made by Romanzo Adams, but they have also revealed certain developments which he could not have anticipated.

Records of the racial ancestry of both parents are available for a total of 194,430 births which occurred in Hawaii between July 1, 1931, and December 31, 1950. Of this number, 134,272 or 31 per cent were of mixed racial ancestry, i.e., had known ancestors from two or more of the seven principal ethnic stocks recognized in Hawaii. The proportion of children whose ancestry was exclusively from one ethnic group has steadily declined during this period, from 77.6 per cent in the first two years to 69.5 per cent in the years 1938–42, and to 66.7 per cent in the last period, 1946–50.

Nearly half the children born between July 1, 1931, and June 30, 1933, had at least one parent, if not both parents, of Japanese, Chinese, or Korean ancestry. While the ratio of parents of Oriental ancestry declined steadily to 41.5 per cent in the last four-year period (1946–50), the ratio of parents of Caucasian ancestry increased from 16.7 per cent to 27.0 per cent. During the same time span, the ratio of parents of Hawaiian or part-Hawaiian ancestry remained substantially the same.

The ethnic combinations revealed among the children born in Hawaii have become progressively more complex. For example, twenty years ago the Japanese population contributed only slightly to the birth of mixed-blood children and that chiefly among the Hawaiians. Of a total of 8,592 children born to Japanese parents during the initial two-year period, only 458, or 5.3 per cent, had one non-Japanese parent. This ratio had increased to 14.2 per cent during the period of World War II and to 17.6 per cent in the postwar period. Moreover, the non-Japanese parents of the Japanese hybrids were noticeably more evenly distributed among the various ethnic groups then than in the early thirties. A similar trend, to a more marked degree, is evident among the Hawaiians, Puerto Ricans, Koreans, and Filipinos, whereas among the Caucasians and Chinese the trend is less marked or even reversed.

ANDREW W. LIND

METO—MARSHALLESE NAVIGATION

Marshallese navigators base their sailing instructions largely on the prevailing ocean-swell patterns. Four principal swells are recognized:

Swell from	General term	Navigational term: when traveling north or south	Navigational term: when traveling east or west
North	Non-en	Bontok-en	Drilep
East	Non-in-rear	Drilep	Bontok-rear
South	Non-rok	Bontok-rok	Kaelep
West	Non-kobiling	Kaelep	Bontok-lik

These swells are distinguished by differences in size and velocity. The drilep (backbone) is either the large swell from the north or that from the east, whichever has crests paralleling the desired direction of travel. Waves resulting from interference of opposing swells, either from north and south or from east and west, are kaileptok. As islands are approached, reflected or interference waves are encountered: jalotlot-ae, farthest from the island, jalot-ae next, and juk-ae closest. The types of waves discussed above are those diagrammed on elementary stick charts, the simplest type of a series of five types used by Marshallese navigators. The advanced charts show local complications of wave patterns.

In addition to the swell pattern, kōklol (signs) are used to determine position, their significance being recorded in chants. These signs include the appearance of birds, accumulations of floating trash, etc.

After "textbook" training from stick charts and by chant memorization, students are taken to sea and taught to recognize the features they have learned, first visually, then by the motion of the vessel on various headings.

Most skilled Marshallese navigators were employed during World War II by the Japanese navy and were lost during the Battle of Midway. Few survive, and their skill is not being adequately transmitted.

JAMES MILNE

SOME FACTORS AFFECTING INTERRACIAL ATTITUDES

Both sexes of seven national-racial groups characterized eight national-racial groups (including themselves). They also judged the favorableness or unfavorableness of the traits assigned. This report concerns uniformity (amount of agreement), intensity (degree of favorableness-unfavorableness of traits), direction (approval-disapproval of the group rated), and familiarity. Besides interrelations among these variables, self-characterizations were compared to characterizations of others. Analyses were conducted by means of chi-square and tests of significance of differences between percentages.

Uniformity, intensity, direction, and familiarity operate much as expected. Thus, "good" groups are characterized with many high uniformity-high intensity traits, "bad" groups with many high uniformity-low intensity traits. More familiar groups are characterized with more uniformity than are less familiar groups.

Self-characterizations consist of predominantly high intensity traits, though not to the degree typical of good groups. There is little difference in uniformity between self-characterizations and characterizations of others.

Two especially revealing tendencies were found. There is evidence that a group is influenced in its characterizations of others by the favorableness or unfavorableness with which it is characterized by them. Tentatively, it is hypothesized that bad groups are characterized more favorably by those they consider bad than by those they consider good, and that good groups are characterized more favorably by those they consider good than by those they consider bad. Each group also tends to rate more favorably traits considered typical of self than other groups rate those same traits. This difference is much greater in comparison to ratings by good groups than to those by bad groups. This tendency may be a function of projection.

In general, the results bear out the contention that stereotyping can best be understood as an intricate pattern of two-way processes.

W. EDGAR VINACKE

EFFECTS OF CHEMICALS ON A SCHOOLING FISH

Published in full under the title of "Effects of Chemicals on a Schooling Fish, *Kuhlia sandvicensis*" in *Biological Bulletin,* 104(1): (1953), 28–44.

The object of this research is to discover chemical substances which, in exceedingly dilute proportions, will induce blindness or will act as extreme irritants or repellents to effect rapid dispersion of schooling fish. Types of chemicals found most successful thus far in effecting the dispersal of the schooling fish, *Kuhlia sandvicensis,* are halogenated ketones, organic thiocyanates (particularly unsaturated, halogenated, and nitrated), organic isothiocyanates (particularly unsaturated, halogenated, and nitrated), nitrated olefins, and inorganic cyanides. In general, it has been found that sulphur and a high degree of halogenation in an organic molecule increase the desired irritant property. Chemicals possessing power as lacrymators and skin irritants are most likely to be effective as fish-dispersing agents, and the most effective compounds of a related series are usually those of lowest molecular weight, presumably because of their great solubility in sea water.

ROBERT W. HIATT, JOHN J. NAUGHTON, AND DONALD C. MATTHEWS

MECHANICAL PROPERTIES OF THE RESTING HOLOTHURIAN MUSCLE

The muscle, as an organ, has two functions to perform: (1) to contract and by so doing to cause a movement, and (2) to maintain a certain length or tension. Both these functions are performed by striated and by smooth muscle, but the second is usually more characteristic of the smooth muscle. Because this muscle maintains a certain tension practically indefinitely and (contrary to the striated one) apparently without an increased metabolism, it has been claimed that this muscle is physiologically fundamentally different from the striated muscle. Therefore, its tonus would be fundamentally different from the tonus of the striated muscle which is based on a rotating tetanus of a certain number of muscle fibers, the other fibers remaining completely relaxed. An increase in metabolism goes hand in hand with this kind of tonus.

In Holothurians we have two different kinds of smooth muscle: (1) the longitudinal and circular muscles, especially used in the movements of the animal, and (2) the cutis muscles, which maintain the tone, or the turgor, of the animal. To study the tonus of the smooth muscle, the muscle must be at rest, as the rapid contractions are used only in motility.

Since the tonus (the maintenance of a certain tension in the muscle) is maintained without an appreciable increase in metabolism, the structure of the muscle must be (partially) responsible for it. When the muscle is stretched, it will yield to the stretching force in such a way that the tension does not change. This expresses itself in the peculiar stretching curve, a curve which can also be obtained in such lifeless matter as plasticized, nonvulcanized rubber: a perpendicular "free fall" which gradually curves out into a steady, straight decline (the Bingham curve). Rubber research has revealed the probability that such a curve is the result of (1) the stretching of elastic, submicroscopic micellae (free fall), and (2) their displacement through an intermicellar viscous fluid. As the stretching curve of the smooth muscle is actually of the same type, it might be possible that it has the same type of submicroscopic structure. The following experiments seem to confirm this hypothesis.

When the muscle is stretched for a certain period of time, after which the load is suddenly released, the muscle does not shorten to its original length (as the striated muscle will do), but achieves only partial recovery, remaining in a state of relaxation until it again contracts. Recovery must be the result of a shortening of the stretched elastic micellae, as the recovery is constant. Relaxation is, therefore, an expression of the displacement of the micellae as a result of the stretching.

When the micellae are pulled through a viscous medium, a resistance will be built up in front of them proportional to the pulling force, just like the resistance in front of a moving snow plough. The snow "wave" has a height more or less proportional to the force which builds it. When, in a smooth muscle, the pulling force ceases, it will take some time for this wave of resistance to flow off. This snow-plough effect really exists in the smooth muscle. When a high wave is built by a pulling force, the micellae will not move any further; when this force is suddenly weakened, when enough of the wave has flowed off, the weaker stretching force can pull the micellae through the remaining resistance. The result is that, instead of a continuously sloping stretching curve, there is a horizontal one for some time. The snow-plough effect is also well demonstrated in the so-called paradoxon of the decrescent (Jordan).

If a viscous intermicellar fluid exists, a change in temperature will markedly affect the velocity of micellar displacement (the stretching of the muscle). The lower the temperature, the slower the stretching, when the same weight is used. Therefore, this hypothesis must be accepted as a very real possibility. Although the physical properties do not take care of the maintenance of the tonus (the continuous slight positive pressure exerted by the muscle), it no doubt helps. Consequently, only a very small amount of energy is needed for this purpose. As the entire muscle takes part in this process, and not only a few muscle fibers as in the striated muscle, it is possible that the increase in metabolism is so small that it escapes our methods of determining it. In this respect the smooth muscle indeed differs fundamentally from the striated one. There is no tetanus, as recording of action currents shows. The cutis muscle shows exactly the same phenomena, except that the wave effect is much more pronounced because the intermicellar fluid is apparently much more viscous.

P. B. VAN WEEL

EFFECT OF ROOT TEMPERATURE AND CATION BALANCE ON SNAP BEANS

In this study, snap beans were grown in solution cultures supplied with varying ratios and concentrations of the cations K, Ca, and Mg, with anions remaining constant in all treatments. The total concentration of cations in the nutrient solutions was 25.5 m.e./L. The plants were subjected to controlled root temperatures, but the top environment was that which prevailed in the greenhouse during the experiment. The controlled root temperatures were 80°F. and 60°F. There were a total of 96 temperature-nutrient treatments in the experiment.

The following significant results were obtained.

1. Variations in growth as measured by total dry weight of the plants were obtained with variations in the nutrient substrate and the root temperature.
2. Under an environment presumably favorable to maximum photosynthesis, a root temperature of 80°F. resulted in twice the growth produced at 60°F.
3. Good vegetative growth was obtained over a wide range of cation concentrations in the substrate. Growth was decreased when one cation overwhelmingly dominated both of the other cations in the substrate. Under these conditions, high Ca produced the best growth, high K less growth, and high Mg the least growth. When Ca exceeded K in the substrate, the toxic effect of high Mg in the substrate was greatly reduced. At low levels of any one of the cations, i.e., 3 m.e./L. or less, much better growth was obtained when the remaining two cations were nearly in balance. Under these conditions, the greatest reduction occurred when Ca was at a low concentration in the substrate.
4. Vegetative growth was little affected by extreme variations in leaf concentrations of K or Mg, whereas low levels of Ca were associated with reduced growth.
5. The concentration of a cation in the leaf tissue increased as the cation increased in the substrate.
6. At a given level of K in the substrate, K concentration of the leaf tissue increased as the ratio of Mg:Ca increased; at a given level of Mg in the substrate, Mg concentration of the leaf tissue remained constant regardless of the K:Mg ratio.
7. Analyses of leaf tissue grown in any nutrient treatment containing 8.5 m.e./L. or more of Ca in the substrate indicated that K concentration in the tissue decreased with increases in root temperature while Mg and Ca increased.
8. Under the conditions of this study, Ca had the greatest influence on growth and ultimate concentration of both K and Mg in the leaves.
9. The effect of temperature on the concentration of cations in the leaf tissue differed depending on the cation balance of the nutrient solution.

WALLACE G. SANFORD

HIGH-LEVEL TROPICAL CYCLONES

Published in full under the title of "Impulsive Generation of Certain Changes in the Tropospheric Circulation" in *Journal of Meteorology,* 10:(1953), 1–9.

An article in the October, 1951, issue of the Transactions of the American Geophysical Union entitled "On High-Level Cyclones Originating in the Tropics" suggested, as a result of the study of two weather situations, one in June, 1946, and another in March, 1949, that cyclonic circulations may originate in the high troposphere above 30,000 feet and between 15°N and 10°N in the longitudes of the Marshalls. The cyclones, originating in a region normally showing anticyclonic zonal wind shear, may remain stationary over the Marshall Islands for as long as two weeks, extending downward to 20,000 feet or less. After the initial period of genesis they usually move toward higher latitudes.

Since the publication of the A.G.U. article more evidence, chiefly derived from data acquired during the nuclear weapon tests of 1951 and 1952, has accumulated to confirm and amplify the original hypothesis. This paper is devoted to a discussion of this evidence, with special reference to the weather situation over the Marshalls in mid-April, 1951. The situation yields new data concerning the cloud distribution that develops during the cyclogenesis, the precipitation regime, and the distribution of the vertical component of vorticity. These new data are then used in discussing the relation of upper level tropical cyclones to the cold lows of higher latitudes, described by Palmén. It appears that the present practice of ascribing all tropical cold lows, that are cut off from high-level pressure troughs, to the dynamical processes first advanced by Palmén may be erroneous.

C. E. PALMER

MOSS SOCIETIES ON OAHU

The study of the societies, or associations, of Hawaiian mosses has been given little attention by previous bryologists who have been acquainted with the local flora. There are two reasons for this—no earlier worker has been a permanent resident in Hawaii, and the primary concern has been with the taxonomy of the mosses. Some of the associations have been selected from the forests on Oahu and briefly described within rather broad limits. These communities have been grouped within the life forms proposed by Gams (1932), a European bryocenologist with experience in Java.

NEREIDIA. *Limbella tricostata,* known on Oahu from Punaluu, Kipapa, and Makaleha streams, is our only aquatic moss.

AMPHI-NEREIDIA. Some Hawaiian mosses undergo periodic submerging (i.e., *Baldwinella kealeensis, Philonotis, Ctenidium*), but none are restricted to this particular habitat.

EPIPETRIA. *Rhacopilum cuspidigerum* is the most common moss on rocks in mesophytic forests. *Thuidium* and *Homaliodendron* occur together on moist stones. Deep humid gulches contain rocks covered with *Ctenidium, Ectropothecium, Thuidium, Hookeriopsis,* and *Mnium rostratum. Fissidens* and *Homaliodendron* occur on the sides and *Baldwinella* at the base of these rocks. *Philonotis* is almost restricted to dripping rocks or banks, but *Campylopus introflexus* and *Macromitrium brevisetum* are found on exposed rocks subject to frequent desiccation.

EPIPHYTIA. Epiphytes are abundant in the rainforests, with *Macromitrium piliferum, M. owahiense,* and *Acroporium fusco-flavum* the most common. Other species of *Macromitrium,* Dicranaceae, Sematophyllaceae, and Meteoriaceae, are found growing on bark or hanging in pendant masses on limbs.

XEROGEOPHYTIA. Mosses which grow on soil and which are annuals or have a dry "resting period" are relatively rare in Hawaii. *Weisia ovalis, W. viridula,* and *Bryum argenteum* var. *lanatum* have been collected by the author on Koko Head and on the dry flats at Kealia and should be included here.

HELOPHYTIA. The major peat-forming mosses on Oahu are species of *Leucobryum, Rhizogonium,* and *Campylopus.* Liverworts play a vital role in peat formation, but *Rhacomitrium,* which is so abundant in the bogs of Kauai, Molokai, Maui, and Hawaii (along with *Sphagnum* on the latter two), is unknown on Oahu.

BRYOCHAMAEPHYTIA. Humus soil, including decaying logs, is the substratum for many Hawaiian mosses. The more conspicuous of these are *Leucobryum, Rhizogonium, Plagiothecium,* and members of the families Hookeriaceae, Dicranaceae, and Sematophyllaceae.

EXOCHOMOPHYTIA. *Dicranella, Pogonatum, Funaria, Bryum, Trematodon, Campylopus,* and *Anoectangium* are found in dense tufts on exposed mineral soil.

Detailed descriptions of *coenosia* could be employed by foresters and others interested in developing natural resources.

HARVEY A. MILLER

CONTROL OF THE SWINE KIDNEY WORM, *STEPHANURUS DENTATUS* (NEMATODA, STRONGYLOIDEA)

To be published in full under the same title in *American Journal of Veterinary Research.*

Stephanuriasis is one of the most important parasitic diseases of swine in many areas, including Hawaii and other Pacific islands. Economic losses are sustained from emaciated carcasses and condemnation of parasitized livers and kidneys at slaughter. Of 16,323 hogs slaughtered in Honolulu during a part of 1952, 3,466 or 21.2 per cent showed kidney worms.

Because of the need for improved methods of kidney worm control, observations have been conducted on the value of Polybor-3 (Pacific Coast Borax Co.), a combination of sodium pentaborate tetrahydrate and sodium tetraborate pentahydrate, for the destruction of the larvae in soil. In these experiments the soil was artificially infected with infective larvae, and the chemical was applied dry or as a spray at the rate of 5 pounds to 100 square feet. The treated soils and the corresponding untreated controls were then examined for viable larvae ten and twenty days later.

In experiments carried out in small outdoor plots, the percentage of viable larvae recovered from treated soils in contrast with corresponding untreated controls was 9.7 to 15.1 per cent at ten days after treatment and 0.1 to 0.2 per cent at twenty days after treatment.

Further observations on the viability of the infective larvae in the above experiments revealed that rabbits fed larvae taken from soils ten days after chemical treatment showed only a few liver lesions at necropsy one month later; a rabbit fed larvae recovered from soil twenty days after treatment showed no liver lesions. In contrast, all the corresponding control rabbits fed larvae from untreated soils developed extensive liver lesions. In addition, a pig fed infected soil twenty days after treatment showed no liver lesions at necropsy, whereas the corresponding control pig fed untreated infected soil exhibited many liver lesions.

In experiments where kidney worm eggs were superficially mixed with soil recently sprayed with Polybor-3, no live larvae were recovered when the soil was examined five days later. Many active infective larvae, however, were recovered from the corresponding untreated control soils.

No ill effects were noted in a young pig kept for one month in a small enclosed area which was treated twice with Polybor-3.

It is concluded that Polybor-3 can be utilized to good advantage by hog raisers in (1) rendering an already infected hog lot comparatively free of kidney worm larvae, and (2) in maintaining, by frequent application, a low level of kidney worm larvae in soil where infected animals are kept. Polybor-3 is injurious to plants and should not be used where vegetation is to be maintained.

JOSEPH E. ALICATA

A METHOD OF ESTIMATING REEF FISH POPULATION

There is a need to obtain a measure of abundance of reef and inshore fish populations in Hawaii which does not depend upon a study of fluctuations in the fishermen's catch. Although a considerable quantity of table fish from reef and inshore areas is taken by commercial fishermen and statistics of the landings from this source are routinely obtained, the unrecorded catch of those who fish for sport or food may be of greater magnitude, and satisfactory statistics of the catch of this group are most difficult to obtain. However, if these fisheries are to be managed, methods of measuring abundance are necessary, because, if the effects of management cannot be discerned, justification of management or regulation disappears.

During the last year an attempt was made to develop a method of visually estimating abundance of reef and inshore fish populations. Advantage was taken of the clear warm waters of Hawaii and the availability of a self-contained compressed air diving apparatus to make counts of fishes along a 1,500-foot guide line laid across the sea floor. Two divers, together for safety's sake, would count all fish within a band 40 feet in width along the guide line and also estimate the lengths of the fish counted. The area covered in counting was 60,000 square feet.

Some seventeen transect fish counts have been made in nine different localities. Variations in numbers of fish enumerated among areas and in weights computed from those numbers and length estimates has been great, from a high count of 6,417 and computed total weight of 2,917 pounds for Keahole Point, Kona, Hawaii, to a low count of 77 and a computed weight of 9 pounds for Rabbit Island, Oahu. The replicate counts within localities gave a much lower range of variation. Counts were made in both windward and leeward areas and in depths from 3 to 80 feet.

VERNON E. BROCK

THE TSUNAMI (TIDAL WAVE) OF NOVEMBER 4, 1952

On November 4, 1952, a major displacement of the earth's crust off the southeast coast of the Kamchatka Peninsula gave rise to a tsunami that struck Hawaiian shores approximately six hours later in the early afternoon. No casualties were suffered, largely because of the effectiveness of the Pacific Seismic Sea Wave Warning System for which the Magnetic Observatory of the U. S. Coast and Geodetic Survey at Barbers Point, Oahu, acts as the operation center. This warning system embraces the co-operation and facilities of many military and civilian organizations of the United States, as well as the Peruvian and Japanese governments. The damage caused by the tsunami amounted to somewhat over $800,000.

The Hawaiian archipelago is particularly vulnerable to tsunamis from the seismic rim of the Pacific because of its central location. Large tsunamis are not common phenomena, but many minor waves of this type occur and escape notice except on tide-gauge records. Over a reasonable period of time an average of about one tsunami per year is recorded on gauges in the Hawaiian Islands, but since 1835 only fifteen have caused measurable damage. The most common sources of the tsunamis recorded in Hawaii are off the Pacific coasts of the Japan-Kuriles arc, the Kamchatka Peninsula, the Aleutian Islands, and South America.

The first wave of the recent tsunami struck Hawaii during a period of low tide after traversing the North Pacific at a velocity of approximately 500 mph. About four major waves occurred, but minor oscillations affected tide gauges until November 10. The waves approached shore as gentle swells. Damage was greatest and waves were reported highest in the Waialua Bay area of Oahu, the Kahului-Spreckelsville region of Maui, and Hilo Bay on Hawaii. On Oahu the highest wave reached 20 feet above mean lower low water, but on unexposed coasts heights averaged only 5 to 10 feet or less. In Hilo Bay a maximum high-water mark of 12 feet was recorded. In general, the coasts exposed to the unrefracted wave path of the tsunami experienced the highest waves. Coral reefs and other offshore barriers, submarine topography, and shore-line configuration also influenced the magnitude of the wave as it struck land.

The period of the tsunami as determined from tide gauges showed great variations between stations. It ranged from as little as 8 minutes at Midway to 48 minutes at Guam and Eniwetok. The period at Honolulu was 38 minutes, at Port Allen 30 minutes, and at Hilo 20 minutes. It is probable that the natural period of the harbors where the tide gauges are located and perhaps the periods of large ocean troughs influenced the recorded periods. For island stations throughout the Pacific, periods ranging between 30 and 40 minutes were most common.

JOHN F. MINK AND KIYOSHI J. TAKASAKI

A POSSIBLE PREVENTIVE TREATMENT FOR BALDNESS IN YOUNG MEN

Two relatively new drugs, beta pyridyl carbinol tartrate and benzazoline hydrochloride, used in the treatment of nerve diseases, seem to have the effect of increasing hair growth in males. The first two patients were men in their late twenties being treated with benzazoline hydrochloride for nerve disorders. They reported that where their hair had been thinning it was becoming much thicker following treatment. Their statements were ignored. The third patient was a man of twenty-five under treatment with beta pyridyl carbinol tartrate who said that his beginning bald spot began to show a regrowth of hair after a month of treatment. With this evidence in mind, each drug was tried on a different man with beginning baldness. After about a month the balding tendency appeared to be arrested and hair to be growing back. About ten months have passed, and both of these men have hair in the former bald spot.

Apparently the drugs act principally by stimulating the circulation to the hair follicles. They produce a warm, tingling sensation and a visible flush to the scalp when taken. It may be that a hair follicle degenerates slowly over a period of time to produce baldness and if the drug is given before the follicle is dead, regeneration may occur. It would probably have no effect on baldness in spots where the hair is completely gone. All five subjects in whom the effects were noted were males with beginning baldness or balding spots. It is too early to say whether these drugs can definitely prevent baldness, but they are safe and fairly inexpensive, and the results thus far suggest that further trial in men who are beginning to lose their hair is justified.

JOHN S. HORAN

A SIMPLE LABORATORY PROCESS TO DISTINGUISH GENUINE FROM FAKE HUI–HSIEN CERAMIC SPECIMENS

Accepted for publication in full under the title of "Chemistry and Art Work Together" in *Journal of Chemical Education.*

The simple laboratory process referred to is the extraction of a material, by means of organic ester-alcohol mixtures, which manifests the properties usually attributed to natural and synthetic lacquers. The paper presents a brief review of the origin of natural lacquers and their properties and the desirable characteristics of lacquers in general.

A brief account is given of a long-existing controversy as to whether or not the gloss of genuine Huihsien ceramic ware, a black pottery produced in China in the fifth pre-Christian century, was produced by burnishing or by treatment with lacquer. In this paper the proof of lacquering was established by an extraction process applied to a Chan-Kuo 17 pottery bell.

The paper is illustrated by photographs of genuine and fake objects and by a photograph of lacquer deposit obtained from a presumably genuine article.

LEONORA NEUFFER BILGER, GUSTAV ECKE, AND CLAUDE HORAN

THE NEED FOR TAXONOMIC WORK ON CENTRAL PACIFIC MARINE ORGANISMS

One of the primary prerequisites of all biological work is that we know and can make known to others the organisms with which we are working. The foundation for such knowledge is provided by taxonomy. Today taxonomic work on Central Pacific marine organisms has not progressed far enough to permit most identifications to be made with any degree of certainty or unanimity. Until a firmer taxonomic foundation has been laid, this situation will continue to handicap all marine biological work in the area. The need for further taxonomic work on Central Pacific marine organisms is therefore stressed, and the point is made that the proper place to carry on such work is in the Central Pacific.

WILLIAM A. GOSLINE

OCEANIC PREHISTORY

See "Time Perspective in Micronesia and Polynesia" in *Southwestern Journal of Anthropology*, 8: (1952), 457–465, and "A Program for Micronesian Archeology" in *American Anthropologist*, 53: (1951), 594–597.

The reconstruction of Oceanic prehistory has been based primarily on contemporary evidence drawn from linguistic, ethnographic, and physical anthropological studies. Though much significant work remains to be done in these fields, greater attention to archaeology is a necessity if the prehistory of Oceania is to be unraveled. Successful archaeological work, in turn, demands (1) a sound strategy in the planning of field research, (2) a review of previous conceptions as to the spacial classification of Oceanic cultures and peoples, and (3) the development of a framework of Carbon 14 dates to establish temporal sequences linked to the spacial relationships of past cultures. Oceanic archaeology must begin with excavations in a series of key island groups, whereby local chronologies of culture change are established. One such set of excavations was conducted in 1950 in the Mariana Islands by the Chicago Natural History Museum. Here a cultural sequence, running from 1527 B.C. to approximately A.D. 1700, was found. The past relationships of the Marianas probably lay with the Palau Islands to the south and with the Philippines. The Marianas Carbon 14 dates suggest that by 1500-2000 B.C. a developed form of water transport had been invented in Malaysian–Southeast Asian regions and that the movement of the Malayo-Polynesian peoples into Micronesia had commenced. If Micronesia is coupled with Polynesia as lying within the area encompassed by the great eastward movement of Malayo-Polynesian peoples, then the time span between the earliest Oceanic Carbon 14 date of 1527 B.C. on Saipan and Emory's date of A.D. 1005 for Oahu is a critical 2,500-year period, the events of which form a focus of interest for students of Oceanic prehistory.

ALEXANDER SPOEHR

RELATION OF THE GHYBEN-HERZBERG LENS TO HORIZONTAL ZONATION ON ATOLL CORAL REEFS

Horizontal zonation of coral species on well-developed seaward reefs has been described in several accounts. Those authors who attempt to discern the underlying physical factors related to this zonation consider exposure to air and silt deposition as most salient. At Arno Atoll, where comparative zonation studies were made on the sea and lagoon reefs, these factors were found to play only a partial role at most, with silt deposition being a factor only on the lagoon reefs. Transect studies on salinity, temperature, and exposure disclosed very sharp gradients of salinity and temperature on the sea reef and a near lack of such gradients on the lagoon reef flat. Such experimental evidence as is available indicates that coral growth over a long period is profoundly influenced by lowered salinity, particularly salinities as low as 60 per cent of normal oceanic water. Dilutions of this order were very common during ebb tides on the shoreward section of the sea reef. This fact pointed to the Ghyben-Herzberg fresh-water lens as a probable new and highly important factor influencing horizontal zonation on coral reefs.

The predominance of boulders, cobbles, and coarse sand on the ocean beach as compared to the fine sand on the lagoon beach suggests strongly a greater permeability to fresh-water outflow on the seaward side. This idea is borne out by the characteristic shape of the lens as seen in vertical section across an atoll island. Since the maximum water-table elevation at Ine Island is about 1 foot above mean sea level, the saline ocean water at flood tide effectively prevents fresh-water outflow at the beach, but at ebb tide the outflow onto the reef flat is extensive. Lagoonward, the outflow is much smaller at low water because of the impermeability of the fine sandy deposits.

The species density of both corals and fish show a remarkable correlation to the salinity gradients on the sea reef, whereas the lack of sharp zonation on the lagoon reef is attributable to the more uniform physical conditions characteristic of the entire reef flat. As the species density is usually very great under optimum conditions but decreases as the environment becomes less favorable, the rather precise zonation of both corals and fish on the seaward reef indicates that fluctuations in salinity, temperature, and exposure limit the number of inshore species, while the invariable physical factors at the sea reef edge favors a plethora of animal types.

ROBERT W. HIATT

COSMIC STATIC

Cosmic static is the name applied to long electromagnetic waves of natural origin which arrive from the sky similar to starlight. As the wave lengths cover the range from a few centimeters to many meters, the apparatus necessary for detection is quite similar to radio equipment. These radiations were postulated theoretically and experiments made for their detection around the turn of the century. Because the equipment of that day was quite crude, nothing could be found, and the subject seems to have been forgotten.

The discovery of the phenomenon was made in 1931 by K. G. Jansky as a by-product of some investigations of terrestrial atmospherics. However, the subject did not receive approbation in the scientific world, and few advances were made until after World War II. Now these studies of long-wave celestial radiation are being actively prosecuted, especially in England and Australia, under the title of radio astronomy.

The earth's atmosphere acts as a shield, preventing the arrival at the earth's surface of most celestial radiations and particles. There are, however, two windows in the range of wave lengths where the atmosphere is reasonably transparent. The first is from approximately 0.4 to 1.0 micron wave length, in which region the eye over a long period of time had developed its ability to detect electromagnetic waves. Until recently, practically all our knowledge of the universe had been secured through this window. The second window is from approximately 1 centimeter to 30 meters wave length, in which region the new subject of radio astronomy is being developed.

The ability of any optical device to select one direction in preference to another is directly proportional to its aperture in terms of wave lengths. Cosmic static radiations follow all the laws of optics. However, since their wave length is several million times as long as visible light, conventional optical apparatus cannot be directly applied. In spite of this handicap, these radiations have been shown to arrive from a variety of directions which approximate the plane of the Milky Way. Particular intense regions are located in the constellations of Sagittarius, Cygnus, Cassiopeiae, Canis Major, and Puppis. Recent work in Australia has shown some of these sources to be quite small in size and perhaps approaching stellar dimensions. Such objects have been termed radio stars although there is no evidence that any such physical object exists. In fact none of the bright naked-eye stars such as Vega, Antares, Sirius, etc., produce any detectable cosmic static.

The origin of this energy is one of the fundamental problems of modern astronomy and physics. The sources must be of frequent occurrence because of the concentration within the Milky Way, which is our galaxy. Their plentiful distribution throughout the universe seems certain because of the recent measurement in England of cosmic static from the Andromeda nebula, which is a neighboring galaxy. The known magnitude of intensity and the distribution of intensity with wave length absolutely preclude any possible thermal origin. This is in agreement with the above statement that the sources are not photogenic. Whatever the source of this energy, it is probably something which converts mechanical energy of motion directly into electromagnetic energy without the need of any type of furnace; literally, dynamos in the sky.

The experiments atop Haleakala on Maui are attempts to learn more of this subject. The particular setup is known in optics as a Lloyd's mirror experiment. Since the wave lengths are very long, the size of the apparatus must be scaled up proportionately. In this case the sea is the mirror which extends to the horizon over 140 miles away. Initial results show the sky to contain a multitude of these sources. However, it will be some time before enough data has been gathered and analyzed to provide much new knowledge. Hawaii is quite suitable for this type of study because the low latitude makes it possible to observe all the Milky Way from one station.

GROTE REBER

A LOCALLY APPEARING POISONOUS MUSHROOM, *LEPIOTA MOLYBDITES*

Lepiota molybdites (G. Meyer ex Fr.) Saccardo, for taxonomic reasons sometimes treated as *Chlorophyllum,* is a large, attractive agaric of wide distribution in Oceania and tropical America, ranging extratropically to Minnesota, Michigan, and New York, and southward to Argentina. In North America it is commonly referred to as Morgan's Lepiota (*L. Morgani* Sacc.), is sometimes mistaken for the edible parasol mushroom (*L. procera* (Fr.) S. F. Gray), and no doubt occasionally avoided by mushroom gatherers when mistaken for the edible *Lepiota rachodes* (Vitt.) Quélet. Fresh spore deposits of the two latter species are white, whereas those of *L. molybdites* are some shade of green. Throughout its range, this mushroom is usually seen in loose, irregular clusters, or in fairy rings, quite conspicuous in open grassy plots, forest clearings, fields, and gardens.

In October and November, 1952, the species appeared in a garden clearing off Tantalus Drive at an elevation of about 850 feet in such quantity that it was possible to make a careful study and photographic record of various developmental stages. On November 12, fifty-three mushrooms were counted in an area approximately 20 feet in diameter. The largest specimens had caps 16 centimeters broad and conspicuously annulate stalks 14 centimeters tall, 4 to 6 centimeters in diameter at the swollen base, and 2 centimeters at the apex.

Expanding caps of intermediate size were used for spore deposits. Diagnostic staining reactions were noted for the same caps. Fresh deposits on white paper are greenish gray to slate color; on gray or black papers, pale ochraceous. The spores are 10–12 x 7 microns, smooth, somewhat ovoid but in one view with unequal sides, subtruncate by a lens-shaped area, thick-walled, and with a conspicuous germ pore at the end of attachment; the wall is hyaline, grayish, or greenish in 5 per cent KOH but, after washing, reddish brown with Melzer's chloral hydrate-iodine and yellowish brown with aqueous iodine-potassium iodide (thus definitely pseudoamyloid). After hasty treatment with ammonium hydroxide, careful washing, and addition of faintly bluish aqueous cresyl blue, both the wall and the content of the spore are immediately distinctly bluish. Clamp connections are lacking in these caps and basidia and hyphae are nonamyloid. All the above characteristics are in agreement with the present concept of the species. Without the spore print and the microscopic study, the most reliable feature suggestive of this species is the progressive coloration of the gills which at first are nearly white, then become grayish green, and finally brownish. There are no pinkish, rusty brown, or purple-brown states.

Cases revealing various degrees of poisoning are known for North America and the Philippines; likewise, there are records of no ill effects.

M. L. LOHMAN

ALGEOMORPHIC DISEASES

Presidential Address, 1953

The concept of cause before effect has long been firmly entrenched in man's thinking about disease. A disease must have a cause, even if the cause be little more than a name.

Physical injuries are from obvious causes, but in early times most diseases were attributed to the displeasure of the gods. This explanation may have, on close inspection, a great deal more philosophic merit than appears at first glance.

During the past century certain organisms have been found to produce specific symptoms. The typhoid bacillus causes typhoid fever and nothing else. There is belief that every disease has a particular cause, if it can be found. The same belief holds true of the allergic diseases. We believe that if we eat certain foods we get hives, and therefore we think the food causes hives.

Many diseases are without constant causes. Some forms of cancer, for example, have resisted all efforts to find their cause. Many allergic diseases seem to result from different causes at different times, from many simultaneous causes, or from emotional disturbances.

It has been found that certain symptoms are present in a wide variety of diseases. Increased excretion of certain hormones by the adrenal cortex seems to relieve such symptoms. Some of these hormones have been isolated and can be used to relieve patients in various conditions such as rheumatic arthritis.

One such hormone is cortisone. Some facts learned about cortisone are (1) it does not cure anything, it merely supresses symptoms as long as it remains in the body; (2) it does not accomplish this of itself by relieving any deficiency in the body; (3) many diseases of unknown cause, but associated with allergic or psychogenic mechanisms, can be controlled quite successfully by the administration of the hormone. Numerous examples may be cited.

There are certain limitations on its use. It aggravates tuberculosis, internal ulcers, high blood pressure, and some other conditions.

Not only does cortisone bring relief to victims of diseases; it also brings relief to the minds of researchers and practicing physicians who must cope with these diseases.

These diseases may be brought on chiefly by the patient's own inherent tendencies to disease. Some individuals may have colic in infancy, asthma in childhood, and hay fever, hives, or migraine headaches when they grow up. It seems to make little difference whether these patients are insulted by strawberries, milk protein, egg albumen, streptococcus toxin, aspirin, or an intolerable life situation.

An outstanding feature of these diseases is their relative incurability, except by identification and removal or avoidance of the "cause." Many of these conditions are known to be caused or aggravated by allergic or psychosomatic factors. The majority are greatly benefited by cortisone or related hormones. Regardless of the immediate apparent cause, the particular symptoms are, in most instances, the result of the sick person's own inherent predilection to be ill in this particular way.

An unbearable, and therefore repressed, sense of anger or guilt may cause one man to develop high blood pressure, another merely to suffer intermittent eczema or asthma. It is as though the patterns of diseases were latent within the sick person before he felt ill, and were only released by the causative agent.

Thus, there is a large group of diseases which may be called "algeomorphic," meaning "formed by the patient," as distinct from the many diseases whose patterns are determined by their causative agents.

HARRY L. ARNOLD, JR.

NECROLOGY

EUGENE C. AUCHTER

Eugene C. Auchter was the director of the Pineapple Research Institute from 1945 until May, 1952. His death on July 8, 1952, ended a long and productive career in horticulture.

Dr. Auchter was born in Elmgrove, New York, in September, 1889. In his boyhood he gained a practical knowledge of horticulture through work on family farms. He capped this practical knowledge with studies at Cornell University leading to a B.S.A. degree in 1912, an M.S. in 1918, and a Ph.D. in plant physiology in 1923. His scholastic work was interspersed with both teaching and research. He was assistant pomologist at Cornell in 1911, held various positions in horticulture at the University of West Virginia from 1914 to 1918, and was head of the Department of Horticulture of the University of Maryland from 1918 to 1928. During this period he wrote a number of papers on his researches and, with H. B. Knapp, two texts published in 1929: *Orchard and Small Fruit Tree Culture* and *Growing Trees and Small Fruit.*

In 1928 he was brought to the U. S. Department of Agriculture to head a consolidated Division of Horticultural Crops and Diseases in the Bureau of Plant Industry. He became assistant chief of the Bureau in 1935 and chief in 1938. In 1942 he was appointed the first administrator of the Agricultural Research Administration, thus co-ordinating all the research activities of the Department. While in the Department of Agriculture, he was active in the organization of a number of special laboratories scattered over the country, most notably the Plant Industry Station at Beltsville, Maryland.

Dr. Auchter was brought to Hawaii in 1945 to head the Pineapple Research Institute. Under his leadership, the Institute expanded its personnel, its physical equipment, and its service to the pineapple industry. At the urging of its board of trustees, Dr. Auchter continued his association with the Institute as consulting scientist when illness forced his retirement as director.

Gene Auchter's career in horticulture started parallel to one in baseball, which ended with a broken finger while a semipro at college. He always held a great interest in the game, as well as in hunting and fishing.

Dr. Auchter belonged to a number of scientific societies, including the Royal Horticultural Society of London of which he was an honorary fellow, the American Association for the Advancement of Science of which he was a fellow, the American Society of Plant Physiologists of which he was president in 1926, the American Phytopathological Society, the American Genetics Association, the Botanical Society of Hawaii, and several honorary societies. He was an officer of the Pacific Science Council. He became a member of the Hawaiian Academy of Science in 1945, served as vice-president in 1949–50, and as president in 1950–51. The American Pomological Society awarded him the Wilder Medal in 1952 for outstanding achievement in horticultural science.

EDWARD L. CAUM

Edward L. Caum, a charter member of the Hawaiian Academy of Science, died on August 17, 1952. Mr. Caum was the first secretary-treasurer of the Academy in 1925–26 and served again in that capacity from 1929 to 1935. He was a councilor of the Academy from 1936 to 1938. He was also a charter member of the Hawaiian Botanical Society and served that society as its secretary-treasurer in 1928 and as its president in 1936. He was a graduate of Punahou School and of Swarthmore College and took postgraduate work at George Washington University. He held degrees of B.A. and M.A. and was elected to membership in the Honorary Scientific Society of the Sigma Xi.

Mr. Caum was born in Philadelphia on April 3, 1893. He came to Hawaii in July, 1908. He joined the staff of the H.S.P.A. Experiment Station on February 8, 1916, as assistant plant pathologist but a few years later was named associate botanist and superintendent of the Manoa Arboretum, both of which positions he filled efficiently and enthusiastically until stricken with his last illness.

Although primarily a botanist, Mr. Caum was an all-around naturalist and gained recognition as an authority on the birds which inhabit or visit this far-flung archipelago.

FRANK T. DILLINGHAM

Frank T. Dillingham, emeritus professor of chemistry, University of Hawaii, was born in Honolulu on February 11, 1878. He attended the public schools of Worcester, Massachusetts, and received a B.S. degree from Worcester Polytechnic Institute in 1901.

In 1916 he received the M.A. degree from Yale University and was a fellow in plant nutrition at the University of California in 1922–23. Professor Dillingham was assistant instructor in chemistry at the Bussy Institute of Harvard University from 1901 to 1905 and instructor in agricultural chemistry from 1905 to 1908.

He returned to Hawaii in 1908 and joined the Experiment Station of the Hawaiian Sugar Planters' Association as assistant chemist. The following year Professor Dillingham was appointed professor of chemistry at the College of Hawaii, remaining with the college which later became the University of Hawaii until his retirement in 1943.

Under his leadership the Department of Chemistry grew to be one of the largest departments of the University, with an enrollment of over 1,000 students.

Professor Dillingham was active in the affairs of the American Chemical Society and the Hawaiian Sugar Technologists, as well as the Hawaiian Academy of Science, of which he was a charter member. During his long career as a teacher he contributed numerous scientific papers in the fields of sugar technology and biochemistry.

Professor Dillingham died on July 6, 1952.

THOMAS AUGUSTUS JAGGAR

Thomas Augustus Jaggar, Jr., was born in Philadelphia on January 24, 1871. He received the B.A. degree in geology from Harvard University in 1893 and the M.A. degree in 1894. During the next two years he studied at Munich and Heidelberg, returning to Harvard in 1897 to take his Ph.D. degree with a thesis including methods for determining the hardness of minerals, a subject to which he returned years later after his retirement.

From 1895 to 1903, Jaggar was instructor in geology at Harvard, and in 1903 he was made an assistant professor. In 1906 he became professor and head of the Department of Geology at Massachusetts Institute of Technology. During the summers he worked for the U. S. Geological Survey in the Black Hills region, in the Yellowstone region, and in Arizona. His first major publication was on the laccoliths of the Black Hills.

In 1902, after study of the results of the catastrophic eruptions of the volcanoes Mont Pelée and Soufrière in the Antilles, Dr. Jaggar decided to adopt the field study of geophysics, especially volcanology and seismology, as his life work.

On a succession of expeditions to Italy, the Aleutian Islands, Japan, and Central America, he studied volcanoes and earthquakes, geophysical methods, and the work being done to mitigate the effects of natural disasters in those countries. He became convinced that the only satisfactory way to study volcanoes was with permanent observatory stations, keeping constant record of all detectable changes. When, therefore, in 1911, money became available through a grant from the Whitney Estate to Massachusetts Institute of Technology to set up a permanent station for the study of volcanoes, preferably in Hawaii, Professor Jaggar was enthusiastic. Preliminary work began immediately, and in 1912 Jaggar established the Hawaiian Volcano Observatory on the rim of Kilauea Crater. From the beginning, his work received the wholehearted support of the people of Hawaii, and more than half the money for the establishment of the Observatory came from the Hawaiian Volcano Research Association and from public subscription.

Though the struggle was often difficult, Dr. Jaggar labored for the next twenty-eight years to strengthen the science of volcanology in general and the Observatory in particular. The pre-eminence of the Hawaiian Volcano Observatory may be attributed to his enterprise. When he retired as director of the Observatory in 1940, he became research associate in geophysics at the University of Hawaii. He continued in that position until his death.

Dr. Jaggar's contributions to the literature of volcanology were great. His scientific bibliography contains more than 250 titles in addition to the journal of activity of Kilauea and Mauna Loa that continued for many years in the Bulletin of the Hawaiian Volcano Observatory and the Volcano Letter. Still other essays are in the fields of philosophy and religion. The amazing diversity of his interests and abilities is illustrated by his invention of the amphibian boat, the lineal predecessor of the military amphibian vehicles that played so important a part in World War II.

Dr. Jaggar was a Fellow of the American Academy of Arts and Sciences, a Fellow of the Washington Academy of Sciences, a member of the Seismological Society of America and of the American Geophysical Union, and a corresponding member of the Geological Society of Belgium. From 1912 until his death, he was the scientific director of the Hawaiian Volcano Research Association. Dr. Jaggar's membership in the Hawaiian Academy of Science dated from its first year (1925–26). He served as councilor in 1943–45 and 1947–48, as vice president in 1945–46, and as president for the year 1946–47.

With his death on January 17, 1953, Hawaii lost one of its outstanding scientists and best-known citizens.

LOUISE S. JESSEN

Louise Stevens Jessen, outstanding agricultural writer and untiring community worker, a member of the Academy since 1946, was born in Larned, Kansas, on May 6, 1888; she came to Hawaii in 1937 and died in Honolulu on May 13, 1952.

Mrs. Jessen attended the University of Chicago as a young woman but was forced by circumstances to leave before graduation. Her determination to complete her education brought her back to Tulane University in New Orleans twenty-six years later; she received the B.A. degree in sociology from that institution in 1936. In 1941 she enrolled at the University of Hawaii for graduate study, and had nearly completed requirements for the M.A. degree at the time of her death. Because of her belief in the importance of an education, she spent much time in teaching and arranging further study for others whose educational opportunities had also been limited.

She was also recognized for her work in the field of agricultural news publication. Gaining her basic knowledge of agriculture as a farm wife in Mississippi during her earlier years, she served as extension editor of the University of Hawaii College of Agriculture from June 1, 1942, to January 31, 1951. During that time an enormous volume of agricultural news and feature stories as well as articles on other subjects were published under her byline in island and national newspapers and periodicals. Before her retirement from the University of Hawaii in 1951 because of ill health, she was the recipient of a special award from the American Association of Agricultural College Editors.

JOHN J. WOLFORD

John J. Wolford died on February 19, 1953. He had been a member of the Academy for a number of years since a period spent in Hawaii as an officer in the U. S. Air Force during World War II. At the time of his death, Dr. Wolford was professor of geology at Miami University, Oxford, Ohio. He had previously assisted the U. S. Army Engineers in the original geological examinations of dam sites of the Tennessee Valley area and carried on field surveys for the Kentucky Geological Survey. During his service in Hawaii he found time to make observations on local geology and marine phenomena.

MEMBERSHIP

MAY 1953

Akamine, Ernest K.
Akana, Theodore K.
Akers, Ernestine
Alicata, J. E.
Anderson, Earl J.
Appleton, Vivia B.
Arkoff, Abe
Arnold, Harry L.
Arnold, Harry L., Jr.
Atherton, Ballard
Aust, Ruth
Austin, Thomas
Ayers, Arthur S.

Baker, R. J.
Ballard, Stanley S.
Balock, J. W.
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Bartling, Wray B.
Baver, L. D.
Beaumont, J. H.
Berk, Morton
Bess, Henry A.
Bianchi, Fred A.
Bice, Charles M.
Bilger, Earl M.
Bilger, Leonora N.
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Bonk, William J.
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Bowers, Neal M.
Bowers, Mrs. Neal M.
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Brown, Elizabeth D. W.
Brown, Forest B. H.
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Burr, Mildred
Burton, Otto L.
Bush, Wm. M.
Bushnell, O. A.

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Carter, Walter
Cartwright, Gordon D.
Chong, Mabel
Christian, Eloise
Chu, George W.
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Clements, Harry F.
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Connor, Mary R.
Cooil, Bruce J.
Corboy, Philip M.
Cornelison, A. H.
Cox, Doak C.
Cox, Joel B.
Crosby, William
Cross, Robert F.
Crowell, David
Cushing, Robert L.

Danielsson, Bengt
Davis, Clifton J.
Davis, Dan A.
Defibaugh, Betty Lou
Degener, Otto
Deibert, Austin
Deming, Horace G.
Denison, Harry L.
Digman, John
Doi, Mitsugi
Doty, Maxwell S.
Doty, R. E.
Duncan, Richard A.

Eber, Laurence
Edmondson, C. H.
Eguchi, George
Ehret, William F.
Eller, W. H.
Emory, Kenneth P.
Enright, James R.

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Finch, Ruy H.
Fong, Francis
Forbes, Theo. W.
Fosberg, F. R.
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Fukuda, Mitsuno
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George, David
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Gortner, Willis A.
Gosline, W. H.
Gowing, Donald P.
Gray, Reed A.
Greenwell, Amy B. H.
Gregory, Christopher

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Halperin, Sidney L.
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Hamre, Christopher J.
Handy, E. S. C.
Hanson, Noel S.
Harada, M. B.
Hardy, D. Elmo
Harris, Anna E.
Harris, Wray
Harry, J. V.
Hartt, Constance E.
Hartwell, Alfred S.
Heinicke, Ralph M.
Henke, Louis A.
Herrick, Colin J.
Hiatt, Robert W.
Holmes, Wilfred J.
Horan, John S.
Hosaka, E. Y.
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Howe, Guy L., Jr.
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Hu, Stephen M. K.
Hudson, Loring G.
Humbert, Roger P.

Ihrig, Judson L.
Ikeda, Warren
Ikehara, Isaac I.
Ito, Kiyoshi

Jackson, Dean C.
Jermann, Fred
Johnson, David
Jones, Thomas A.
Jones, Thomas S.
Jorgensen, J. Paul
Jorgensen, Margaret K.
Joyce, Charles R.

Kamemoto, Haruyuki
Kanehiro, Yoshinori
Kask, John Laurence
Katsuki, I.
Kaulukukui, Felice W.
Kawano, Henry
Keller, Arthur R.
Kenda, William
Kerns, Kenneth R.
King, Joseph E.
King, Maurice V.

King, Will Norman
Kingsbury, Joe W.
Klinkman, Helena M.
Koike, Hideo
Kondo, Yoshio
Kopf, Kenneth
Kortschak, Hugo P.
Krauss, Beatrice
Krauss, F. G.
Krauss, Noel H.

Lam, Margaret M.
Lam, Robert L.
Lamb, Alvin R.
Larrabee, L. M.
Larsen, Nils P.
Larsen, Norma
Larson, Harry W.
Lau, Howard K. S.
Lee, Hyun Moo
Leeper, Robert W.
Lennox, Colin G.
Levine, Max
Levine, Melvin L.
Lind, Andrew W.
Livesay, T. M.
Lohman, Marion L.
Look, Wm. C.
Lord, Edith
Loucks, Burton J.
Loucks, Ruth Baker
Louis, James L.
Louis, Lucille
Lum, C. K.
Lyon, Harold L.

McCleery, Walter L.
Macdonald, Gordon A.
McGuire, Thos. R. L.
McKernan, David L.
McMorrow, B. J.
Magistad, O. C.
Manchester, Curtis A.
Mangelsdorf, A. J.
Martin, Joseph P.
Maruoka, Rose M.
Mason, Leonard
Matsumoto, Walter M.
Matthews, Donald C.
Mau, Kong Tong
Midkiff, Frank E.
Miller, Carey D.
Miller, Robert C.
Mink, John F.
Mitchell, Donald
Mitchell, Wallace
Moe, Clayton R.
Mordy, Wendell A.
Morgan, Edward J.
Mottl, Joseph R.
Moir, Wm. W. G.
Mumaw, Charles
Murphy, Garth I.
Murray, Hazel C.

Naiditch, Sam
Nakamoto, Goichi
Nakao, Harry
Naughton, John J.
Neal, Marie C.
Newell, Irwin
Newhouse, Jan
Nickerson, Thomas
Nishida, Toshiyuki
Nordfeldt, Sam
Nutter, Ben E.

Okimoto, Marion
Okubo, Shigeo
Orr, Kathryn J.
Otsu, Tamio

Palafox, A. L.
Palmer, Harold S.

Payne, John H.
Pemberton, C. E.
Pen, Florence
Pinkerton, F. J.
Poole, Charles F.
Porter, H. Paul
Potter, Colin
Powers, Howard A.
Price, Samuel
Price, Saul
Puth, Maybelle J.

Reber, Grote
Rhead, Clifton C.
Riesenberg, Saul
Ripperton, J. C.
Rose, Stanley J.
Royce, William F.
Rusch, Kenneth H.

St. John, Harold
Sakimura, Kay
Sanford, Wallace G.
Scheuer, Paul J.
Schmidt, Carl T.
Schmidt, Helen D.
Scott, Arlen M.
Seeley, Delos O.
Sekiguchi, Nao
Sette, Oscar E.
Sher, S. A.
Sherk, Kenneth W.
Sherman, G. Donald
Shigeura, Gordon T.
Shomura, Richard S.
Sideris, C. P.
Simpson, Robert H.
Sinclair, Gregg M.
Slattery, Mabel
Slipp, John W.
Smith, Elbert G.
Smith, Madorah
Smith, R. Q.
Spalding, P. E.
Spiegelberg, Carl H.
Spitzer, Blanche H.
Spoehr, Alexander
Springer, Doris
Stacey, Mary
Sterns, Marjorie
Stewart, William S.
Stokes, J. F. G.
Storey, W. B.
Suehiro, Amy
Suzuki, F. T.
Sykes, Walter E.

Takahashi, David
Takahashi, Makoto
Takasaki, Kiyoshi J.
Takazawa, Futoshi
Tanimoto, Ralph H.
Tanimoto, Tyrus T.
Taylor, A. R.
Taylor, Keith L.
Tester, Albert L.
Thorne, M. D.
Titcomb, Margaret
Trouse, Albert C., Jr.
Tuthill, Leonard D.

Urata, Rokuro

Vaksvik, K. N.
Van Campen, Wilvan
van Weel, Pieter
Van Zwaluwenburg, R. H.
Vernon, Mabel D.
Vinacke, W. Edgar
Vinacke, Winifred R.
Voorhees, George

Wadsworth, Harold A.
Wakai, Ted Y.
Wallace, George C.
Wallace, Keith K.
Warner, H. H.
Warner, John N.
Watson, Leslie J.
Wayman, Oliver
Weatherbee, Carl
Weaver, Herbert
Weight, Leslie
Weller, D. M.
Wentworth, C. K.
Wentworth, Juliette
White, J. Warren
Wilbar, Chas. L.
Wismer, Chester A.
Withington, Paul
Woffinden, Charles M.
Wong, Arthur G. H.

Yamashita, Daniel T.
Yanagihara, Iichi
Yee, Florence
Yoshioka, Tad T.
Young, Hong Yap
Yuen, Heeny
Yuen, Quan Hong

Zeitlin, Harry
Zimmerman, E. C.
Zoebisch, Oscar C.

PROCEEDINGS OF THE

HAWAIIAN ACADEMY OF SCIENCE . . .

TWENTY-NINTH ANNUAL MEETING 1953-1954

Published by the University of Hawaii Honolulu, Hawaii, 1954

CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

ANNUAL REPORT 1953-54

In its twenty-ninth year the Hawaiian Academy of Science functioned under a new structure that was defined by the revised Constitution adopted in April, 1953, and that was designed to spread the load of Academy responsibility farther and to permit it to undertake a more significant role. Success in spreading of the load is evident from the lists of officers and committee members. It is to be hoped that some success in expanding the role of the Academy will also be apparent from the following compilation from the reports of committees and officers.

MEMBERSHIP

The Academy ended its twenty-eighth year with a membership of 345. Seventy-two persons were elected to membership last April and 62 last November. Of these, 127 were recorded as new members, the other 7 having failed to pay dues. One old member was dropped and nine resigned. Four losses by death are the hardest to record. They were:

F. B. H. Brown	Wray Harris
Guido Giacometti	O. C. Magistad

As of the end of the twenty-ninth year, therefore, the membership was 458, an increase of 33 per cent. The election of new members at the final business meeting on April 24 set the membership for the beginning of the Academy's thirtieth year over 500.

AFFILIATION

The Academy is affiliated with the American Association for the Advancement of Science, and was represented at its 1953 meetings in Boston. Through the AAAS and its associated Academy Conference, much of value to the Academy has been received. The Academy received $117 from the AAAS for research awards. The Academy Conference has indicated numerous ways in which our Academy might be of more service to teachers and students of science in the high schools. In response to a Conference suggestion, our Proceedings have been distributed to all affiliated state academies of science, and the publications of 20 of them have been received in exchange.

Seven local scientific societies, listed elsewhere in these Proceedings, have been designated Associated Societies of the Academy. The Affiliation Committee, composed of representatives of these societies, the Academy's representatives to the AAAS, and a few additional members, undertook the administration of the AAAS research grants. The recipients of the grants are listed elsewhere. In response to a recommendation from the Affiliation Committee, the Academy has commenced advertisement of special meetings of the Associated Societies that are of general interest.

The Academy was represented at the Eighth Pacific Science Congress and on the Conservation Council for Hawaii, and assisted the Pacific and Asian Affairs Council in preparing a catalogue of research organizations in Hawaii.

PROGRAM

The Annual Meeting comprised two scheduled and one special session, totaling six evening meetings, at which 22 individual scientific papers were presented. These included four papers in a symposium on soil management, the presidential address, and an address by Dr. Hans Pettersson at a special session sponsored jointly with the Society of the Sigma Xi and the Geophysical Society of Hawaii. Seven exhibits at the scheduled sessions added greatly to the attraction of the meetings, attendance at which ranged from about 75 to over 150. Business meetings were held during the first scheduled session in November, 1953, and following the annual banquet in conjunction with the final scheduled session in April, 1954. A detailed program of the meetings and abstracts of the papers presented are included elsewhere in these Proceedings.

SCIENCE TEACHERS

A special committee was appointed to organize a competition of high-school students for honorary junior memberships in the AAAS and possibly other prizes, and to investigate possible permanent organization of the science teachers in the high schools either in or in association with the Academy. The Academy moved into the field of active assistance to teachers and students through participation by the President in "Careers Day" at one of the high schools.

ISLAND OF HAWAII

Three meetings of the Academy were organized on the Island of Hawaii by a special committee appointed to investigate possible interest there. Attendance averaged about 40, and the success was so great that a constitutional amendment was drawn up to permit organization of regional divisions. The Hawaii membership has petitioned the Council for the establishment of a Hawaii Division under this provision.

MISCELLANEOUS

Through the co-operation of the University of Hawaii, the Twenty-eighth Proceedings were published in an edition of 850 and distributed to the membership and to 220 institutions in various sections of the world.

Constitutional amendments, drawn up by a special committee and adopted during the year, changed the office of vice-president to that of president-elect, changed the method of election of officers to a mail ballot, made other minor changes in voting procedure, permitted the establishment of regional divisions, and permitted changes in dues without the necessity of Constitutional amendment.

FINANCES

Balance on hand April 17, 1953		$791
Receipts		
Dues	$434	
AAAS awards	117	
Miscellaneous	21	
Total	$572	
Expenditures		
Proceedings (HAS share)	$204	
AAAS awards	117	
Programs	26	
Stationery and mailing	148	
Honorarium	25	
Miscellaneous	8	
Total	$528	
Net income		44
Balance on hand April 15, 1954		$835
Liabilities: Dues paid in advance, less back dues collectible		159
Net assets		$676

Council and Committees 1953–54

OFFICERS

W. B. Storey....President
Colin G. Lennox....Vice-President
Doak C. Cox....Secretary
Beatrice Krauss....Treasurer
Kiyoshi Ito....Councilor (2 yrs.)
Donald Mitchell....Councilor (1 yr.)
Harry L. Arnold, Jr....Councilor (ex officio)

Note: The Council consisted of the officers and the chairmen of the Membership, Affiliation, and Program Committees.

STANDING COMMITTEES

Membership Committee

Fred I. Gilbert, Chairman
J. W. Balock — Harold H. Hagihara
Fritz W. Forbes — Evelyn Johnson

Affiliation Committee

Doak C. Cox, Interim Chairman
George O. Burr, Amer. Chem. Soc., Hawaii Sec.
Fred I. Gilbert, Jr., Hawaii Med. Assoc.
D. Elmo Hardy, Hawaii. Ent. Soc.
Howard Leak, Geophys. Soc. Hawaii
Katherine Luomala, Anthrop. Soc. Hawaii
G. Donald Sherman, Sigma Xi, Hawaii Chap.
Marlowe D. Thorne, Amer. Soc. Agron., Hawaii Chap.
Edward J. Britten
Leonard Tuthill
L. D. Baver, ex officio

AAAS Representatives

L. D. Baver, AAAS Council delegate and Academy Conference representative
T. W. Forbes, alternate
Doak C. Cox, Academy Conference representative
Marion Okimoto, alternate

Program Committee

Carey D. Miller, Chairman
Harold W. Civin — Alexander Spoehr
C. E. Pemberton — O. E. Sette

Nominating Committee

Harry L. Arnold, Jr., Chairman
E. H. Bryan, Jr. — Robert W. Hiatt
Walter Carter — John H. Payne

Auditing Committee

William M. Bush, Chairman
Chester A. Wismer

Note: The President is ex officio a member of all committees except the Auditing Committee, and the Secretary of all except that and the Nominating Committee.

SPECIAL COMMITTEES

Publication Committee

Marjorie B. R. Milnes, Chairman
Lydia C. Nickerson

Publicity Committee

Mary Lou Rothwell Lloyd, Chairman
Harry L. Arnold, Jr. — John D. Ramsey
E. H. Bryan, Jr.

Constitution Committee

W. A. Gortner, Chairman
H. L. Arnold, Jr. — David Johnson
E. H. Bryan, Jr.

Science Teachers Committee

R. W. Clopton, Fritz Forbes — Chairmen
Walter Curtis — Morris Pang
William J. Geiger — Bernard Rose
Natalie Holladay — William M. Spooner

Hawaii Island Committee

C. K. Wentworth, Chairman
Hannah K. Bowman — Amy Greenwell
Clifton J. Davis

Representatives to:

Pacific Science Congress....C. E. Pemberton
Conservation Council....Doak C. Cox

ASSOCIATED SOCIETIES

American Society of Agronomy, Hawaii Chapter
American Chemical Society, Hawaiian Section
Anthropological Society of Hawaii
Geophysical Society of Hawaii
Hawaii Medical Association
Hawaiian Entomological Society
Society of the Sigma Xi, Hawaii Chapter

The Academy is affiliated with the American Association for the Advancement of Science

AWARDS

1952–53 AAAS Research Grants

Shirley M. Trefz—For research on "The digestive physiology of holothurians with reference to their role in the ecology of coral reefs."

John Forster—For research on "Samoan communities on Oahu."

THE 29th ANNUAL MEETING 1953-54

Program

FIRST SESSION

November 19, 1953

SOIL MANAGEMENT AND IMPROVEMENT IN HAWAII—A SYMPOSIUM

R. L. Cushing, Moderator

G. Donald Sherman: The Nature and Potentialities of the Humid Tropical Soils.
Joe W. Kingsbury: Soil Survey and Land Classification in Hawaii.
M. D. Thorne: Recent Advances in the Use of Crop Residues in Pineapple Production.
Roger P. Humbert: Building Hawaiian Soils.

November 20, 1953

William F. Royce and Tamio Otsu: Finding Skipjack in Hawaiian Waters.
Sidney Halperin and Richard G. Johnson: Psychological Test Findings Prior to and Following Treatment of an Acute Mental Illness.
E. J. Britten: Cytology of Hawaiian Plants.
Earl M. Bilger, Leonora N. Bilger, and Clarence Suzuki: The Bound-Water Concept and the Karl Fischer Reagent.
George W. T. C. Chu and Charles E. Cutress: Human Dermatitis Caused by Marine Organisms in Hawaii.
David H. Crowell: Reliability in the Measurement of Intelligence Scores of Cerebral-Palsied Children.

Exhibits

Bernice P. Bishop Museum and A. H. Cornelison: Hawaiian Semi-Precious Stones.
Soil Conservation Service, H.S.P.A. Experiment Station, and University of Hawaii: Hawaiian Soil Types and Their Distribution.
Pacific Oceanic Fishery Investigations, Fish and Wildlife Service: Pacific Oceanography.

SPECIAL SESSION

(Sponsored jointly with the Society of the Sigma Xi and the Geophysical Society of Hawaii)

January 6, 1954

Hans Pettersson: Recent Deep-Sea Research.

FINAL SESSION

April 22, 1954

C. E. Pemberton: Report on the Eighth Pacific Science Congress in Manila.
Ernest K. Akamine, Toru Arisumi, and Martha Nakayama: Tolerance of Chinese Bananas to Ethylene Dibromide.
E. J. Britten: Photography as an Aid to the Research Worker.
Doak C. Cox: Shape of the Mixing Curve in a Ghyben-Herzberg Lens.
Harold S. Palmer: Geomorphic Contrasts within the Koolau Range.

April 23, 1954

Charles H. Lamoureaux, Martha H. Bell, and David Gould: Stelar Morphology of Hawaiian Pteridophytes.
Charles F. Poole: Tomato Ascorbic Acid Inheritance.
Constance E. Hartt, Hugo P. Kortschak, and George O. Burr: Photosynthesis by Sugar Cane Fed Radioactive Carbon Dioxide.
Donald C. Matthews: Further Studies on Hermit Crab Reproduction.
Shoichi Hashimoto: Chemical Fertilization of Mullet Ponds.

Exhibits

J. Warren White: Orthopedic Manifestations of Hansen's Disease.
C. E. Pemberton: Insects of Potential Danger to Hawaii.
E. J. Britten: Photography for the Science Worker.

April 24, 1954

Business Meeting
Address of the Retiring President, W. B. Storey: Cytology of Taro and Other Edible Aroids.

ISLAND OF HAWAII COMMITTEE

October 10, 1954

Kenneth P. Emory: Studies in Polynesian Archaeology.

February 5, 1954

Clifford J. Davis: Oriental Fruit Fly (*Dacus dorsalis*) Investigations on the Island of Hawaii.

March 19, 1954

Gordon A. Macdonald: Philippine Volcanoes.

Abstracts

THE NATURE AND POTENTIALITIES OF THE HUMID TROPICAL SOILS

The development of agriculture in the wet tropics has always been the object of much speculation. Many diverse opinions, ranging from pessimistic to optimistic evaluations, are held by the various students of tropical soils as to their potentialities for supporting a productive agricultural system.

The humid soils cannot be considered on an annual rainfall basis alone. Under tropical weathering conditions, widely different soils can develop under an annual rainfall of 100 inches. The distribution of the rainfall during the year is equally or more important in the development of tropical soils as is total rainfall. Thus, in discussing the humid tropical soils, it was found necessary to include all soils which are dominated by seasonal wet conditions, which means all soils which owe their chemical and physical properties to weathering in a preponderately wet condition. In doing this, soils developed under wet and dry conditions are included. Factually, such an interpretation will permit us to eliminate the tropical black soils, the "red and black" complex soils, and the friable tropical red loams. It does include those various types of soils which have been called laterites. The laterite has been described as being the following: (1) A ferruginous cell-like, concretionary, slag-like material which will harden on exposure sufficiently to use as a building material; (2) ferruginous soils having a definite accumulation of iron oxide, especially in concretionary form; (3) a soil containing bauxite in sufficient quantities to be called an ore; (4) a ferruginous bauxite; (5) titaniferous-ferruginous soils; (6) titaniferous-bauxite soils; and (7) a soil in which the oxides of aluminum, iron, and titanium make up more than 90 per cent of the soil constituents. All the soils listed above occur in the wetter tropical regions. Weathering environment, especially climate, determines which one of these soils will be the ultimate product of soil development. Under a climate having alternate wet and dry seasons, the ferruginous and titaniferous-ferruginous soils will develop, whereas under continuous wet conditions bauxite formation is favored. However, this statement only covers the general types, because in nature there is a certain amount of overlapping.

In tropical areas, the development of agriculture in the wet tropical regions has been very primitive. It has consisted of clearing a patch of soil by removing the forest, and growing crops on this clearing as long as crop production is satisfactory. When unsatisfactory yields were obtained, the area would be allowed to return to the forest and a new area was cleared. Under this system the soil deteriorated fast. The ferruginous types harden into crust which is so hard that plant growth is impossible. The bauxite types harden some, but of more serious consequences is the soil deterioration due to loss of nutrient ions through leaching, the loss of organic matter due to oxidation, and, most serious of all, the loss of adsorptive capacity of the soil. Regardless of the type of soil, the exposure causes the development of serious physical and chemical properties, which adversely affect the growth of crops. Only in Indonesia and the Hawaiian Islands has a successful system of agriculture been developed in the humid tropical areas. Intensive use of chemical fertilizers has maintained a reasonable productivity of these soils. In Java the development of laterite crust is still a problem in these areas, but even there some progress has been made.

In the Hawaiian Islands, the humid areas are the only ones which still have appreciable amounts of undeveloped land. The soils of the Humic Ferruginous group have been developed by the sugar and pineapple industries, but because of their low productivity they have been either abandoned, taken over by small farmers, or used as pastures. Pasture management has been reasonably successful as long as the soil has been heavily fertilized and steps taken to prevent dehydration. The latter is accomplished either by using mulches and cover crops or, in the case of pastures, by preserving a good grass cover by not overgrazing. The soils of the Humic Latosols and Hydrol Humic Latosols are used for growing tree crops, coffee and macadamia nuts, sugar cane, vegetables, and pastures. In general, tree crops which can take a very heavy rainfall are best adapted to these areas. These soils produce poor yields of sugar and vegetables, and, although some grasses make excellent growth, they are of an inferior type from a nutrition standpoint. However, these soils do offer opportunity for expansion in Hawaii through (1) introduction of new methods of soil management which will maintain desirable chemical and physical properties; (2) the introduction of new crops, such as passion fruit and tropical legumes, adapted to the rainfall of these areas; (3) the development of existing crops, such as macadamia nuts, which are adapted to the area; (4) fertilizer practices which will raise the level of fertility of these soils; and (5) a public-supported program of planting forest trees of economic value, such as trees which can be utilized for their lumber or for other wood products.

G. DONALD SHERMAN

SOIL SURVEY AND LAND CLASSIFICATION IN HAWAII

A basic systematic and scientific approach to soil management and improvement has been made through the use of soil surveys and land capability classification.

A soil survey is an inventory of soil characteristics and associated factors shown on an aerial photograph or other satisfactory base in accordance with nationally established standards.

Factors observed for mapping soil differences are effective soil depth, texture, permeability of the subsurface, underlying material, slope, erosion, climate, and other factors essential to land use. Symbols to designate these conditions are listed and defined so uniformity in mapping is obtained.

Two nationally developed types of surveys have been used—the morphogenetic or taxonomic type and the utilitarian type.

Soil classification of the taxonomic type progresses systematically from the broad group of conditions at the "order" level through the suborder, group, family, series, to the narrow group of conditions—the soil type. Names are assigned to the soil series which are correlated nationally to prevent the same name from being used for two different soils.

The utilitarian type of survey was designed to symbolize factors on the map so that the map, nationally, could be interpreted in the field. If the number or letter and its position in the symbol is known, a general picture of the land condition and general use potential can be obtained.

Land capability classification is the systematic arrangement of different kinds of land to show its most intensive safe use and management requirements. The land capability classes are designated by Roman numerals I through VIII—I being the best land and VIII having no agricultural value. These classes are further divided into subclasses which indicate the general problem. The class, subclass, and unit are called the land capability unit and may include one or more soil mapping units.

There is a national movement to merge the two types of surveys, wtihout losing the desirable features of each, with the land classification system.

Soil surveys and land classification are used primarily in research and land management. Experimental data and land management trials on known soils can be projected to these same soils in other areas. Such data can be used for technical assistance to farmers and ranchers, for irrigation development, and for forest management.

JOE W. KINGSBURY

RECENT ADVANCES IN THE USE OF CROP RESIDUES IN PINEAPPLE PRODUCTION

Pineapple culture presents an unusual opportunity for utilization of crop residues. The amount of residues is large and there is often a rather long time available for their treatment. The main methods of trash utilization which are to be discussed are:

1. *Plowing under of trash.* This is the most usual method. The machinery for accomplishing this has been improved recently so that the time required may be markedly decreased.

2. *Burning of trash.* This is generally considered as an "emergency measure" and not one to be practiced regularly. Considerable effort has been devoted to the evaluation of this practice, and some of the results are discussed.

3. *Leaving residues on the surface as "trash mulch."* This is a newer development which offers great advantages for the dry areas. Recently developed machinery for handling trash has allowed field-scale installations to be made. Some experiments evaluating trash mulch are discussed.

M. D. THORNE

BUILDING HAWAIIAN SOILS

The Hawaiian Sugar industry has several thousand acres of land, the productive capacity of which is limited by poor physical properties of the soil. Restricted root growth in the heavier clay soils, such as the gray hydromorphic and dark magnesium clays, limits the tonnage of cane and sugar that can be produced.

An active research program has been pursued in recent years in the improvement of the physical properties of these soils by additions of organic materials. Excess bagasse, or that not used for fuel at the sugar mills, and cane trash separated from the stalks in the cleaning plants have been used in quantities ranging from 5 to 60 tons dry weight per acre, with resulting increases in yield from 1 to 2.7 tons of sugar per acre. The beneficial effects in "soil tilth" have been observed to last for a minimum of 15 years, thus making it economically feasible to undertake costly soil improvement practices.

The accompanying moving picture, "Building Hawaiian Soils," showed cane trash hauled from the Kekaha Sugar Company mill to storage areas on sandy waste land, reloaded after 2 years and transported to the field, dumped and spread, and finally incorporated in the heavy clay soils by the Towner 44-inch disk plow, Howard rotary hoe, and the Storey plow. The addition of 15 to 20 tons of organic matter per acre, well distributed throughout the plowed depth, ensures better internal drainage and aeration and encourages deeper rooting of the sugar cane. Significant increases in yields of cane and sugar have resulted.

The movie also covered the operations of the hydroseparator at Ewa Plantation Company, where 35 acres of new land are made each year. The mud from the cleaning plant is pumped a distance of approximately 2 miles and deposited on coral outcrops with thin pockets of residual soil. Twenty- to 24-inch deposits of silt and clay heavily laden with finely divided organic matter eventually settle to soil depths of 15 to 18 inches. This man-made land produces lush-growing cane which is used for seed. As newer areas come into production, the older areas are then used for commercial sugar production.

ROGER P. HUMBERT

FINDING SKIPJACK IN HAWAIIAN WATERS

On six cruises around the Hawaiian Islands during 1953, 90 days were spent searching for skipjack (aku) schools. Six flights in U. S. Navy PBY amphibians were also made. The purposes were to evaluate and improve the scouting techniques and to determine the distribution of the skipjack.

Skipjack schools are located almost entirely by accompanying birds which flock and maneuver characteristically when working over skipjack. Flocks are seen as far as 4 miles out from the vessel, but most are seen within 2 miles. A new method of estimating the scanning efficiency indicates that only 6 per cent of total flocks are seen beyond 2 miles, and 39 per cent between 1 and 2 miles. Obviously many flocks are missed. Careful scanning aft of the vessel on recent cruises resulted in up to a 40 per cent increase in number sighted.

Numerous factors affecting the occurrence of flocks and the methods of sighting them were investigated. Poor weather conditions reduced the proportion of distant flocks seen. Large flocks were seen farther from the vessel. Fishermen maintain consistent watches and are good at estimating distances. In April more flocks were seen in early morning and midafternoon; in June more around noon.

Airplane scouting is much less effective than vessel scouting, probably because the dark-colored birds cannot be seen against the water.

The local fleet catches 75 per cent of skipjack within 20 miles of land, but skipjacks are not more abundant there. In this zone during the spring 4.9 schools per 10-hour day were seen, whereas 7.0 were seen in the 20- to 40-mile and 5.2 in the 40- to 60-mile zone. During autumn, skipjack schools were about equally abundant south and west from the Islands out to 300 miles but were less abundant to northeast. The best area in autumn was near a large eddy 80 miles west of Hawaii, outside the active range of the fleet.

The average number of schools seen per day was 4.2 in February, 8.5 in April, 7.0 in June, 3.8 in September, and 2.5 in October.

W. F. ROYCE AND
TAMIO OTSU

PSYCHOLOGICAL TEST FINDINGS PRIOR TO AND FOLLOWING TREATMENT OF AN ACUTE MENTAL ILLNESS

The individual case used in the discussion was a 25-year-old male member of the Armed Services. He was admitted to the hospital because of severe anxiety, considerable somatic concern, feelings of guilt and of a desperate need for help in order to avoid "breaking up." He was admitted to the closed Service with an initial impression of incipient schizophrenia. After a few days' stay on the closed Service, the initial panic-like reaction subsided. He was then transferred to the open Service for further observation and possible psychotherapeutic treatment. The patient's symptomatology decreased, and he stated, "I've regained the normal outlook." Examination, however, showed a serious underlying pathological residual. He did appear well motivated for psychotherapy, particularly because of a strong anxiety element and a desire for change. Detailed psychological testing was performed before active therapy on the eleventh of the month of his admission. A similar battery of tests was again administered on the twenty-fifth of the following month upon completion of a brief but intensive course of psychotherapeutic interviews. The patient was seen in daily hour interviews for 24 sessions. After establishment of the therapeutic relationship, he was allowed to ventilate and eventually to regress symbolically to an infantile level of conflict within the therapeutic situation. He was able to achieve a symbolic release of long-repressed, unconscious materials, and to visualize consciously some of his original conflicts and ambivalences. In the therapeutic framework, his recognition of his "subconscious or deeper self" could be accepted and reintegrated into his functioning personality. This corrective emotional experience allowed for a release of hostile and other unacceptable feelings without the previous overwhelming guilt.

Such an experience, no matter how intense, is too brief to undo, by itself, behavior patterns set up and conditioned over many years. It is felt, however, that it opened the way for further emotional and personality growth, and probably avoided an overt and serious psychotic break. The release and insight can be sufficient, we believe, to open the way for continued personality strengthening, productivity, and peace of mind.

The dramatic changes observed prior to and following therapy were likewise demonstrated by psychological tests. The test results were demonstrated in a series of eight slides.

SIDNEY L. HALPERIN AND
RICHARD G. JOHNSON

CYTOLOGY OF HAWAIIAN PLANTS

Cytology has proved in recent years to be indispensable in determining interrelationships among plants. It has provided a valuable tool in differentiating species and in analysing the probable parentage of natural hybrids.

The unique character of Hawaiian flora is indicated by the high percentage of endemism found therein. Ninety-four per cent of the native species and 13 per cent of the genera are found nowhere else in the world. This remarkable example of evolution might be expected from one of the most isolated island areas of the world. But there are also examples of isolation within the island group which are remarkable. Some species have developed their whole evolutionary species history apparently confined to a small section of one gulch—an area comprising only a few miles.

No less interesting than the evolutionary development of species within the Islands is the relationship of the island flora to that of other areas. Cytological evidence should provide valuable information regarding the geographical origins of the first plant invaders of the Islands.

Polymorphism of Hawaiian species has sometimes discouraged critical taxonomic work on certain groups. Cytological work on such groups, particularly where differences are at or below the species level, would probably be less conclusive than it would be in settling the correct relationships of distinct species within a genus. Cytological comparisons between a controversial member of a genus with other members of that genus might reveal a picture different enough to warrant transferring the species in question to another genus.

Natural crossing among our native species forms another interesting phase of the cytology of Hawaiian plants. Certain apparent cases of natural hybridization between closely related species must wait for cytological and, if possible, genetic study for confirmation.

Present knowledge of Hawaiian plants is very sketchy. Workers outside the Islands have contributed a little to our knowledge, but workers here must be encouraged in this study.

E. J. BRITTEN

THE BOUND-WATER CONCEPT AND THE KARL FISCHER REAGENT

Since 1894 and perhaps earlier, the concept of "bound water" has entered into the considerations of research workers who were concerned with the moisture content of their biological working media and related materials, such as soils. The elder Gortner is probably more responsible than anyone else for giving the bound-water concept a strong place in studies of plant and animal colloids. Prominent for over half a century, the idea received strong support in the present in Crafts' excellent treatise, "Water in the Physiology of Plants," in the words, "To deny the binding of water molecules would require a complete neglect of those secondary valence forces that, through hydrogen bonding, account for so many of the unusual properties of water."

Crafts also pointed out that, although a study of 12 different methods for determining bound water showed variations in results, all methods showed appreciable quantities of water that failed to obey the laws of dilute solutions and differed from ordinary water in its action as a solvent. The concern of differences of opinion that have characterized the bound-water problem through many years has been, not that there is no such entity, but that the idea cannot easily be pinned down to definition and characterization inasmuch as different methods lead to different results.

The authors of this paper hold that such variations are unimportant compared with the *fact* of bound water and emphasize the point that bound-water data are strictly *relative* to the methods used. This is so for readily understandable reasons when the character of the methods are taken into consideration.

Experimentally the strict relativity of data to methods used was established by determining the bound-water content of three Hawaiian soils by two extreme methods, the dilatometric procedure which did not easily cause the "unbinding" of water and the Karl Fischer potentiometric titration method which involves the use of a very "thirsty" reagent. Omitting details for lack of space, the average results, expressed in terms of bound water per 100 grams of oven-dry soil, for the dilatometric determinations were 29.85, 29.27, and 6.55. Corresponding values for the Karl Fischer analysis were 1.12, 1.08, and 0.11 in the same order.

Obviously, almost all the water present in the soil samples was titrable by the Karl Fischer reagent, whereas the dilatometric method showed relatively large amounts incapable of being frozen out. The wide diversity in values obtained from the two sets of analyses emphasizes once more the relativity of bound-water values to the method employed and most likely to the character of samples and types of binding forces. These conclusions do not, however, vitiate the whole concept of bound water but strengthen its importance when considered in the light of a controlled and comparable set of experiments.

EARL M. BILGER, LEONORA N. BILGER,
ANTON POSTL, AND CLARENCE SUZUKI

HUMAN DERMATITIS CAUSED BY MARINE ORGANISMS IN HAWAII

The investigation of dermatitis-producing marine organisms in Hawaii, sponsored by the Public Health Service, has to date revealed several demonstrable agents belonging to the phylums Platyhelminthes and Coelenterata.

In the phylum Platyhelminthes one Hawaiian species has been found to cause dermatitis. The organism is the cercaria of the avian schistosome, *Austrobilharzia variglandis* (Miller and Northup, 1926) Penner, 1953. The intermediate host of this trematode is the marine snail, *Littorina pintado* Wood; the definitive host is the ruddy turnstone, *Arenaria interpres interpres* (L.).

The coelenterate species that thus far have been implicated in cases of dermatitis represent six orders of the phylum. These all contain stinging cells (nematocysts), contact with which is capable of evoking a dermatitis and, in some cases, anaphylactic shock.

Two species of the order Hydroida that have been incriminated are *Pennaria tiarella* and *Halecium beani,* the latter previously reported as a cause of dermatitis by G. De Oreo (Arch. Derm. Syphilol. 54: 637–649, 1946).

Several species of Hawaiian medusae are capable of causing dermatitis and anaphylactic shock. Three species occasionally encountered on the reefs and unprotected coasts are a trachyline medusa, *Liriope* sp.; a siphonophoran medusa, *Physalia utriculus;* and a cubomedusa, *Charybdea moseri.* Two species common the year around in bays and salt-water canals are a semaeostomian medusa, *Aurelia labiata,* and a rhizostomian medusa, *Cassiopea medusa.* Contact with any of these may cause a dermatitis. In addition, the slightest agitation of water surrounding *Cassiopea* detaches myriads of minute mouth parts, all containing numerous nematocysts and capable of living suspended in the water for days. These free particles have been used experimentally to produce dermatitis in rabbits and humans.

The relationship of the so-called "Pearl Harbor Itch" (Arnold and Bonnet, 1950) and dermatitis caused by the above-mentioned marine organisms is currently being investigated.

GEORGE W. T. C. CHU AND
CHARLES E. CUTRESS

RELIABILITY IN THE MEASUREMENT OF INTELLIGENCE SCORES OF CEREBRAL-PALSIED CHILDREN

The reliability of objective psychological evaluations of cerebral-palsied children has been questioned. These results, nevertheless, are important to medicine in determining individual prognosis for rehabilitation.

This investigation attempts to estimate reliability coefficients for intelligence scores of cerebral-palsied children by taking into account the effect of the test-retest interval and by disregarding the particular instrument used and the specific psychologist involved.

Cerebral-palsied children on the register of the Bureau of Crippled Children, Board of Health, Honolulu, who had (1) two or more psychological examinations, (2) the first and last of which involved the same instrument, and (3) had mental ages specifically stated by the examiner, were placed in two groups on the basis of the test-retest interval. Group I, N = 28, represented an average test-retest interval of 15 months and Group II, N= 33, an average test-retest interval of 43 months. For these groups and the total group, respectively, Pearson product moment correlation coefficients were computed.

Coefficients of reliability obtained were as follows: Group I, $r = +.98$; Group II, $r = +.78$, and Total Group, $r = +.92$. By means of Fisher's z transformation these obtained reliability coefficients were considered highly significant.

These results indicate that intelligence scores of cerebral-palsied children vary little over short test-retest intervals and vary more over longer test-retest intervals. Extremes in variability are related to initial examinations which were done at very early ages and which tended to be overestimations.

Generally speaking, intelligence scores of cerebral-palsied children are reliable, in spite of what measuring instrument is used and which clinical psychologist does the evaluation. Clinical psychologists with adequate training and experience can evaluate the potentialities of cerebral-palsied children with a high degree of reliability. Errors of clinical judgment tend to be relatively low.

DAVID H. CROWELL

RECENT DEEP-SEA RESEARCH

Published under the title "Some Results from the Swedish 'Albatross' Cruise" in PACIFIC SCIENCE 8 (3): 359–362.

The Swedish Deep-Sea Expedition with the motor schooner "Albatross," July 1947–October 1948, gave a new aspect on submarine geology, thanks to new methods largely evolved in Sweden. Cores up to 60 feet long, raised from the deep-sea deposits and, in the case of the red clay cores from the Central Pacific Ocean, spanning a time of 15 million years or more, have on close study revealed important traits of deep-sea sedimentation, on the origin and distribution of deep-sea radium, etc. Seismic measurements of the thickness of the sediment carpet by a reflexion method gave results, afterwards confirmed through refraction shooting by other expeditions, proving the sediment carpet to have a thickness in the Pacific Ocean which is only a fraction of what geochemical calculations had led us to expect. Also, measurements of the geothermal gradient in the deposit gave unexpectedly high values, also confirmed afterward by later expeditions, indicating a heat flow upward through the ocean bottom much higher than what theoretical estimates have indicated.

It may be stated that the "Albatross" expedition has exerted a catalytic effect also in other countries, so that expeditions sent out by Denmark, by Great Britain, and by the United States have worked along the lines followed by the Swedish expedition, using partly the same technique.

The speaker emphasized the unique position of Honolulu as a future center for deep-sea research and expressed hopes that a geophysical institution devoted to such and related research shall be established there in the near future.

The results from the "Albatross" cruise are being published in Göteborg, Sweden, under the title "Reports from the Swedish Deep-Sea Expedition."

HANS PETTERSSON

REPORT ON THE EIGHTH PACIFIC SCIENCE CONGRESS IN MANILA

The Pacific Science Association held its Eighth Congress jointly with the Fourth Far-Eastern Prehistory Congress November 16–28, 1953, on the campus of the University of the Philippines at Quezon City. Over 700 delegates from 30 countries attended. This was the largest group of scientists ever assembled in the Pacific. The opening plenary session was held before an audience variously estimated at from 3,000 to 6,000 persons. A number of the countries sent large delegations, the United States being represented by 75 scientists, 15 of whom were from Hawaii. Ensuing days were devoted to meetings divided into 20 different specialized groups. Several evening lectures were given by outstanding scientists to the Congress as a whole and proved of absorbing interest.

The importance of symposia was emphasized in Congress plans. There were nine on geology and geophysics with 70 papers, six on oceanography with 85 papers, nine informal and popular symposia on meteorology, and one or more on rice problems, soil resources and land classification, animal and crop improvement, rats and rat control, land tenure, population, education, and administration in the Pacific region. Biological sciences covered zoology, botany, forestry, agriculture, public health, nutrition, and Pacific conservation and utilization of natural resources. It was noticeable that applied science was an important feature in many of the papers.

A full day was devoted to museums and their problems, with a visit to the remnants of the Philippine Bureau of Science that was demolished in 1945. Two days were spent by the entire membership visiting historic Bataan and the College of Agriculture at Los Banos. A number of other tours were arranged for special sections. All were well attended.

At the closing plenary sessions some 60 resolutions were passed that had vital bearing on Pacific problems. The establishment of a permanent secretariat in Honolulu for the Pacific Science Council was approved.

No praise can be too high for the hospitality of the official and unofficial people of the Philippines and the efficient manner in which the Congress was planned and carried through to a successful termination.

C. E. PEMBERTON

TOLERANCE OF CHINESE BANANAS TO ETHYLENE DIBROMIDE

Studies reported in this paper were conducted largely under Grants 5X and 42 of the Industrial Research Advisory Council, Territory of Hawaii, to the Hawaii Agricultural Experiment Station.

Chinese bananas to be shipped to the mainland United States from Hawaii must be treated to destroy the Oriental fruit fly. This treatment consists of fumigation with ethylene dibromide at a dosage of ½ pound per 1,000 cubic feet of space for a period of 2 hours at a minimum temperature of 70° F. However, under ordinary conditions bananas are injured by this treatment. By covering the bunch with an opaque or semiopaque wrapper in the field for a period of approximately 2 months just prior to harvest, tolerance to ethylene dibromide can be induced in bananas grown in any location.

Effects of covering were determined. Moisture percentage in the peel was increased by covering, but some open bunches with high moisture levels and other bunches with high moisture percentages brought about by covering with transparent or semitransparent wrappers did not tolerate the fumigation. There was no difference in the ascorbic acid content and in the amount of ethylene dibromide absorption between covered and open bunches. The practice of removing the blossoms at an early stage of development of the bananas had no effect on tolerance. Open bunches exhibited injury symptoms at all storage temperatures studied.

A reduction in chlorophyll development in the bananas seems to be necessary for tolerance. Bananas covered with opaque or semiopaque materials are lighter green in color and probably contain less chlorophyll than those covered with transparent or semitransparent materials or those not covered.

In bananas injured by fumigation, the injury is most severe on the blossom end of the fruit, diminishing in severity toward the stem end where it is least severe or nil. In chlorophyll content the blossom end is probably the highest, and it diminishes toward the stem end where the degree of greenness of the finger is at its lowest due to the shading caused by the crowding of the fingers. Ethylene dibromide probably interferes with the breakdown of excessive amounts of chlorophyll molecules in the ripening process.

ERNEST K. AKAMINE, TORU ARISUMI, AND MARTHA NAKAYAMA

PHOTOGRAPHY AS AN AID TO THE RESEARCH WORKER

Photography may be employed in all phases of a research program; searching the literature; as a means of recording experimental work; for obtaining data; for instructional presentation of results; and for purposes of publication. The present paper is confined to photography involving problems in which a camera is not used.

A simple method of copying printed matter or drawings is by reflex printing. In this method photosensitive paper is placed in contact with the material to be copied. Illumination is from the back of the photographic paper. Light passing through the photosensitive paper is absorbed by the printed areas and reflected back from the nonprinted areas of the copy material, thus differentially exposing the emulsion. Upon development a white on black, laterally reversed, high-contrast copy is obtained, which may be read with a mirror or by holding it up to the light. The copy may also be used as a negative for a contact print which is black on white and correct reading. The relative light tolerance of some photographic papers, enables them to be used under subdued room light conditions. Autopositive paper is highly tolerant to room light and yields a black on white print with, however, lateral reversal of the image. The necessity for an intermediate negative is thus obviated.

The high contrast of certain photographic papers may be utilized in copying herbarium sheets or other scientific material on which pencil notations occur. Reflex copies of the pencil notations are made, and from these positive prints are prepared. This print, which has great contrast compared to the original pencil material, is then placed over the pencil notation prior to copying with the camera.

Alterations and corrections on drawings may easily be made without damaging the original by preparing a contact photographic paper negative using high contrast photopaper. Unwanted areas are then blocked out with India ink or pencil. Additions to the drawing may then be made on a positive print made from the corrected negative. The method is useful in making a series of comparison graphs.

Low-power photomicrographs are frequently difficult to make because of the trouble of obtaining even lighting. Such photographs, evenly illuminated, may readily be made without use of microscope or camera by utilizing a photographic enlarger. The microscope slide is inserted in the negative carrier and the film placed on the easel where it is exposed. Ease of handling the film is facilitated if the sheets are placed in plate holders.

E. J. BRITTEN

SHAPE OF THE MIXING CURVE IN A GHYBEN-HERZBERG LENS

Ghyben-Herzberg lenses of fresh ground water floating on and displacing salt water in the rocks are the sources of major supplies of irrigation, domestic, and industrial water in Hawaii. Evaluation of safe yields of such lenses involves study of storage changes that result from variations in the depth of fresh water below sea level as well as in the head of fresh water above sea level. The changes in depth are potentially 40 times as large as the associated changes in head, but no provision yet exists for their measurement in any Hawaiian lens, and measurement will be complicated by the nature of the base of the lenses.

The bottom of a Ghyben-Herzberg lens is not a sharp salt-fresh contact, but a zone of mixture. C. K. Wentworth has shown that the thickness of this zone is variable and depends on the amount of vertical movement of the zone resulting from changes in head. From a numerical model he deduced that the curve of salinity with depth would be a symmetrical ogive.

The mixing curve in actual Ghyben-Herzberg lenses must generally be asymmetrical. The thicker Ghyben-Herzberg lenses have had in their history a shrinkage induced by the beginning of draft that was much larger than previous or subsequent variations in thickness. The consequent predominant raising of the base can be shown by the same process used by Wentworth to result in an asymmetrical mixing curve with the more sudden change in salinity at the upper or fresher end. Even in lenses in which growth and shrinkage are approximately balanced, the lateral flow in the lens should produce an asymmetry of the same sort. The effects of mixing are cumulative as the water in the lens moves seaward, so that the mixing zone thickens seaward. The lateral flow has, thus, a tendency to flush out brackish water with fresher water in the upper part of the zone of mixture and with saltier water in the lower part. The velocity of the lateral flow is dependent, however, on the head gradient, which is greatest in the upper part of the zone of mixture because the water in it is lightest and the head in it is highest, and diminishes asymptotically toward zero at the bottom of the zone of mixture where the water approaches sea water in density and the head approaches zero. The flushing action, therefore, must produce a more sudden change in salinity in the upper part of the zone of mixture than in the lower part, where the brackish water is very ineffectively flushed out.

The determination of the actual shape of the mixing curve at the base of the Ghyben-Herzberg body near Spreckelsville on Maui is one of the aims in the construction of an experimental well to be equipped with sampling tubes terminating at various depths as much as two and a half times the mean local theoretical depth of fresh water below sea level. The well will also permit studies of density variations other than that originating through fresh water-sea water mixing and studies of changes in the position of the mixing curve.

DOAK C. COX

GEOMORPHIC CONTRASTS WITHIN THE KOOLAU RANGE

Attention is directed to the following contrasts between the southeastern and the northwestern parts of the Koolau Range of the Island of Oahu.

(1) Wide alcoves in the southeastern part of the windward side of the range, as against narrow valleys in the northwestern part.
(2) The degree of indentation of the crest line in the two parts.
(3) The existence of much more high-level terrain in the northwestern part.
(4) The width of the leeward valley floors.
(5) Straight, as against winding stream courses.
(6) The cross-profiles of the leeward valleys.
(7) The lengthwise profiles of the crests of the leeward ridges.
(8) The presence or absence of extensive, gently sloping upland areas.
(9) The presence of reverse slopes in parts of the gently sloping upland.

These contrasts suggest as a working hypothesis two modifications of the geologic history of the Koolau Range as heretofore understood. A first volcanic episode is thought to have operated in what is now the southeastern part of the Koolau Range. A second episode may have built a rather narrow ridge northwestward from the first dome. A third volcanic episode not only made the various ash and cinder cones and the intra-valley flows of the southeastern part, but also saw effusion of large volumes of very fluid lava from fissures on the southwest side of the northwesterly ridge so as to build the gently sloping, extensive upland surfaces of the Wahiawa Plateau.

HAROLD S. PALMER

STELAR MORPHOLOGY OF HAWAIIAN PTERIDOPHYTES

The pteridophytes are those plants that have vascular tissue but do not produce seeds. Many of them are represented in Hawaii, including *Psilotum,* the club mosses, and the ferns. These plants are an important element of the Hawaiian flora. Fosberg, in Zimmerman's *Insects of Hawaii,* states that there are 37 native genera of pteridophytes of which 3 are endemic, and 168 native species and varieties of which 119 are endemic.

These plants are very interesting to the morphologist because, as a group, they show all variations in structure from the very primitive to the highly advanced. One of the structures the plant morphologist uses in attempting to determine the phylogenetic interrelationships is the stele. The stele is that structure in the plant composed of the vascular tissue, the pith (if present), the pericycle, and the endodermis. The stele of a plant has been compared to the skeleton of an animal. To be more accurate, this analogy should be extended a bit as the stele functions not only as a skeletal system but also as a circulatory system.

A list of the types of steles with a brief description of each and some of the Hawaiian pteridophytes that possess them follows:

Protostele—a stele that lacks a pith

Haplostele—the xylem is circular in cross section; *Vandenboschia davallioides, Selaginella arbuscula*

Actinostele—the xylem is star-shaped in cross section; *Psilotum complanatum*

"Mixed" stele—phloem cells scattered among the xylem cells; *Lycopodium phyllanthum*

Plectostele—xylem in parallel plates as seen in cross section with the phloem cells between the plates; *Lycopodium venustulum*

Siphonostele (Solenostele)—a stele that has a pith, and the vascular tissues forming an unbroken ring

Amphiphloeic siphonostele—phloem both inside and outside the xylem; *Microlepia setosa, Adiantum*

Ectophloeic siphonostele—phloem only outside the xylem; *Sphenomeris chinensis*

Dictyostele—a stele that has a pith, and the vascular tissues broken into discrete bundles as seen in cross section; *Cyclosorus cyatheoides, Asplenium nidus, Dryopteris paleacea, Pteridium aquilinum* var. *decompositum*

CHARLES H. LAMOUREUX, MARTHA H. BELL, AND DAVID GOULD

TOMATO ASCORBIC ACID INHERITANCE

Although most informed people today know the uses and value of the main vitamins, there is still ignorance of the roles of heridity and environment on the concentration of particular vitamins. Different clones of citrus fruits and sweet potato, or varieties of tomato and cabbage, vary in their genetic constitution as well as their response to environment. Furthermore, there is a negative correlation in most plants between the large size of the useful organ, whether fruit or fleshy vegetable, and ascorbic acid concentration. Occurrence in the tomato of negative correlation involving weight, vitamin, and disease susceptibility presents special problems for the plant breeder who attempts to make the most favorable combination in a new plant.

The solution chosen to combine the quantitative characters in this problem was the double backcross technique called convergent improvement. Briefly stated it was: (1) Cross a high vitamin, low weight, disease susceptible parent with a low vitamin, high weight, disease resistant parent; then backcross to both parents to have two divergent lines in both original directions. Backcrossing to the recurrent parent tends to fix the characters of that parent but to lose those of the nonrecurrent parent. (2) Self-pollinate the best plants in each direction which yield highest in characters of the nonrecurrent parent. (3) From the best plants thus obtained, recross to obtain a secondary F_1 hybrid. This secondary is on a higher performance level than the first, because several nonrecurrent parent genes from both directions had been present in both plants chosen to converge the series. (4) Resume backcrossing in both original directions; after which again converge. (5) Follow this sequence until further backcrossing is unnecessary to effect the combinations sought.

The slides chosen to illustrate results obtained show: (1) Initial presence of negative correlation between fruit size and vitamin yield, which practically disappeared by the third convergence. Backcrossing was then discontinued in favor of outcrosses to new varieties resistant to three additional diseases (six diseases were then included). (2) From this stage onward, progress was traced by a panoramic view of yields of fruit and vitamin concentration from April, 1949, to January, 1954.

The slide portraying environmental effect showed the ascorbic acid profile above and the weight profile below, by tracing in three colors the average and individual plant yields of the two original parents which always appeared with hybrids in all seven trials. Graphic representation of fluctuation in yields showed strikingly that weight is more susceptible to environment than ascorbic acid concentration.

Variation in parent population yield arises mostly from environmental effects, but variation in segregating population yield arises from both environmental and genetic sources. Separation of the two among the experimental plants is approximated by converting individual plant yields to their ratio in relation to parent P_B for ascorbic acid and parent HES 2958 for weight. The last two slides showed the progress in ratio performance (1) from the second convergence to the third convergence, and finally (2) after outcrossing to obtain the maximum possible number of disease resistances.

Successful attainment of objectives will be shown when ratios for *both* vitamin and fruit weight exceed 1.0. Movement of these ratios toward and away from 1.0 in all seven breeding trials indicates that genes for high ascorbic acid are dominant in interaction over those for low ascorbic acid, and those for high weight are recessive to those for low weight. Weight genes are thus slower to accumulate at first, but more readily fixed eventually, than those for ascorbic acid, which are in a heterozygous condition and must be more laboriously made homozygous.

C. F. POOLE

PHOTOSYNTHESIS BY SUGAR CANE FED RADIOACTIVE CARBON DIOXIDE

Steady state photosynthesis by blades of sugar cane in artificial light and supplied with radioactive carbon dioxide for 6 seconds resulted in the formation of malic acid, glucose, fructose, and several as yet unidentified compounds. When blades after dipping for 6 seconds in C 14 were then placed in C 12 for 5 minutes, the following changes took place:

1. Malic acid and three unidentified compounds decreased in radioactivity.

2. Glucose and fructose continued to gain in radioactivity and are therefore classed as end products of photosynthesis.

3. Sucrose, which had no detectable radioactivity after 6 seconds dipping in C 14, had 45 per cent of the total radioactivity after 5 minutes in C 12.

The counts lost by malic acid were not enough to supply the counts gained by sucrose, glucose, and fructose. The chief forerunner of sucrose was an unknown, phosphorylated compound, insoluble in 95 per cent alcohol but soluble in dilute alcohol, a constituent of the barium-soluble, alcohol-insoluble precipitate, and not a sugar phosphate.

CONSTANCE E. HARTT, HUGO P. KORTSCHAK, AND GEORGE O. BURR

FURTHER STUDIES ON HERMIT CRAB REPRODUCTION

Certain reproductive activities of hermit crabs are obscured by the opaque shells in which they live. Largely because of these shells, oviposition and copulation have not been observed, and the sequence of these activities remains unknown. The transparent plastic shells described in this paper facilitate observation of heretofore hidden phenomena.

Calcinus elegans (Milne-Edwards), *C. herbstii* de Man, and *C. latens* Randall are immersed in hot water (80°C) until they abandon their gastropod shells. Now vulnerable to attack, they are isolated from one another while replicas of their old shells are made. First the spiral cavity of the shell is filled with paraffin, next the calcareous shell is dissolved in hydrochloric acid, then the paraffin spiral is imbedded in plastic (a polyester resin), and lastly the paraffin is removed by heat and the plastic shell thoroughly cleaned. Each dispossessed hermit crab is then offered the plastic replica of the natural shell from which it had been evicted, and once this is explored by the chela and found empty, the abdomen is inserted quickly.

Although observations to date are too meager to warrant any conclusions concerning oviposition or copulation, two are noteworthy: (1) A specimen of *Calcinus herbstii* was observed during the oviposition of 13 ova which she then promptly removed from the plastic shell; and (2) since only the ventral side of the abdomen is in contact with the shell, there is no foundation for the notion that the right pleopods have been crowded out.

D. C. MATTHEWS

CHEMICAL FERTILIZATION OF MULLET PONDS

The use of chemical fertilizers to increase the production of fish in fresh-water ponds is a common practice on the mainland. Many investigations have been conducted on fertilizer treatment in fresh-water ponds, but there is a dearth of corresponding information on sea-water ponds.

The chief food of mullet is plankton, which is a community of free-floating animal and plant life. The plant form of plankton provides the basic food supply of marine life and, like the plant on land, manufactures carbohydrates and proteins by photosynthesis, giving off oxygen as a by-product. Similar to vegetation on land, the plant form of plankton responds in growth and development to availability of the three primary plant nutrients; namely, nitrogen, phosphoric acid, and potash.

Three years of commercial fertilizer application to a mullet pond on windward Oahu has been made to correct a problem in nutritional deficiency of plankton life. A change in conditions of the pond's watershed during the past 10 years had caused a depletion of mineral nutrients required for development of the plant form of plankton in the pond. This had resulted in a decrease of food and oxygen supply for the mullets. The growth of the fish was retarded, and their edible qualities deteriorated. During summer months, toxic sulphide gas was formed and many fish died. The use of chemical fertilizer in the pond eliminated these troubles.

A method for estimating the amount of chemical nutrients required in a mullet pond is given, using a rich sea water as the criterion.

Not all mullet ponds in Hawaii lend themselves to chemical fertilizer treatment. They must have several essential conditions, such as clear water, a good gate and sea wall, not excessive depth, ample sunlight, and provision for adding fresh water to compensate for evaporation loss during the dry summer months. Where satisfactory conditions are present, however, this technique of chemical fertilization promises to correct serious nutritional deficiencies and help save the Hawaiian pond mullet industry.

SHOICHI HASHIMOTO

CYTOLOGY OF TARO AND OTHER EDIBLE AROIDS

Presidential Address, 1954

Cytology is the branch of scientific biology which deals with the structure, organization, mechanics, and function of protoplasm.

In the higher plants, protoplasm is usually found in the form of cells. A conspicuous feature of the cell is the nucleus, the structure which contains the chromosomes, the minute bodies in which reside the bearers of heredity called "genes." At certain stages in cell division, the chromosomes are condensed and may be made readily visible for observation at high magnifications by the use of certain specific stains.

Each species of plant has a characteristic and constant number of chromosomes, and, in general, the species which comprise a genus tend to have the same number, or a multiple thereof, although the chromosomes themselves may differ in size, shape, and other characteristics from species to species. The differences between varieties of a plant species sometimes are due to differences in chromosome numbers.

The botanist, geneticist, plant breeder, and experimental horticulturist are interested in chromosome numbers because they often provide clues to origins and relationships among species and varieties which can be obtained in no other way. This paper is a brief report on a study of chromosome numbers in taro, extended, however, to include other edible aroids which occur in the Hawaiian Islands.

The aroids are members of the family Araceae, a family of more than 100 genera and 1,500 species of monocotyledonous plants, chiefly of the tropics.

Sixty-five species of aroids distributed through 25 genera have been recorded as growing in the Hawaiian Islands. None of the species is indigenous to the Islands, although two species, the taro, *Colocasia esculenta* (Linn.) Schott., and the ape, *Alocasia macrorrhiza* (Linn.) Schott., were already in the Islands at the time of their discovery in 1778. These species seem beyond doubt to have been brought by the Polynesian people who colonized the Islands at a time variously estimated to have been between 500 and 1000 A. D. They are edible species, which may account for their early introduction, although the ape was little used for food because of its high degree of acridity; whereas taro was a staple food of the Hawaiian people, principally in the form of poi.

Five other edible species of aroids, *Monstera deliciosa* Liebm., *Amorphophallus rivieri* Dur., *Cyrtosperma chamissonis* (Schott.) Merr., *Xanthosoma sagittifolium* (Linn.) Schott., and *X. braziliensis* (Desf.) Engl., and the dasheen, a nonglutinous Asiatic variety of taro, *Colocasia esculenta* var. *globulifera* (Engl. and Krause) Young, presently occur in the Islands. All these seem to have been introduced sometime after 1871.

The somatic chromosome numbers of the species and of various varieties, as determined from root tip cells, are as follows:

Monstera deliciosa, 2n = 48
Amorphophallus rivieri, 2n = 26
Alocasia macrorrhiza, 2n = 26
Cyrtosperma chamissonis, 2n = 24
Xanthosoma sagittifolium, 2n = 26
Xanthosoma braziliensis, 2n = 26
Colocasia esculenta, 2n = 28 (42 varieties); 2n = 42 (1 variety)
Colocasia esculenta var. *globulifera,* 2n = 42

The chromosome numbers of various species which have been determined in this study or reported in the literature indicate that the basic or monoploid chromosome numbers of the genera considered here are: *Monstera,* 12; *Cyrtosperma,* 12; *Amorphophallus,* 13; *Alocasia,* 13; *Xanthosoma,* 13; and *Colocasia,* 14.

The identical chromosome number of 2n = 28 for all varieties of taro, both Hawaiian and Oriental, with one exception, indicate that the varieties have arisen through genic rather than chromosomal changes. The difference between glutinosity of the Hawaiian taros and its lack in Oriental taros may be attributed to selection by the early Polynesians and the Asiatics for those characters. The dasheens, in all probability, are triploid derivations of Oriental taros.

W. B. STOREY

STUDIES IN POLYNESIAN ARCHAEOLOGY

The type of modern archaeological investigation described and illustrated by the slide and sound-tape lecture "Advances in Hawaiian Archaeology" was carried to west Molokai in 1952 and initiated on Hawaii in the summer of 1953. The summer's work on Hawaii resulted in the extensive excavation of a prehistoric habitation site at the tip end of South Point and the commencement of the excavation of a large cave shelter a quarter of a mile inland. These sites were yielding the largest collection of ancient fish hooks ever assembled in the Hawaiian Islands and artifact, faunal, and floral material essential to the reconstruction of history from the first occupation of the Islands onward.

KENNETH P. EMORY

ORIENTAL FRUIT FLY (*DACUS DORSALIS*) INVESTIGATIONS ON THE ISLAND OF HAWAII

After the discovery of the Oriental fruit fly in Hawaii in May, 1946, various agencies contributed to initial studies of the fruit fly problem. Among these was the search for natural enemies which was undertaken by the Board of Agriculture and Forestry in 1947 and later augmented by other agencies. Ecological studies of the fruit fly at various climatic stations on Hawaii were also undertaken in 1948.

In 1949, full-scale research on *Dacus dorsalis* began as a fully co-operative venture between the U. S. Bureau of Entomology and Plant Quarantine, Territorial Board of Agriculture and Forestry, Hawaii Agricultural Experiment Station, California Agricultural Experiment Station, Pineapple Research Institute, Hawaiian Sugar Planters' Association Experiment Station, and, on an informal basis, the California State Department of Agriculture. The work of these organizations was co-ordinated by Dr. Walter Carter who also directed the research activities of the Bureau until 1951. These activities included biological control, chemical control, area control, commodity treatment, and ecology-biology. Later, physiology was added.

Ecology-biology studies were pursued on Oahu, Maui, and Hawaii under the direction of the U. S. Bureau of Entomology and Plant Quarantine and are continuing up to the present time. The islands of Maui and Hawaii provide ideal ecological stations from sea level to 9,200 feet elevation, and much has been learned about the effect of climate on the Oriental fruit fly. In the higher, cooler areas where it is not unusual for the temperatures to drop below 32° F., *Dacus dorsalis* is often in a state of suspended animation, and life cycles are greatly extended. Sexual maturity is also delayed, and it has been demonstrated that mating does not occur when twilight temperatures are below 60° F.

Population studies in which citronella is used as a lure indicate that the highest fly density occurs at Kupaahu, Puna District. A population index of 800 or more flies per trap day has been attained in this locality. The high fly density is attributed to a large host reservoir of guavas and mangoes and to optimum climatic conditions.

Fruit collections made all over the island from sea level to 7,000 feet elevation indicate that *dorsalis* "rules the roost" at the lower elevations and the Mediterranean fruit fly, *Ceratitis capitata,* dominates at higher elevations. Over 90 per cent of the adult emergencies in Jerusalem cherries, plums, and peaches at the higher elevations (3,000–4,000 feet) are Mediterranean fruit flies. These fruit collections also serve as a basis for evaluating parasitism of fruit flies.

Although many of the studies carried on are primarily for the benefit of Mainland agriculture, Hawaii has benefited largely through the co-operative importation of natural enemies, some of which are well established throughout the Territory. These parasites are responsible for drastic reductions in Oriental fruit fly population in the Hawaiian Islands, but the fly populations nevertheless continue to occur at pest levels.

CLIFTON J. DAVIS

PHILIPPINE VOLCANOES

Published with approval of the Director, U. S. Geological Survey.

Eleven Philippine volcanoes have erupted during historic time, and 13 others exhibit solfataric activity. In addition, there are some 30 known centers of Quaternary volcanism that have shown neither eruptive nor solfataric activity during historic time. The latter have been somewhat eroded but still preserve well the general conical form of volcanic mountains. Both they and the volcanoes showing only solfataric activity must be regarded as potentially eruptive. The histories of Mounts Vesuvius and Lamington, among others, demonstrate the fallacy of assuming that because a Quaternary volcano has not erupted for several hundred or even a few thousand years, it will not erupt again.

Philippine volcanic centers are aligned largely along two principal trends, shown also in folded and faulted structures. One trend, approximately NNW–SSE, parallels the Philippine rift zone and the axis of the Philippine deep. The other, approximately NE–SW, is reflected in the orientation of the Palawan and Sulu-Zamboanga ridges.

Among the active volcanoes of the Philippines, Taal, Mayon, and Catarman (Hibok-Hibok) have taken the greatest tolls of human lives. Taal Volcano is a complex of cones forming an island in a large lake, which occupies a graben at the crest of a broad structural arch. The graben probably is a volcano-tectonic depression but is not a caldera in the strict sense of the term. In 1911, fairly low-temperature explosions, apparently phreato-magmatic, caused the death of about 1,300 persons on the island and around the shores of the lake.

The cone of Mayon Volcano probably is the most perfectly symmetrical volcanic cone in the world. It is a composite cone, composed dominantly of cinder and ash, but with many lava flows. The great symmetry of the cone probably results from a constancy of position of the central vent, lack of lateral vents, dominance of pyroclastic materials, absence of prevailing winds strong enough to cause a strongly asymmetrical accumulation of the pyroclastics, sufficient interbedded lava flows to strengthen the cone but too small a number to result in the typically humpy outline of a cone in which lava is abundant, and the absence of truncation of the cone by either violent explosion or collapse during recent times. Mudflows are common at Mayon, and a broad apron of mudflow deposits completely surrounds the base of the cone. Mudflows have killed several hundred (possibly a thousand) persons around Mayon during historic time and are the principal cause of loss of life at that volcano.

Catarman Volcano erupted in 1871–75 and built a dome of andesite (Mount Vulcan) on its northwest slope. The dome and a short flow from it destroyed the old city of Catarman. In 1897 solfataras became active in a crater near the summit of the mountain, east of an old summit dome. Numerous earthquakes during August, 1948, were succeeded on September 1 by an explosion at the site of the solfataras in the summit crater, and a mudflow on the north flank of the mountain. This was followed by emission of a thick flow of block lava on the northeast flank and gradual building of a dome in the summit crater, accompanied by occasional vulcanian explosions. The dome gradually expanded beyond the crater rim on the north and east sides. On September 15, 1950, a small *nuée ardente,* probably formed by avalanching from the hot dome, destroyed part of a barrio on the north slope. On December 4 and 6 powerful *nuées ardentes* swept down the northeast flank of the mountain, killing some 500 persons. They resulted from explosions that apparently occurred near the base of the dome and were directed outward at a low angle. Following the catastrophe, a danger zone was established around the base of the mountain, and residence in that zone was prohibited. Examination of the volcano during December, 1953, and January, 1954, showed that the dome was no longer growing and that its slopes had been largely reduced to an angle of equilibrium, and hence that there is no longer any great danger from it unless activity is resumed. On that basis it was recommended that people be permitted to resume residence in the former evacuated zone, except for a zone of 2 kilometers' radius around the summit of the mountain. The possible danger of renewed activity was pointed out, however, and careful watch is being maintained on the volcano.

GORDON A. MACDONALD

NECROLOGY

FOREST BUFFEN HARKNESS BROWN

Dr. Forest Buffen Harkness Brown, retired botanist of Bernice P. Bishop Museum, died April 16, 1954.

He was born in Rushville, Vine Valley, New York, December 11, 1872, moving to Ypsilanti, Michigan, at the age of three. He was educated there, graduating from the Michigan State Normal School. He received his A.B. from Michigan in 1902, and M.S. in 1903. He was an instructor in Michigan Normal College from 1898 to 1900; Curator of the botanical garden, Michigan, 1908–1909; and in charge of the botanic gardens and instructor in plant anatomy at Ohio State University, 1911–1916. In 1918 he went to Yale University, where he received a Ph.D. degree and was a research fellow until leaving for Hawaii in 1919. He specialized in the anatomy of tropical plants and produced a report on the identification of Hawaiian ligneous plants by their wood characters, published by Bishop Museum in 1922. In 1918 he married a fellow botanist at Michigan and Yale, Dr. Elizabeth Dorothy Wuist. Dr. and Mrs. Brown's first major assignment by Bishop Museum was to make a botanical survey of the Marquesas Islands as part of the Bayard Dominick expeditions, 1921–1922. He and Mrs. Brown also visited various islands in the Society and Tuamotu groups, and during the following years produced an extensive account of the flora of southeastern Polynesia which was published by the Bishop Museum in three volumes. Because of ill health, he retired as botanist in 1928, but continued to devote what time he could to studies at the Museum, completing his descriptions of plants from southeast Polynesia and working on the distribution and anatomy of gourds. Dr. Brown was a charter member of the Hawaiian Academy of Science and the Hawaiian Botanical Society and a member of various other scientific organizations, including Sigma Xi.

GUIDO GIACOMETTI

Guido Giacometti, a leader in scientific phases of the sugar industry for many years and an Academy member since 1936, died April 17, 1954. Born in Bari, Italy, January 24, 1877, Mr. Giacometti was educated in Italy, Austria, and Switzerland. He graduated as a chemical engineer from the Federal Politechnicum, Zurich, Switzerland, in 1901, and a year later he came to Hawaii. After 2 years as assistant chemist for Waialua Agricultural Company on Oahu, he transferred to Olaa Sugar Company on Hawaii, where he was first chemist and later mill superintendent. He was associated with Olaa for 44 years, retiring in 1947. Mr. Giacometti was greatly interested in improvements in laboratory control and in accounting methods used in sugar manufacturing, as evidenced by his contributions to technical journals. He was quick to adopt the latest advances in factory methods and equipment at Olaa. His widespread interest in scientific and technical research is indicated by his membership in the Academy, the Hawaiian Volcano Research Association, the Hawaiian Sugar Chemists Association, and its successor, the Hawaiian Sugar Technologists, of which he was president in 1926. His interests in the business and civic organizations of the community were equally widespread.

ALBERT WRAY HARRIS

Albert Wray Harris, marine malacologist at Bernice P. Bishop Museum, died December 17, 1953, at the age of 59.

Mr. Harris was born in Canada on July 30, 1894. He served with the U. S. Navy during World War I and continued in the Navy, becoming a pharmacist. Stationed in various Pacific outposts, he was able to observe and collect shells. This interest was encouraged by Dr. C. Montague Cooke, Jr., veteran authority on land shells at Bernice P. Bishop Museum. During 1927–1929, Mr. Harris collected land and marine shells in Hawaii and American Samoa. Returning to California, he was stationed at Vallejo and married Anna Elizabeth Hoffmann. They both returned to American Samoa in 1934 and remained there until 1939 when Mr. Harris had to retire from active service because of a heart ailment. During this time, he had charge of the dispensary on the island of Ta'u and there administered to the medical needs of the more than 2,000 Samoans, who became very fond of him and made him a chief. Both he and Mrs. Harris collected shells enthusiastically, sending the land shells to Dr. Cooke and building up an extensive collection of marine shells. Returning to Hawaii, he commenced an association with Bishop Museum on June 1, 1940, and assumed charge of the museum's huge marine shell collection. He made welcome all who were interested in marine shells and generously helped them to identify their collections. He worked tirelessly on a card catalogue of all the marine shells known in the tropical Pacific, with their distribution and bibliography. He was instrumental in founding the Hawaiian Malacological Society and was its first president. He also was an expert on genealogy and took an active part in civic affairs, being president of the Republican Club of the thirty-third precinct. He had a vast interest in natural history and corresponded with a wide circle of scientists.

OSCAR C. MAGISTAD

Oscar C. Magistad, past president (1937) and counselor (1936) of the Hawaiian Academy of Science, was born in Forestville, Wisconsin, on September 8, 1900. His untimely death on May 6, 1953, terminated a career successful in both science and business.

Dr. Magistad graduated from the University of Wisconsin with the B.S. degree in 1922, the M.S. degree in 1923, and the Ph.D. degree (major: soil chemistry) in 1924. Two years later he married Lila Simon.

He was employed by the United Fruit Company in Honduras from 1924 to 1927 to organize the agricultural research department for the company, became an authority on tropical soils and tropical agriculture, and was called upon for advice and counsel in this respect throughout his life. In the interim between 1927 and 1930 he was at the Arizona Agricultural Experiment Station as associate professor of agricultural chemistry. In 1930 he joined the Pineapple Research Institute as chemist and served as head of the chemistry department until 1935.

From 1935 to 1938 Dr. Magistad was director of the Hawaii Agricultural Experiment Station.

In 1938 the U. S. Government established the Regional Salinity Laboratory at Riverside, California, and selected Dr. Magistad to organize and direct this laboratory. From 1940 to 1941 he was the assistant to the Chief of the Bureau in charge of soil research, United States Department of Agriculture in Washington, D. C. In 1941 he returned to the Regional Laboratory at Riverside as the director of the station, where he remained until 1945.

In 1945 he accepted a position with Libby, McNeill and Libby as manager of research. He remained in this position until his death in 1953.

Dr. Magistad's advice and counsel were especially sought for solving problems concerning pineapple production, soil salinity, and tropical soils.

Errata

Proceedings, 28th Annual Meeting

Page 1, line 12: Twenty-eight should read thirty-nine.

Page 2, Program, Nov. 14, 1952: The papers by Hiatt, Naughton, and Matthews and by van Weel were presented by title only.

Loc. cit., April 16, 1953: The paper by Horan was presented by title only.

Page 13, Obituary of F. T. Dillingham, column 2, line 6: 1,000 should read 600.

Page 15, column 1, under B's: The name of Elwood L. Bartz was omitted.

Page 16, column 2, under T's: A. R. Taylor should read A. R. Tyler.

1954–55

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CONSTITUTION

HAWAIIAN ACADEMY OF SCIENCE

Adopted July 23, 1925, amended December 4, 1936, revised April 18, 1953, amended November 19, 1953, and April 23, 1954.

Article I. NAME

The name of this society shall be the Hawaiian Academy of Science.

Article II. OBJECTS

The objects of this Academy shall be the promotion of scientific research and the diffusion of scientific knowledge, particularly as related to Hawaii and the Pacific area.

Article III. MEMBERSHIP

Section 1. Any resident of Hawaii interested in science or any person not a resident of Hawaii who is interested in scientific problems related to Hawaii shall be eligible for election as a member.

Section 2. Nomination of candidates to membership shall be made in writing to the Membership Committee at least two weeks before the scheduled session at which they are to be elected. Each nomination must be signed by three members of the Academy, and should be accompanied by a deposit of a year's dues.

Section 3. The Membership Committee shall examine into the fitness of nominees and, at scheduled sessions of the Academy, shall recommend for election such nominees as it approves.

Section 4. The members of the Academy shall vote on the nominees by ballot, unless, by unanimous viva voce vote, the Secretary is instructed to cast a unanimous ballot for the entire list of nominees recommended. Election to membership shall require a favorable vote from three fourths of the members present and voting.

Section 5. Fiscal years of the Academy shall begin and end at the close of the Final Sessions of consecutive Annual Meetings. The dues of members shall be an amount recommended by the Council and voted by a majority of the members present and voting at a scheduled session. Notice of a proposed change in dues shall be sent with the final announcement of the session. Dues shall be payable before the second month of each fiscal year. A member of the Academy in arrears for eighteen months in the payment of annual dues shall thereby forfeit his membership in the Academy, provided the Treasurer shall have sent the delinquent member two written notices of the existence of this rule and of his delinquency.

Article IV. AFFILIATION

Section 1. The Academy shall be affiliated with the American Association for the Advancement of Science, so long as the regulations of the Association on affiliation do not conflict with other provisions of this Constitution. The President, with the approval of the Council of the Academy, shall, in even years, appoint a member to serve as Delegate to the Council of the Association and Representative to the Conference of Academies of Science affiliated with the Association, in accordance with the regulations of the Association and the Conference. The Delegate-Representative shall serve for a two-year term. Additional and alternate delegates or representatives, as permitted by the regulations of the Association and the Conference, shall be appointed annually by the President with the approval of the Council.

Section 2. Other scientific societies in Hawaii whose objects are in keeping with the objects of the Academy may, if they so desire and at the discretion of the Council, be affiliated with it as Associated Societies. The Academy, through the Affiliation Committee, shall co-operate with the Associated Societies in such manner as the Council shall designate, subject to other provisions of this Constitution.

Article V. OFFICERS

Section 1. The officers of the Academy shall be a President, a President-Elect, a Secretary, a Treasurer, and three Councilors.

Section 2. The President-Elect, Secretary, and Treasurer shall be elected annually for one-year terms or until their successors are elected. At the close of his term the President-Elect shall succeed to the office of President. The President shall serve a term of one year.

Section 3. One of the Councilors shall be ex officio the Retiring President. The other two Councilors shall be elected, one each year, to serve for terms of two years, or until their successors are elected.

Section 4. The Nominating Committee shall forward to the Secretary by February 15 a list of nominations for new officers of the Academy. Nominees shall have been members of the Academy for at least one year. At least two names shall be listed for each elective office, except that where an incumbent may be nominated to succeed himself, only one name need be listed. The list of nominees shall be sent to each member of the Academy at least six weeks before the date scheduled for the Final Session of the Annual Meeting. Additional nominations may be proposed by petition of five members prior to three weeks before the date scheduled for the Final Session. The names of members so nominated shall be included with the names of those nominated by the Nominating Committee on a ballot which shall be sent to each member of the Academy at least two weeks prior to the Final Session. The willingness of the prospective nominees to serve shall be ascertained prior to the formal nomination.

Section 5. Election shall be by mail ballot of the members, and voting shall be closed when the business meeting at the Final Session of the Annual Meeting is called to order. Ballots may be mailed or handed to the Secretary. The name of the member voting must appear on the outer envelope of mailed ballots but need not appear on the ballot. Tellers at the Annual Meeting shall count all valid ballots which shall have been received and shall certify to the result of the election. The person receiving the highest number of votes for a particular office shall be declared elected.

Section 6. The President shall preside at the meetings of the Academy, perform other duties provided for him in these rules, and carry out such functions as usually pertain to the chief officer of such a society. He shall deliver an address at the Annual Meeting.

Section 7. The President-Elect shall perform the functions of the President in the absence of the latter.

Section 8. The Secretary shall be the custodian of the records and papers of the Academy, shall keep a record of the Proceedings of the Academy, shall send all necessary notices to the members, and shall make a written report of the year's activity of the Academy at the Final Session of the Annual Meeting.

Section 9. The Treasurer shall prepare notices of dues, collect the dues of the members, administer all funds under the direction of the Council, keep a detailed account of the receipts and expenditures of the Academy, and render a written report at the Final Session of the Annual Meeting.

Section 10. The Council shall appoint a member to fill any vacancy in an elected office until the next Final Session, at which time the Academy shall elect a member to fill the unexpired term if any. The Council may appoint a substitute for any officer, except the President, absent from the Island of Oahu. In the event the office of President-Elect is filled by such interim appointment, or the President-Elect will not be available to succeed to the Presidency, the Academy shall elect both a President and President-Elect at the next Final Session.

ARTICLE VI. COUNCIL

Section 1. The Council of the Academy shall consist of the officers. The Representative of each Regional Division and the chairmen of the Membership, Affiliation, and Program committees and of such other committees as the Council may designate, shall be advisory members of the Council without vote.

Section 2. The Council shall be the governing body of the Academy, and shall strive in every way to promote the interests and efficiency of the Academy as opportunity may be found so to do.

Section 3. A meeting of the new Council to form committees for the year shall be held within the first month of a new fiscal year. Additional meetings of the Council may be called by the President at such times as he may deem necessary, and shall be called upon the written request of three members of the Council.

Section 4. Four voting members of the Council shall constitute a quorum.

ARTICLE VII. COMMITTEES

Section 1. There shall be a Membership Committee to promote interest in membership among eligible persons, to examine into the fitness of membership nominees, and to recommend for election such nominees as it approves, as provided in Section 3 of Article III of this Constitution. The President and the Secretary shall be ex officio members of the Membership Committee. Other members shall be appointed annually by the President with the approval of the Council.

Section 2. There shall be an Affiliation Committee to foster co-operation between the Academy and other societies with similar objects. The President, the Secretary, and the delegate to the Council of the American Association for the Advancement of Science shall be ex officio members of this committee. Other members may be appointed by the President with the approval of the Council, and one each by Associated Societies.

Section 3. There shall be a Program Committee to arrange the scientific programs for Sessions of the Academy. The President and the Secretary shall be ex officio members of the Program Committee.

Section 4. There shall be a Nominating Committee to nominate officers of the Academy as provided in Section 4 of Article V of this Constitution. Members shall be appointed annually by the Council. The President shall be ex officio a member of this committee.

Section 5. There shall be an Auditing Committee of two, appointed annually by the President with the approval of the Council. The Auditing Committee shall examine the financial accounts of the Academy and report their condition at the Final Session of the Annual Meeting.

Section 6. The Council may establish such other standing or special committees as it may deem desirable to further the objects of the Academy.

Section 7. Each committee shall make a brief report of its activities to the Academy at the Final Session of the Annual Meeting. It may make reports during any other session by prior arrangement with the Program Committee. It shall make a detailed report to the Council or the Academy whenever required by the Council. The chairman of each committee shall be appointed by the President, and shall be a member of the Academy. Each committee shall choose other officers as needed, and shall keep its own records.

ARTICLE VIII. MEETINGS

Section 1. The Academy shall hold a meeting in April or May of each year, to be known as the Final Session of the Annual Meeting. It shall hold such other scheduled sessions for the presentation of papers and the transaction of business as the Council deems fitting, such sessions to be known as the First Session, Second Session, and the like, of the Annual Meeting in question. Each such scheduled session shall consist of a scientific program and a business program.

Section 2. Each scheduled session shall be announced by a preliminary circular at least six weeks before the date scheduled for the session, calling for papers for the scientific program and for nominations for membership. Final announcement, giving dates and places of meeting, shall be sent out at least two weeks prior to each such session. The program, places, and dates shall be determined by the Program Committee.

Section 3. All members desiring to present papers at scheduled sessions of the Annual Meeting must forward to the Program Committee at a time to be announced in the preliminary circular, full titles of all papers which they propose to present, with such other data on them as shall be required by the preliminary circular. The Program Committee shall have the right to accept or reject any paper offered, and may accept it for presentation by title only. Abstracts of all papers to be presented shall be submitted at a time designated by the Program Committee.

Section 4. Special sessions of the Academy may be called for the transaction of business by the Council and must be called by the Council upon the written request of ten members. New members may not be elected at such sessions. Announcement of special sessions for business, stating date, place, and reason called, shall be sent out at least a week prior to each such session.

Section 5. Special sessions of the Academy may also be called by either the Council or the Program Committee for purposes other than the transaction of business.

Section 6. The order of business at the Final Session of the Annual Meeting shall be as follows:

a. Call to order by the presiding officer.

b. Approval of minutes.
c. Announcements.
d. Recommendations from the Council.
e. Report of the Secretary.
f. Reports of the Treasurer and the Auditing Committee.
g. Nomination and election of new members.
h. Reports of other Committees.
i. New business.
j. Election and installation of new officers.
k. Address of the Retiring President.
l. Adjournment.

The scientific program may be inserted as appropriate in the business program.

Section 7. The order of business at other sessions shall be the same as that at the Final Session except: That reading of minutes may, by unanimous viva voce vote, be postponed to the Final Session; that reports of officers and committees may be postponed to the Final Session at the discretion of the Council unless specifically requested in writing by ten members at least a week prior to the Session; that the nomination, election, and installation of new officers and the address of the Retiring President shall be omitted; that the nomination and election of new members shall be omitted at special sessions; and that no business not previously announced shall be introduced at special sessions.

Section 8. At all sessions of the Academy, 20 Members shall constitute a quorum.

Section 9. The rules contained in "Roberts Rules of Order Revised" shall apply as appropriate in all cases in which they are not inconsistent with other provisions of this Constitution.

ARTICLE IX. PUBLICATIONS

Section 1. Annual publication of the Proceedings of the Academy shall be arranged by the Council, if feasible.

Section 2. The Academy shall encourage the publication of papers presented at its meetings in appropriate scientific journals. The Council shall give such aid as it may in securing publication.

ARTICLE X. REGIONAL DIVISIONS

Section 1. Any ten or more members of the Academy resident in a part of Hawaii remote from Honolulu may form and maintain, with the approval of the Council, a Regional Division.

Section 2. Only members of the Academy shall be eligible for membership in a Regional Division.

Section 3. A Regional Division may make by-laws for its own government subject to the approval of the Council and consistent with the Constitution of the Academy.

Section 4. A Regional Division shall elect its own officers, one of whom shall be a Representative to the Council of the Academy. All selections for office and changes in office shall be certified promptly by the Division to the Secretary of the Academy.

Section 5. A Regional Division may receive up to one fourth of the annual Academy dues paid by its members, the amount to be set annually by the Council.

Section 6. The Division shall meet at least once in each calendar year. Proceedings of the Division shall be regarded as a part of the Proceedings of the Academy. Each Division shall submit a brief report of its activities to the Academy at the Final Session of the Annual Meeting.

ARTICLE XI. AMENDMENTS

Section 1. Amendments to this Constitution may be proposed by the Council or, if submitted to the Secretary at least two months before the session of the Academy at which they are to be considered, by any group of ten members. The Secretary shall send notices of proposed amendments to the members at least a month before the session at which they are to be considered.

Section 2. Amendments to the Constitution, proposed as required, may be adopted at any session of the Academy by a three fourths vote of the members present and voting. Voting on amendments shall be by ballot.

PROCEEDINGS OF THE
HAWAIIAN ACADEMY OF SCIENCE...

THIRTIETH ANNUAL MEETING 1954–1955

Published by the University of Hawaii Honolulu, Hawaii, 1955

CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

ANNUAL REPORT 1954-55

In 1955 the Hawaiian Academy of Science completed thirty years of service in its efforts to "promote scientific research and the diffusion of scientific knowledge in Hawaii and the rest of the Pacific area." At the final session of the Annual Meeting on April 23, 1955, members paused a moment to honor the memory of Dr. F. C. Newcombe who, in 1925, gathered together a small group of local members of the American Association for the Advancement of Science and other scientific organizations to inaugurate the formation of the Hawaiian Academy of Science. That Dr. Newcombe might well be proud of what has come from his original idea and his efforts will be testified to in the following compilation from the reports of committees and officers.

MEMBERSHIP

At the end of its twenty-ninth year the membership of the Academy totaled 458. Forty-four persons were elected to membership in April, 1954, and 58 in November, 1954. Of these, 95 were recorded as new members, the other 7 having failed to pay dues. In addition, one old member was reinstated, making the total gain in membership 96. There was a loss in membership of 5, through resignation, and 14 were dropped because of failure to pay dues. We regret the loss through death of one member:

Ralph J. Borden

As of the end of the thirtieth year, therefore, the membership was 534. The election of 37 new members at the final business meeting in April, 1955, set the membership for the beginning of the thirty-first year at 571.

Membership Committee

Charles F. Poole, Chairman
Floyd Ashton
Edwin H. Bryan, Jr.
Horace Clay
Doak C. Cox, ex officio
Ralph Heinicke
Stephen M. K. Hu
Colin G. Lennox, ex officio
Kathryn Orr
Pieter van Weel
J. Warren White

AFFILIATION

The Academy is affiliated with the American Association for the Advancement of Science, and was represented at its 1954 meetings in Berkeley. The Academy has benefited from this association with the AAAS and its Academy Conference. A research grant of $67 from the AAAS was supplemented from Academy funds to make a total of $100. The recipients of this AAAS–HAS grant were:

Madorah Smith—For special costs involved in the publication of a paper, "Relation between word variety and mean letter length with chronological and mental ages."

Ralph N. Akamine—For special equipment in research on carbohydrate-protein complexes in cartilage autographs and homographs.

A set of standards or requirements for associations or societies invited to affiliate, or requesting affiliation with the Academy was drawn up by the Affiliations Committee. These standards have primarily to do with membership, programs, and evidence of stability.

Two new affiliates, the Hawaii Psychological Association and the Hawaiian Botanical Society, were admitted as Associated Societies during the year. This makes a total of nine societies which have affiliated with the Academy to date.

The Academy was represented on the Conservation Council for Hawaii by President Colin G. Lennox.

Affiliation Committee

Colin G. Lennox, Chairman
Arthur S. Ayres, Amer. Soc. Agron., Hawaii Chap.
Fred A. Bianchi, Hawaii Ent. Soc.
George O. Burr, Amer. Chem. Soc., Hawaii Sec.
Doak C. Cox, ex officio
Dan A. Davis, Geophys. Soc. Hawaii*
Fred I. Gilbert, Jr., Hawaii Med. Assoc.
D. Elmo Hardy, Hawaii Ent. Soc.*
Katharine Luomala, Anthrop. Soc. Hawaii
John F. Mink, Geophys. Soc. Hawaii
O. E. Sette, ex officio
G. Donald Sherman, Sigma Xi, Hawaii Chap.*
Marlowe D. Thorne, Amer. Soc. Agron., Hawaii Chap.*
W. Edgar Vinacke, Sigma Xi, Hawaii Chap.
Herbert Weaver, Hawaii Psychol. Assoc.

* Resigned.

AAAS REPRESENTATIVES

Dr. Leonard D. Tuthill, alternate for Mr. O. E. Sette, served as official delegate to the annual AAAS Council meeting held in Berkeley in December. The question of security clearances and concomitant regulations and procedures on the part of the federal government in research supported by government funds was one of the principal matters of concern at the meeting.

Dr. Robert W. Hiatt, alternate for Dr. Leonard D. Tuthill, represented the Academy on the AAAS Academy Conference in Berkeley.

PROGRAM

At the first and final sessions of the Annual Meeting a total of twenty papers was presented, including a symposium on areas for action in developing Hawaii's resources, an invitational paper on research progress in Central America and Mexico, and the presidential address on the land use of an isolated Hawaii valley, Waipio.

The Academy was cosponsor, with the Geophysical Society of Hawaii, of two symposia on the physical problems in rain and cloud, and on problems in atmospheric chemistry, on November 16 and 17, 1954. The speakers were research men from all over the world, gathered in Hawaii to engage in "Project Shower." The Academy also jointly sponsored, with the University of Hawaii Geophysics Committee, the Geophysical Society of Hawaii, the Hawaii Chapter of the Society of the Sigma Xi, and Sigma Phi Sigma, a lecture on the opportunities in geophysics by Dr. H. Kirk Stephenson, program chairman of Earth Sciences of the National Science Foundation.

At the suggestion of the Council, a subcommittee on popular programs was initiated. The plans of this subcommittee called for a series of meetings to acquaint members, especially those who are science teachers, with the activities and facilities of the various research institutions of Honolulu. The first of these meetings, arranged by the Hawaii Chapter of the Society of the Sigma Xi and cosponsored by the Academy, consisted of a symposium entitled "An introduction to marine biology and oceanography in Hawaii"; this covered research carried on in the botany and zoology departments of the University of Hawaii, the Pacific Oceanic Fisheries Investigations laboratories, and the Division of Fish and Game in the Territorial Board of Agriculture and Forestry. The second meeting in the Popular Series was held at the Bishop Museum, where members of the staff of that institution presented a symposium on research conducted there.

Business meetings were held during the first scheduled session in November, 1954, and following the annual banquet in conjunction with the final session in April, 1955.

Program Committee

A. J. Mangelsdorf, Chairman
Brenda Bishop
Leroy D. Christenson
Doak C. Cox, ex officio
Maxwell S. Doty
George Felton
Fred I. Gilbert
J. Linsley Gressitt
Beatrice Krauss, ex officio
Colin G. Lennox, ex officio
Leonard Mason
Marlowe D. Thorne*
John N. Warner

* Resigned.

NOMINATIONS

The Nominating Committee prepared a slate of candidates for the following offices for 1955–56: president-elect, A. J. Mangelsdorf and G. Donald Sherman; two-year councilor, Donald L. McKernan and Colin J. Herrick; secretary, Doak C. Cox; treasurer, Beatrice H. Krauss—the latter two, incumbents. Ballots were distributed and returned by mail, and tallied at the business meeting at the final scheduled session in April, 1955.

Nominating Committee

Robert W. Hiatt, Chairman
L. D. Baver
Walter Carter
Colin G. Lennox, ex officio
Carey D. Miller

AUDIT

The Auditing Committee, consisting of W. M. Bush, as chairman, and T. T. Tanimoto, examined the Treasurer's report, which is presented under FINANCES, and found it correct and in order.

SCIENCE TEACHERS

At an organizational meeting, this Committee decided that it should concern itself primarily with ways in which the Academy could be of greatest assistance to science teachers in the secondary schools of Hawaii. A subcommittee investigated means of helping promote the teaching of science in Hawaii, while another subcommittee investigated the possibility of establishing a science film library for private schools, similar to the D.P.I. film center maintained for the public schools. It is hoped that all film libraries—the proposed private schools' film library, the D.P.I. film center, and the Bishop Museum natural history educational units—may be integrated, if this appears desirable and practical.

The two symposia in the Popular Series of Academy programs were specially directed toward the science teachers. Their attendance was encouraging.

Science Teachers Committee

Paul L. Breese, Chairman
Horace Clay, Vice-chairman
Doak C. Cox, ex officio
Natalie Holladay
Ralph Heinicke
Phillip T. Kelley
Colin G. Lennox, ex officio
Donald Mitchell
Katherine O'Dea
Brother John T. Sayer
Spencer Tinker

AAAS FELLOWS

This Committee presented a list of fifteen names of local members of the AAAS for election as Fellows in their respective disciplines. The AAAS accepted the Committee's recommendations and these persons are now Fellows of the AAAS. Fellows of the AAAS are so-designated with a double asterisk before their names in the list of Academy members.

AAAS Fellowship Committee

L. D. Baver, Chairman
J. H. Beaumont
E. H. Bryan, Jr.
Walter Carter
Harold St. John
G. Donald Sherman
O. E. Sette

PUBLICATION

The twenty-ninth Proceedings were published in an edition of 850 copies. Distribution was to the membership of the Academy and to more than 200 institutions scattered over the world, chiefly on an exchange basis.

Publication Committee

Marjorie B. R. Milnes, Chairman
Doak C. Cox, ex officio
Marion P. Goddard
Colin C. Lennox, ex officio
Lydia C. Nickerson

PUBLIC INFORMATION

The work of this Committee, with Harry L. Arnold as chairman, was concerned chiefly with newspaper publicity for the two sessions of the Annual Meeting, the symposia and special lecture meetings. Robert Scott handled this for the *Honolulu Star-Bulletin,* and E. H. Bryan, Jr., for the *Honolulu Advertiser.*

HAWAII DIVISION

The Hawaii Division was established during the year in response to a petition to the Council, permitted under a constitutional amendment. The Hawaii Division is composed of 59 Academy members, resident on the island of Hawaii. The Division held four meetings during the year; three meetings were in Hilo, and one in Kona. The Academy grants the Division a sum of 25 cents per member from the Academy treasury for operational costs.

Hawaii Committee

Chester K. Wentworth, Chairman and Representative on the Academy Council
Elizabeth G. Eklund, Secretary-Treasurer
Hannah Bowman
Clifton J. Davis
Amy Greenwell

FINANCES

Balance on hand, April 15, 1954		$834.72
Receipts		
Dues	$371.00	
AAAS research grant	67.00	
Reprints sold	102.57	
Miscellaneous	143.75	
Total	$684.32	
Expenditures		
Proceedings (HAS share)	$285.00	
AAAS-HAS research grants	100.00	
Programs and reprints	175.80	
Stationery and postage	132.28	
Dues allocation to Hawaii Division	10.00	
Miscellaneous	139.63	
Total	$842.71	
Balance on hand, April 12, 1955		$676.33

Comparative status of dues at end of period:	April 12, 1955	April 15, 1954
Dues paid in advance	$155.00	$211.00
Dues in arrears	135.00	52.00

OFFICERS

1954–55

President	Colin G. Lennox
President-elect	Willis A. Gortner
Secretary	Doak C. Cox
Treasurer	Beatrice H. Krauss
Councilor for 2 years	Vernon E. Brock
Councilor for 1 year	Kiyoshi Ito
Ex officio	W. B. Storey

1955–56

President	Willis A. Gortner
President-elect	A. J. Mangelsdorf
Secretary	Doak C. Cox*
	Beatrice H. Krauss†
Treasurer	Beatrice H. Krauss
Councilor for 2 years	Colin J. Herrick
Councilor for 1 year	Vernon E. Brock
Ex officio	Colin G. Lennox

* On leave, 1955.
† Acting secretary, 1955.

THE 30th
ANNUAL MEETING 1954-55

Program

FIRST SESSION

November 9, 1954

D. T. Fullaway: Coffee Green Scale in Hawaii.
Edward J. Britten: White Clover in Hawaii.
Joseph E. King: Some Observations on the Sea Birds of the Central Pacific.
J. Linsley Gressitt: Natural History of Taiwan.
Sterling B. Hendricks: The Effect of Light on Growth.

November 10, 1954

AREAS FOR ACTION IN DEVELOPING HAWAII'S RESOURCES—A SYMPOSIUM
Colin G. Lennox, Moderator

Robert S. Craig: The Need for Development of Hawaii's Resources and Current Progress.
Frederick Simpich, Jr.: Criteria for Success in Potential Developments and their Application.
Atherton Richards: Land and Water Development.

SPECIAL SESSIONS

November 16, 1954

PHYSICAL PROBLEMS IN RAIN AND CLOUD—A SYMPOSIUM
Wendell A. Mordy, Moderator

Patrick Squires: Drop Size Distribution in Clouds.
John Warner: Liquid Water Content in Clouds.
E. J. Workman: Thunderstorm Electricity.
Duncan C. Blanchard: Electrified Droplets from the Bursting of Bubbles at an Air-Sea Interface.
Vincent Schaefer: A Fire-Weather Program.

November 17, 1954

PROBLEMS IN ATMOSPHERIC CHEMISTRY—A SYMPOSIUM
Wendell A. Mordy, Moderator

Ben K. Seely: A Microchemical Technique for Detecting Atmospheric Particles.
Alfred H. Woodcock: Atmospheric Sea Salt.
Sean Twomey: A Phase-Transition Test for Identifying Atmospheric Particles.
Erik Eriksson: The Place of Atmospheric Chemistry in Meteorology.

(The above symposia were sponsored jointly with the Geophysical Society of Hawaii.)

March 29, 1955

AN INTRODUCTION TO MARINE BIOLOGY AND OCEANOGRAPHY IN HAWAII—A SYMPOSIUM
Vernon E. Brock, Moderator

Howard J. Boroughs: Research at Coconut Island.
Maxwell S. Doty: Research in Marine Productivity.
William F. Royce: Biological Research at the Pacific Oceanic Fisheries Laboratory.
Thomas S. Austin: Oceanographic Research in the Pacific.
Yoshio Yamaguchi: Inshore Fishery Research.

(The above symposium was sponsored jointly with the Hawaii Chapter of the Society of the Sigma Xi.)

April 12, 1955

THE SCIENTIFIC ACTIVITIES AND FACILITIES OF THE BISHOP MUSEUM—A SERIES OF SHORT TALKS BY STAFF MEMBERS, WITH EXHIBITS

Participants:
Colin G. Lennox — J. Linsley Gressitt
Alexander Spoehr — Edwin H. Bryan, Jr.
Kenneth B. Emory

April 14, 1955

H. Kirk Stephenson: Opportunities in Geophysics.

(Sponsored jointly with the Geophysical Society of Hawaii, University of Hawaii Geophysics Committee, Hawaii Chapter of the Society of the Sigma Xi, and Sigma Phi Sigma.)

FINAL SESSION

April 21, 1955

Howard Boroughs, Sidney J. Townsley, and Robert W. Hiatt: The Uptake, Internal Distribution and Excretion of Radiostrontium by Fish.
Maxwell Doty, R. R. Guillard, and E. C. Jones: The Productivity of the Inshore Waters in Hawaii.
John E. Randall: Spawning Cycle, Development, and Growth of the Convict Surgeon Fish or Manini (*Acanthurus triostegus sandvicensis*).
M. Oguri and George W. T. C. Chu: Influence of Diet on the Susceptibility of Domesticated Ducks to Parasitism by a Marine Trematode.
Robert L. Pyle: Pictorial Survey of the Native Hawaiian Landbirds.

April 22, 1955

G. Donald Sherman, Ada C. Chu, and Clarence M. Sakamoto: The Influence of Application of Soluble Silicates on Phosphorous Availability in Certain Hawaiian Soils.
Joseph E. Alicata and Sa'eb W. Dajani: Parasitological Studies in the Hashemite Kingdom of Jordan.
Sidney L. Halperin: Is Mental Illness Inherited.
Samuel D. Allison: Newer Modalities in Dermatology.
Sterling Wortman: Research Progress in Central America.

April 23, 1955

Business Meeting
Address of the Retiring President
Colin G. Lennox: Waipio Valley—An Example of Today's Problems in Land Use of Isolated Hawaiian Valleys.

HAWAII DIVISION

October 29, 1954 (Hilo)
March 4, 1955 (Kona)

Wendell A. Mordy, Vincent Schaefer, E. J. Workman, Duncan Blanchard, and Patrick Squires: "Project Shower."

March 9, 1955

Leonard D. Baver: Soil Puddling and Compaction—an Hawaii Problem.

April 15, 1955

Juliette Wentworth, Clarence Lyman, A. M. Hieronymus, Robert S. Nekomoto, Hitoshi Kamasaki, and David Young: Plant Damage by Volcanic Fumes.

Abstracts

COFFEE GREEN SCALE IN HAWAII

The author pointed out that the coffee plant in Hawaii enjoys comparative freedom from insect pests and disease (we have no Hemilea disease or seed weevil) and explained this happy circumstance by a recital of the known facts regarding the introduction of the coffee plant. However, the green scale has been known here as a coffee pest since 1893, according to the record, and has received attention from various entomologists who have worked in the Kona district of Hawaii on coffee, including Pemberton, Willard, Illingworth, and the author. It is believed the green scale entered the Territory on some ornamental plant, of which many were introduced previous to 1893. As far as coffee is concerned, Nature takes care of this pest to keep its population's level sub-economic. Coffee planters have never had to spray trees with insecticidal liquids or to fumigate with insecticidal gases to control this pest.

D. T. FULLAWAY

WHITE CLOVER IN HAWAII

White Clover (*Trifolium repens*) has been found to be a highly variable pasture plant. It has a worldwide natural distribution, being found under a broad range of environmental conditions. Cross pollination, together with self-sterility factors assures a possibility of constantly changing genetic makeup, enabling it to adapt itself to new locations.

The Hawaiian Islands have compressed within their small land area tremendous variations of such environmental factors as temperature, rainfall, and soil. Mean annual temperature variations on the Islands occur within distances of 20 miles which are comparable to that occurring from New York to Florida. Annual rainfall averages extend from about 20 to nearly 500 inches on the Islands, more than four times the range from the driest to the wettest state of the Union.

White Clover with its inherent capacity for variation was first introduced to Hawaii with its wide environmental extremes over one hundred years ago. It has undoubtedly been introduced a number of times to various localities since that time.

Reports indicating that White Clover has gradually been extending its range on the Islands have instigated a study of its present range with the objective of isolating a strain suitable to the pasture of the lower elevations.

Collections made on Hawaii and Maui have revealed White Clover to be growing at extremes of 8,000–500 feet which have extremes of annual temperature means of about 52° F. and 73° F. Extremes of annual rainfall in areas at which White Clover was collected varied from about 25 to over 200 inches.

Considering the environmental extremes at which White Clover has been collected, and in view of its demonstrated capacity to adapt itself to a wide range of conditions, it seems probable that new strains of White Clover have developed on the Islands. Experiments are planned to test this hypothesis.

E. J. BRITTEN

SOME OBSERVATIONS ON THE SEA BIRDS OF THE CENTRAL PACIFIC

Although primarily concerned with the tuna fishes of the central Pacific, the Pacific Oceanic Fishery Investigations is also interested in the sea birds, and for four reasons primarily: (1) they are a direct aid to both the scientist and the fisherman in finding tuna schools, (2) their variations in abundance may contribute information on the general productivity or amount of available food in different ocean areas, (3) in some localities at certain times of the year they may be serious competitors of tuna for food and also competitors of tuna fishermen for bait, and (4) the staff have found that a study of the birds and their identification relieves some of the monotony associated with long ocean voyages.

POFI scientists have unusual opportunities to observe the sea birds on their nesting grounds and feeding on the open ocean. Most of the islands on which the birds breed are uninhabited by man and rarely visited by ornithologists. Although Oahu is surrounded by water, bird students here who must make their observations from the shore see relatively few species of oceanic birds and never see the dense aggregations characteristic of the breeding islands.

The sea birds ordinarily occurring in the central Pacific belong to six major groups or families: (1) the albatrosses (Diomedeidae), represented by 2 species; (2) the shearwaters and petrels (Procellariidae), by 8 or possibly 10 species; (3) the terns (Laridae), by probably 7 species; (4) the frigate birds (Fregatidae), by 2 species; (5) the boobies (Sulidae), by 3 species; and (6) the tropic-birds (Phaethontidae), by 2 species—a total of about two dozen species. In addition gulls and jaegers are occassionally reported, particularly in the northern portion of the region.

(Kodachrome slides were shown of 15 species illustrating both juvenile and adult stages and nesting habits, with accompanying remarks on the general abundance of different species, their distribution and nesting cycles.)

JOSEPH E. KING

NATURAL HISTORY OF TAIWAN

Taiwan holds a conspicuous position among the islands or archipelagoes fringing eastern Asia. Though just over twice the area of the Hawaiian Chain, it is very rich in natural productions. It is the nineteenth largest island, but the fourth highest, being exceeded by New Guinea, Borneo, and Hawaii. Two of its peaks are nearly as high as Mauna Loa, and some 50 are higher than Haleakala. The eastern half is very mountainous and the western half nearly flat. The world's highest sea cliffs occur along the upper part of the east coast, and to their south is a long narrow rift valley with a lesser steep, narrow range to its east.

The mountains of Taiwan consist of greatly raised and folded sedimentary and metamorphic rocks, many tilted even vertically, and consisting largely of shale, slate, and sandstone. There are minor deposits of coal, sulphur, and a little gold. There is raised limestone, a mud crater, and some old volcanic stocks in the south, and some solfataras and extinct volcanoes in the north. The ocean to the east and south is deep, but that in the Formosa Straits is less than 100 meters deep. Taiwan was considerably raised in the Eocene, later joined to South China, and last separated in the early Pleistocene. It was connected with the Ryukyus as a peninsula from South China before separating from both.

The human population of Taiwan is dense (over 8,000,000). The oldest residents are former head-hunters of six distinct tribes who probably came from Luzon at various periods. They were pushed into the mountains during the past millenium by Chinese, who came mostly from Amoy. Other elements are Hakkas, some Foochownese, some mixtures of Chinese and aborigines in the south, a few remaining Japanese, and many refugees from East China and other parts of China. Agriculture occupies much of the population. Camphor, lumber, and fish are also important.

The flora and fauna are of rich continental nature, richer and more balanced than is the case in Hawaii. That is, representation of families and genera is more complete, although there is less endemism and less spectacular speciation in limited taxonomic categories than in Hawaii.

Higher plants are represented by some 4,000 species. Extensive forests remain in the mountains, with coniferous forests at higher altitudes. There are 27 species of 15 genera of conifers, including familiar Holarctic genera like *Taxus, Abies, Picea, Pinus, Tsuga, Chamaecyparis,* and *Juniperus.*

The fauna is rich in all groups. There are some 50 kinds of mammals, a few hundred kinds of birds, and many reptiles and amphibians. Perhaps 10,000 species of insects are known, with many more still unclassified.

Biogeographically, Taiwan is primarily Indo-Chinese in its relationships, but in the higher mountains there is an extensive Palearctic element. Many species are possessed in common with South China, northern Indo-China, northeastern India, Burma, and the Ryukyu Islands, or are represented by species closely related to those in the above areas, or in Japan. The relationship to the Philippines is distant, and in most cases can be attributed to a common southeast Asian origin, suggesting that the Philippines and Taiwan were never connected except by way of the Malayan regions. However, the small island Botel-Tobago, just east of the south end of Taiwan, is both geologically and biologically part of the Philippine Archipelago.

J. LINSLEY GRESSITT

THE EFFECT OF LIGHT ON GROWTH

Photoperiodism, the control of growth by length of day, or more properly by length of night has been demonstrated locally by the artificial inhibition of flowering in sugar cane and poinsettias by illumination at night. It is a phenomenon of much wider importance affecting both animals and plants in a variety of ways.

In plants light exercises a control over seed germination, internode elongation, leaf enlargement, plumular hook unfolding, epinasty, leaf abscission, cambial activity, rhizome growth, dormancy, root development, bulb formation, pigmentation, phylloidy of bracts, tillering, and sex expression. In different plants the same control may be exercised in opposite ways. For example, the blooming of chrysanthemums is initiated by long nights, that of barley by short nights. The times of lighting required for control may be very short. For example, lettuce seeds, which kept in darkness will not germinate, will germinate if they are exposed to light for a period as short as 10^{-4} sec. The energy levels required for various controls in various plants vary considerably. They vary also with the color of light used, and for all controls with all plants the band of wave lengths of maximum effect is almost exactly the same, varying from about 5400 to 7000 Å, a part of the visible spectrum.

A narrow band in the infrared from about 7000 to 8000 Å with a maximum near 7400 Å has been found that reverses the effects of visible light. For example, lettuce seeds exposed briefly to 6500 Å red light will germinate, but if exposed subsequently to 7300 Å infrared light will not germinate. The reversals may be repeated. The seeds exposed in sequence to red, infrared, and red will germinate. Those exposed to red, infrared, red, and infrared will not.

It appears that there is in plants some unidentified pigment absorbing light in the 5400 to 7000 Å range and sensitive to such light so that it converts to some other pigment sensitive to light in the 7000 to 7600 Å range and reverting to the first pigment. Because the energy levels required for control and reversal are variable but always reciprocal, it appears that another molecule besides the pigment is involved, the variability in energy being explained by the variation in the relative concentrations of the second molecule and its product. The second pigment apparently reacts with some other compound to start the actual control. This reaction takes some time. The reversibility of control with the lettuce seeds is ineffective if the time interval between red light and subsequent infrared light is more than about 30 minutes. The opposite effects in different plants with the same lighting schedule is probably due to attachment of one compound at two points to another, which permits self-inhibition. The means for measuring time in the plant is the return of the infrared absorbing pigment to the red absorbing one by a dark reaction.

In animals such processes as the change of plumage or fur, sexual activity, and migration are controlled by photoperiodicity. Song birds have been brought to voice in Japan by control of day length for the last millennium. Laboratory experimentation on the effective wave lengths of light has been successful only with Hydractinea, a coelenterate, which releases eggs or sperm 55 minutes after sunrise. In Hydractinea, control is effected most efficiently by light with about the same range of color as in the plants plus a very effective band in the blue. The pigment involved has been found to be copraporphyrin III, a pigment found in the central nervous system of vertibrates, and in particularly high concentrations in birds. This same pigment is probably responsible for the control in other animals, but the effective bands of light are narrower and variable because of the deep burial of the pigment in higher animals and the filtering of the light by overlying tissues.

In both plants and animals other controls besides the fundamental photoperiodic control are exercised, and in some organisms, such as man, the additional controls mask the effects of the photoperiodic control, which is nevertheless believed to be still present and effective.

STERLING B. HENDRICKS
Agricultural Research Service
Beltsville, Md.

AREAS FOR ACTION IN DEVELOPING HAWAII'S RESOURCES—A SYMPOSIUM

COLIN G. LENNOX, Moderator

INTRODUCTION

This symposium will present problems of developing Hawaii's economy to meet the demands that are made on it by the growing Hawaiian population. The economy must be based on Hawaii's resources, which were discussed by Academy members in a symposium two years ago. This symposium, conducted by businessmen, is intended to indicate to Academy members, some of whom are relatively remote from applications of their work, the problems in the action line where men and resources are put to work.

It must be recognized that Hawaii is a pocket employment market, in which the employment situation is isolated by travel costs from the mainland. The employment situation has varied repeatedly in the past. In 1936 there was difficulty placing new workers coming onto the labor market in jobs. Between 1941 and 1946 labor was so short it had to be rationed. In 1949 unemployment reached a peak.

COLIN G. LENNOX

THE NEED FOR DEVELOPMENT OF HAWAII'S RESOURCES AND CURRENT PROGRESS

In this mid-century period in America, business leadership dare not fail in achieving impressive results in providing employment and improving living standards. This is because the temper of the times—as measured by such foremost public opinion authorities as George Gallup, Elmo Roper, and Claude Robinson—is this: If business leadership fails in providing employment and rising living standards, the citizen expects his government to do something about it. If his government does not, he will vote it out and vote in a new one. This is significant for Hawaii because our labor force of approximately 200,000 is growing at the rate of about 5,000 a year, and will presumably thus reach 300,000 in 20 years barring unforeseen increases in out-migration.

Hawaii faced a similar problem when 25,000 workers were displaced by mechanization of plantations between 1940 and 1950. Increases in employment in service and other lines, plus Federal defense employment, largely solved this problem.

No one can now predict how additional workers will be employed in 20 years, any more than how the 25,000 displaced would be absorbed could have been predicted in 1940. No single solution is likely.

Hotels now under construction should give employment to some 5,000. There are several prospects, such as sugar and pineapple by-products, fresh and processed foods for export and local consumption, expansion of the garment industry for export, new small industries for local consumption, and entirely new industries in such light products as possibly electronics for export.

There are several requirements for our needed development, first of which is new capital investment ranging upwards of $25,000,000 a year. Others are bold enterprisers, increased use of applied science, a socio-political climate favorable to business growth, community-wide determination to support the needed development, and an educational program geared to achieving the required skills.

The Industrial Research Advisory Council (IRAC) in the past five years through over 50 research grants has already (1) developed new export food products in such lines as papaya, passion fruit, and guava, (2) assisted in developing by-product livestock feeds, (3) shown the way to dehydrated feeds from legumes, (4) stimulated expansion of crafts, (5) solved basic fresh fruit shipping problems, (6) started an impressive experiment in saline agriculture, (7) overcome plant disease and pest problems in commercial flowers, (8) surveyed mainland markets, (9) stimulated formation of three industry associations for self-help, and (10) assisted in launching many public and private new industry studies.

These are a few examples of ways in which skills of scientists have been brought to bear upon the problems of economic expansion. It can be hoped that serendipity will, as in the past, be present in the continuing efforts of researchers. The literature of scientific research is liberally sprinkled with examples of discoveries far more important than the goals originally sought.

ROBERT S. CRAIG
Hawaiian Economic Service
Honolulu, Hawaii

CRITERIA FOR SUCCESS IN POTENTIAL DEVELOPMENTS AND THEIR APPLICATION

It is important in discussing the broadening of our economic base to recognize the economic limitations of our objectives. In considering any new product for export from the Territory, we should recognize that it will have a greater chance of success if it possesses a number of these qualities:

(1) Low labor content per dollar of cost because of our relatively high wage scales;
(2) High dollar value per unit of weight because of our shipping costs;
(3) An agricultural product difficult to grow elsewhere—such as, pineapple or macadamia nuts, for the obvious competitive advantages gained;
(4) It should not be readily subject to spoilage because of the harvesting and labor relations problems spoilage presents;
(5) It should be capable of being packaged in paper because of the costs of importing and forming tin.

Probably no one commodity meets all these criteria, but the nearer we come to satisfying these standards, the more likely we are to achieve a lasting success. For example: papayas do not fare very well against this check list; macadamia, in contrast, fares remarkably well.

Turning to imports, there are undoubtedly many small areas of activity, largely in the processing field, where small enterprisers could find profitable activity, for example the local manufacturer of soft-drink and milk bottles which now come in by ship and which cube very large. But the fact is that only seven or eight commodities are imported at a cost of a million dollars a year or more. Most either cannot be produced locally or cannot be produced locally at a profit. Others break down into so many categories, sizes, etc., that no one type is imported in sufficient volume to merit local production.

There are, however, three other avenues of approach to the problem. The first of these is the possibility of local manufacture or processing of articles for sale on the mainland of a size and nature that neither freight rates nor style changes would disadvantage. We have a highly intelligent population and one that is manually dexterous. Our factory wage scales are lower than those on the mainland, in contrast to agriculture where our rates exceed those on the mainland. What I have in mind is subassembly of articles like electronic devices.

A second area for activity is in the travel field. The potential is staggering. Immediate needs include making some more land at Waikiki and construction of an auditorium so that air and surface carriers can solicit the convention business we must now turn away. The growth of pension plans in the last twenty years, the impact of the social security system, and the lengthening life span are beginning to be manifested in a growing body of prosperous, vigorous, retired persons. The large landowners, the carriers, and the insurance companies, could jointly pool their promotional efforts to induce some of these people to come here and live.

Finally, we must look to scientists, particularly the organic chemists, to give our resources the thorough examination they deserve. My company is studying two possibilities in the drug field. The By-Products Committee of the HSPA has found that the local production of nitrogen from the air would be profitable and that, under slightly improved marketing conditions, the manufacture of furfural from bagasse would make an attractive investment. The same group has learned how to make paper of competitive quality from bagasse. The Sugar Research Foundation in New York, which the HSPA supports, is on the brink of starting a whole new chain of chemical development from carbohydrates. What this may mean may be estimated from the vast field of petro-chemicals that has arisen from twenty years' work with the petroleum molecule. I urge on scientists the need for application of their skills to the problem and assure them that if they develop opportunities, management and venture capital can be found for their development.

FREDERICK SIMPICH, JR.
Castle and Cooke, Ltd.
Honolulu, Hawaii

LAND AND WATER DEVELOPMENT

Current progress in the development of land and water indicate the potentialities of further development of these resources in Hawaii.

Rocky land, both forested and dry, is being successfully cleared for pasture development as in Kohala, and for the cultivation of crops like coffee, as in Kona, and macadamia nuts, as in Puna. Land is being reclaimed for agricultural uses from saline swamps as at Kekaha, Kauai. Crops are being selected on Molokai for growth on lands for which brackish water is available for irrigation. New or expanding crops are increasing the potentialities of lands not formerly used, for example macadamia nuts, papayas, and most recently lilikoi.

Some lands present special problems not yet solved. In general, the large steep-walled valleys, once centers of population, are now abandoned or put to very low use. Waipio Valley on Hawaii is an example. The growth of ti from which to extract levulose is being considered there. Further water development by bulkheaded tunnels in the dike complexes at the heads of some valleys is of interest.

The extension of soil conservation measures is essential to the saving of soils for existing or potential agricultural use in some areas, for instance on Molokai.

The restoration of Hawaiian fish ponds, for example those on Molokai, is of potential economic importance.

ATHERTON RICHARDS
Bernice P. Bishop Estate
Honolulu, Hawaii

DISCUSSION

Lilikoi cultivation, being in a rapidly expanding stage, is the subject of much speculation and experimentation. Experiments on the most efficient types of trellis or terrace are underway. The useful length of life of the lilikoi vines is uncertain, being limited in Australia, at least, by a virus.

Factors tending to increase the tourist and retirement possibilities in the Islands are the decreasing separation from the mainland in terms of the time and cost. The Island atmosphere remains clear, in contrast with the increasing pollution of the continental atmosphere. It is necessary to guard against the replacement of a relaxed way of life by high-pressure attitudes induced by the very striving for tourist trade.

The development of special forms of energy does not appear to be likely in the immediate future, though the utilization of volcanic heat in the area of the active volcanoes, the further trapping of the sun's energy, and the development of atomic energy are of interest.

For the further development of agricultural export business, a solution is necessary to the problem of recurrent strikes that make guarantees of mainland deliveries impossible. The extension of the National Labor Relations Act to the shipping industry is perhaps a solution, though there is no general agreement yet that it is the proper one.

That potentialities of expansion of the economy in the immediate future exist is demonstrated by the recent development of a business processing lilikoi and guava puree, which from a \$50,000 capital expenditure produced \$300,000 in sales in the first year.

THE PANEL AND SPEAKERS FROM THE FLOOR

PHYSICAL PROBLEMS IN RAIN AND CLOUD—A SYMPOSIUM

WENDELL A. MORDY, Moderator

DROP SIZE DISTRIBUTION IN CLOUDS

Rain requires clouds, but clouds do not always produce rain. Understanding of the rain-forming process is sought by studying the colloidal structure of clouds. A raindrop is equivalent in mass to from 1,000 to 1,000,000 cloud drops. How cloud drops grow to raindrop size is the critical issue.

In the case of warm clouds, growth by condensation is inadequate to produce rain and it appears that the cloud drops must coalesce. The most likely way for coalescence to happen is by the accretion of large cloud drops as they fall through and pick up smaller ones. If this mechanism is the dominant one, then some relatively large cloud drops must be present in a cloud before rain can occur.

All drops form initially by condensation on small particles called nuclei. Generally larger nuclei yield larger drops. Condensation occurs when air is cooled beyond some critical temperature. Rising air undergoes cooling at a rate which is proportional to the rate of rise. If the cooling is very rapid, the ensuing cloud will consist of a great many uniform, small drops. If the cooling is slow, the cloud drops will be fewer but more varied in size.

Measurements of cloud drops obtained by exposing coated slides from an aircraft have shown that there are fewer and larger drops in oceanic clouds than in clouds over continents.

PATRICK SQUIRES
CSIRO, Sydney, Australia

LIQUID WATER CONTENT IN CLOUDS

One of the important cloud parameters affecting rain formation is the liquid water content, usually expressed as the number of grams of water per cubic meter of air. An instrument was developed using an electrical technique to make continuous measurements of liquid water in clouds from an aircraft.

Data obtained with the instrument reveal large variations in cloud water content. Using only the peak values at each level, however, a consistent picture for the cloud as a whole is obtained. Liquid water content increases with height from the cloud base to about 1,000 feet below the top, then decreases. Near the cloud base, the values observed are about equal to that expected from condensation due to adiabatic cooling. At higher levels, however, the measured amounts are only a small fraction of the theoretical values. This discrepancy points to mixing of dry environmental air with the cloud air. Such mixing, to account for the observations, must be effective across the entire cloud.

JOHN WARNER
CSIRO, Sydney, Australia

THUNDERSTORM ELECTRICITY

Thunderstorms account for nearly all of the rain which falls in New Mexico. This area has consequently been the center of much thunderstorm research. In 1948, Reynolds and Workman reported on an experiment in which a very dilute solution of caesium fluoride was placed in contact with a copper block maintained at a temperature of –20° C. One end of a wire lead was suspended in the water and the other end connected to the copper block. An ammeter was connected in series with the wire. When the solution began to freeze, a current was indicated by the ammeter. It was found that 1 cc. of the dilute solution freezing per minute produced a current of one-fourth milliampere.

Further investigation revealed that charge generation was restricted to areas where ice and water were in contact. The process is accompanied by the electrolysis of water, and the consequent release of hydrogen. All of the hydrogen in the atmosphere might have been produced by this process.

E. J. WORKMAN
New Mexico Institute of Mining and Technology
Socorro, New Mexico

ELECTRIFIED DROPLETS FROM THE BURSTING OF BUBBLES AT AN AIR-SEA WATER INTERFACE

Salt particle distributions in the atmosphere have been measured and studied by Woodcock. An effort to find a mechanism for transferring salt from ocean to atmosphere led to a study of air bubbles bursting at a water surface. Through laboratory experiments, it was found that, when a bubble bursts, a small jet of water was produced which broke into a number of small drops rising from 1 millimeter to 20 centimeters above the water surface. Further study revealed the drops were charged.

The charge increases with drop radius and is predominantly positive on drops less than about five microns radius. The possible effect of the phenomena on the space charge over the ocean is the subject of continued study.

DUNCAN C. BLANCHARD
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

A FIRE-WEATHER PROGRAM

A program has been undertaken by the Munitalp Foundation in cooperation with the Forest Service to study the problem of forest fires caused by lightning. A school for observers was set up covering the following topics:

- Description of clouds
- Cloud patterns
- Lightning storms
- Fires

An area in the Northwest United States, 150 by 200 miles, was chosen for study. Careful observations were made of clouds, lightning storms, and fires. It was found that about 75 per cent of the fires in the area were started by lightning. The program will stress better forecasting of storms and possible control by cloud-seeding methods.

A film was shown demonstrating the use of lapse time pictures taken from high flying aircraft as a means of recording and observing cloud patterns.

VINCENT SCHAEFER
Munitalp Foundation
Schenectady, New York

PROBLEMS IN ATMOSPHERIC CHEMISTRY—A SYMPOSIUM

WENDELL A. MORDY, Moderator

A MICROCHEMICAL TECHNIQUE FOR DETECTING ATMOSPHERIC PARTICLES

Microchemical techniques were developed at the New Mexico Institute of Mining and Technology to enable identification of atmospheric particles. The method utilizes a spot test analysis which permits identification of masses as small as 10^{-10} to 10^{-15} grams. The particles, collected on a gelatine-coated cellulose acetate strip, form characteristic halos which may be examined under a microscope.

Copper, cobalt, and nickel may be identified by mixing rubeanic acid in with the gelatine. Other reagents are used to identify iron compounds, sodium and potassium chlorides, and carbonates. The test for carbonates is not specific, as certain oxides and hydroxides yield a similar reaction.

The technique has been used as a control in studying the decay rate of silver iodide when used as a cloud-seeding agent.

The technique was also used in the Keanae Valley cloud study on Maui, where copper was used as a tracer in order to determine the effects of spraying small drops into a cloud from the ground.

BEN K. SEELY
New Mexico Institute of Mining and Technology
Socorro, New Mexico

ATMOSPHERIC SEA SALT

Liquid droplets are ejected into the air when the bubbles, which are formed by "white caps," burst at the sea surface. The water quickly evaporates from these air-born droplets, leaving minute saline particles or nuclei. The quantity of this sea salt present in the air over the sea has been measured from aircraft. From these measurements, the variation in number of salt particles with wind speed and altitude was determined. The amount of salt increases with increasing wind and decreases with increasing altitude. The average total weight of salt found near cloud base levels in Hawaii was about 2.5 micrograms per cubic meter.

Comparisons between the number of large atmospheric salt particles and observed salinities of rainwater point to a close relationship between salt and rainfall.

ALFRED H. WOODCOCK
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

A PHASE-TRANSITION TEST FOR IDENTIFYING ATMOSPHERIC PARTICLES

Measurements of hygroscopic particles in the atmosphere were made over SE Australia, following the method of Woodcock. High concentrations were found in air hundreds of miles inland, raising a question as to their source.

The composition of the larger (greater than 10^{-12} grams) hygroscopic particles was investigated, using a phase-transition method. Particles were collected on stretched spider webs exposed from an aircraft. It was found that the hygroscopic particles were usually composed of sea-salt, sometimes in combination with insoluble material. A chemical test on individual particles indicated that no appreciable decrease in chloride content or replacement of chlorides by carbonates took place as air moved inland. Only occasionally were large soluble particles, other than sea-salt, detected.

SEAN TWOMEY
CSIRO, Sydney, Australia

THE PLACE OF ATMOSPHERIC CHEMISTRY IN METEOROLOGY

Meteorology is a study of the atmosphere by means of the senses and by means of instruments. Properties measured may be separated into three classes:

1. Physical, including temperature, pressure, wind, and electricity;
2. Chemical, including nitrogen, oxygen, water, ammonia, etc.;
3. Biological, including bacteria, insects, birds, etc.

Physical properties are studied from the aspect of medical and social effects, physical chemistry and geophysics.

Geophysics and geochemistry involve the distribution and circulation of properties. Thus with regard to sources and sinks, and transport of properties, a close relation exists between atmospheric chemistry and other phases of meteorology.

ERIK ERIKSSON
Institute of Technology
Stockholm, Sweden

AN INTRODUCTION TO MARINE BIOLOGY AND OCEANOGRAPHY IN HAWAII—A SYMPOSIUM

VERNON E. BROCK, Moderator

RESEARCH AT COCONUT ISLAND

The author reported on marine biological research at the University of Hawaii's marine laboratory on Coconut Island, Kaneohe Bay. These studies are chiefly on basic research from which data of economic value can later be learned.

Included are studies of water striders, minute sea-going bugs, by Jon L. Herring; digestion in sea cucumbers, the "earthworms of the sea," by Shirley Trefz; the development and early life of the maomao, a damsel fish, by Philip Helfrich; studies of swimmer's itch, by George Chu and Charles E. Cutress, showing it to be caused by parts of jelly-fishes.

Robert Amai's study of purple pigment in sea urchins; life history of the manini, a surgeon fish, by John Randall; snapping shrimp investigations from Saipan to Tahiti, by Albert H. Banner; reproduction in crustacea, by Donald C. Mathews; plankton studies by Everett C. Jones.

Research on aholehole, nehu, and tuna behavior, by Albert L. Tester; how marine organisms pick up metals from the sea, where do these go and how long do they stay in the organism, studied by means of radioactive substances, by Sidney Townsley and Howard J. Boroughs.

HOWARD J. BOROUGHS

RESEARCH IN MARINE PRODUCTIVITY (ALGAL PRODUCTIVITY NEAR HAWAII)

Various variables and dimensions of the productivity of our island waters have been investigated. The productivity per acre per year seems to be about like that of an acre of good farm land. As the shore is approached closely, however, productivity increases perhaps 100 or 1,000 times. There seems to be evidence also for seasonality.

Though there is little concrete evidence it appears that the standing crop likewise increases as the shore is approached. It is not clear whether the increase in the standing crop is directly proportional to the increase in productivity or not, but it seems this might be so under climax conditions.

MAXWELL S. DOTY

BIOLOGICAL RESEARCH AT THE PACIFIC OCEANIC FISHERIES LABORATORY

The author outlined the biological research being carried on by the POFI whose chief objective is to increase the catch of tuna and related fishes.

Yellow fin tuna are being investigated in equatorial waters, aku or skipjack about the Hawaiian Islands, and albacore in cooler waters to the north.

Problems include not only where are these fishes, but how best to catch them.

One limiting factor is bait fish, and means of catching tuna without bait are being studied. One of the most promising of these is electric fishing. When an interrupted direct current is discharged in water, fish will swim toward the positive pole. Too little current may repel the fish, too much may kill them, so the problem is just how much current should be used.

WILLIAM F. ROYCE

OCEANOGRAPHIC RESEARCH IN THE PACIFIC

The author told how the distribution and abundance of large fish, such as the tuna, are related to chemical and physical forces in the seas.

Chemical substances are most abundant where there are upwellings of water rich in phosphorus and other chemicals which had previously sunk to lower levels of the sea. Such upwellings occur along the equator in the central Pacific, around chains of islands, such as the Hawaiian chain, and in the north Pacific in winter.

It is in these regions that the phytoplankton, which feed on these chemical substances, are found in large quantities. The zooplankton feed on these, and in turn are used for food by the forage fish. The forage fish, are in turn, fed upon by the tunas. Thus it is in these three regions that the tunas are sought commercially.

THOMAS S. AUSTIN

INSHORE FISHERY RESEARCH

An attempt is being made to increase the amount of bait fish, and the introduced *tilapia* shows promise for this use.

Studies are being made of certain inshore food fishes, such as the akule or big-eyed scad. Catches of this are declining steadily, and the reason is being sought.

Most of the reef fish around the Hawaiian Islands are of no use to man. Located on the fringe of the area occupied by the Indo-Pacific fish fauna, Hawaii lacks certain valuable food species which are abundant further south and west.

Study is being made of the possibility of introducing certain snappers and sea bass to Hawaii's reefs. An effective management program is needed for conservation of marine life.

YOSHIO YAMAGUCHI

THE SCIENTIFIC ACTIVITIES AND FACILITIES OF THE BISHOP MUSEUM

(No abstracts)

COLIN G. LENNOX EDWIN H. BRYAN, JR.
ALEXANDER SPOEHR J. LINSLEY GRESSITT
KENNETH B. EMORY

OPPORTUNITIES IN GEOPHYSICS

(No abstract)

H. KIRK STEPHENSON
National Science Foundation
Washington, D. C.

THE UPTAKE, INTERNAL DISTRIBUTION AND EXCRETION OF RADIOSTRONTIUM BY FISH

Although certain elements occur in very low concentrations on the earth, it has long been known that some organisms are capable of accumulating them in excess of that found in their environment. Under experimental conditions other organisms have been shown to be able to substitute one element for a similar one in the periodic table, although the substitution may not be along the same metabolic pathways. Such is the case of strontium. Strontium has been detected in all phases of the biosphere, but due to the difficulties of analyzing trace quantities in the presence of calcium, only a few scattered analyses were reported in the early literature. Until the advent of nuclear fission, the study of this and related elements from a chemical and physiological standpoint was very difficult. The use of radioisotopes now makes it possible to study the role of these elements in the physiological environment of the living organism. We have been investigating the metabolism of strontium in marine organisms using the isotope strontium^{89} as a tracer.

One dose of radioactive strontium^{89} in the form of the chloride solution was fed to fish and the fish were sacrificed at specified time intervals. The organs were then removed, weighed, dried and ashed in a muffle furnace. The remaining ash was then counted using a Geiger-Muller tube to determine the amount of radioactivity in each organ.

Calculation of the total amount of radioactivity remaining at each interval showed that of the total dose administered about 50 per cent had been excreted within the first two hours, and by 24 hours only about 1 per cent remained. Thus radiostrontium is very rapidly excreted. The 1 per cent remaining was found to persist for 27 days after administration of the dose.

The remaining 1 per cent of the dose in the fish was found to be distributed in all the organs. However, it is apparent that there are two distinct groups of tissues with respect to the physiology of this element, namely the visceral and structural. The visceral organs and tissues including the blood, kidney, gut, spleen, liver, caecum and heart showed a continuing decrease in radioactivity from the one hour level. On the other hand, the axial skeleton, head and opercular bones and gill arches, the skin, and the muscle appear to rapidly concentrate the strontium to a level which is maintained more or less constant over a long period of time. The turnover or excretion of strontium in these structures is therefore relatively slow. Within seven hours the distribution of the isotope is practically complete in the structural organs and comprises about 95 per cent of the total radiostrontium in the body.

Of the total activity, 10 per cent is attributable to the skin and this amount may be broken down into 4 per cent from the flesh and 6 per cent from the scales. The extremely rapid excretion of the ingested isotope, coupled with its rapid and increasing appearance in the skin suggests that the skin may be a pathway for the excretion of strontium. In order to test this hypothesis we are now preparing tanks in which fish will be held so that the head will be in water containing the isotope while the tail will be in isotope-free water. Our preliminary investigations have shown that non-radioactive fish kept in tanks with contaminated fish pick up the isotope from solution, although it is not immediately clear how much excretion of the isotope takes place through the skin, gills, urine, or feces.

It is apparent from these experiments that strontium behaves differently in marine fish than in mammals and fresh water fish. The concentration and long biological half-life in the bony elements is similar in all three groups, but the turnover in other organs is considerably different.

HOWARD BOROUGHS, SIDNEY J. TOWNSLEY, AND ROBERT W. HIATT

THE PRODUCTIVITY OF THE INSHORE WATERS IN HAWAII

There are a number of suggestions in the literature that the waters immediately surrounding oceanic islands contain a higher plant and animal population than the offshore waters. Such a population increase is easily observed along the coasts of large land masses, particularly when there is an upwelling of enriched water along the shore. However, around oceanic islands it is difficult to obtain quantitative information describing the population density as a function of the distance offshore.

This paper describes the measurement of plankton photosynthesis at different distances from the shore of Oahu. This measurement is significant because the total animal and plant population ultimately depends upon the production of food materials by photosynthesis.

Photosynthesis has been measured by following the uptake of radioactive carbon by planktonic algae. The water samples come from four stations, one within Kaneohe Bay (Station 4), one just outside the bay (Station 3), and two others, Stations 2 and 1, about five and ten miles respectively from Station 3.

During the period October, 1954, to February, 1955, we observed a consistently increasing rate of photosynthesis from Stations 1 to 4; that is, from offshore to within Kaneohe Bay. The photosynthesis at Stations 1 and 2 was low (up to 0.1 milligram carbon fixed per hour per cubic meter); that at Station 2 was measurably higher at all times except one. Photosynthesis at Station 3 was in general an order of magnitude higher, and that at Station 4, within the bay, two orders higher.

The figures are for surface photosynthesis alone, and it is well known that the depth to which light penetrates in the water influences the total photosynthesis in the body of water. Our measurements of light penetration into these waters are incomplete, but are sufficient to show that the total photosynthesis at these four stations follows the same pattern of increasing as shore is approached.

The periods of highest photosynthesis at Stations 3 and 4 coincided with periods of heavy rain and lower water salinity, suggesting that runoff from the Oahu shore fertilized the Bay and nearby waters, resulting in higher algal productivity. Because of the presence of bottom dwelling algae, the total production within the Bay is higher even than our measurements indicate.

MAXWELL DOTY, R. R. GUILLARD, AND E. C. JONES

SPAWNING CYCLE, DEVELOPMENT, AND GROWTH OF THE CONVICT SURGEON FISH OR MANINI

(*Acanthurus triostegus sandvicensis*)

The acronurus or late postlarva of the manini (*Acanthurus triostegus sandvicensis*) enters tide pools from the pelagic state. It is discoid, naked, transparent with silvery abdomen, has a short digestive tract, and is armed with poisonous second dorsal, second anal, and pelvic spines. Within four to five days transformation to adult-type configuration and coloration is complete, and the digestive tract has lengthened about three times, reflecting the change-over in food habits from feeding on zooplankton to browsing on algae.

Collections of small manini from tide pools indicate that spawning in Hawaii is seasonal. The young were found from February 14 to October 5. A concurrent study of the gonads of adult fish revealed ripe females from December 1 to July 21. Duration of larval life is therefore estimated at 2½ months.

The bulk of the young enter tide pools in Hawaii during the time of new moon. Since the acronuri come into shallow water only at night, it was suspected at first that moonlight inhibited this influx and caused the fluctuation in abundance. It is now believed that some lunar factor influences the spawning of adults, resulting in the periodicity of incoming young. Of 3,641 adults examined throughout the season, 39 running ripe females were found, 35 of these from 12 days before to 2 days after the full moon.

Early development was studied following artificial fertilization of the eggs. The egg is .67 millimeter in average diameter, has a single oil globule, and floats at the surface of an aquarium. Hatching occurs in 26 hours at 24° C. As yolk is used up, the larvae show a progressive tendency to sink. They combat this by upward swimming movements. Feeding begins at the age of 5½ days. No young were maintained in an aquarium past 6½ days; however, postlarvae from 3.5 to 5 millimeters in standard length have been found among the plankton collections of the Pacific Oceanic Fishery Investigations. The most striking feature of their morphology is the extremely elongate second dorsal, second anal, and pelvic spines.

Growth of juveniles, as determined by rearing of captive fish, recovery of marked fish, and progression of modes in successive graphs of tide-pool collections, is 12 millimeters/month. It tapers off to 1.1 millimeter/month in adults 100–120 millimeters in standard length and .81 millimeter/month in 120–141 millimeters adults (growth of adults based on recovery of tagged fish). Growth of both juveniles and adults ceases during winter months.

JOHN E. RANDALL

INFLUENCE OF DIET ON THE SUSCEPTIBILITY OF DOMESTICATED DUCKS TO PARASITISM BY A MARINE TREMATODE

In North America, certain wild birds such as herring gulls and common gulls have long been known to be the definitive hosts for the marine trematode, *Parorchis acanthus* (Nicoll 1906) Nicoll 1907. In Hawaii, we have found that, instead, the definitive host of this parasite was the ruddy turnstone (*Arenaria interpres interpres*), and that several species of marine birds (Noddy terns, Sooty terns, and Wedge-tailed shearwaters), when fed exclusively with squid (*Loligo opalescens* Berry), showed 100 per cent susceptibility to infection with *P. acanthus.*

In contrast to wild birds, when domesticated birds such as chickens and ducks were maintained on a commercial poultry feed (all age mash), their resistance to *Parorchis* infection was complete.

Attempts were then made to feed squid to the chickens and ducks for a few days before and during the tests, in order to simulate the natural diet of marine birds. Only ducks were able to survive as long as three months on a squid diet. In one experiment, two young (2–4 wks.) ducks were fed with squid and two others were kept on a mash diet for control. Their susceptibility was tested by feeding each of them 150–200 cysts of *Parorchis*. When autopsied 3–4 weeks later, the squid-fed ducks proved to have the trematode infection and the mash-fed ducks had none. Similarly, in another experiment, three Pekin ducks were fed with squid and two with mash. Upon autopsy at intervals of 1 week, 1 month, and 2.5 months, again the squid-fed ducks were found to be infected with *Parorchis,* while the mash-fed ducks were uninfected.

Since *P. acanthus* was a parasite of the bird's cloaca, a bacteriological analysis of the feces of the squid-fed ducks and terns and those of mash-fed ducks was made. As far as aerobes, anaerobes, coliforms, and enterococci were concerned, the microflora appeared to be similar in all cases. However, lactobacilli were conspicuously absent from the feces of those animals fed with squid. Whether or not lactobacilli were associated with the factor or factors in determining the resistance or susceptibility of domesticated ducks to parasitism by *P. acanthus* remains unknown at present.

M. OGURI AND GEORGE W. T. C. CHU

PICTORIAL SURVEY OF THE NATIVE HAWAIIAN LANDBIRDS

Kodachrome slides, of a portrait nature, were presented to illustrate nearly all species of the native Hawaiian landbirds. Field marks and other points of difference between species were stressed, with special reference to Amadon's recent reclassification of the Drepaniidae. Present status of each species was mentioned. Mounted birds have been used as subjects of the photographs.

ROBERT L. PYLE

THE INFLUENCE OF APPLICATION OF SOLUBLE SILICATES ON PHOSPHOROUS AVAILABILITY IN CERTAIN HAWAIIAN SOILS

The rapid fixation of phosphorus in difficult available forms is a serious problem in the management of certain tropical Hawaiian soils. Many soils of the latosolic and latosol groups having a high content of hydrated sesquioxides will fix over 90 per cent of added soluble phosphorus in a heavy application of superphosphate within 24 hours after application. These soils have developed under conditions of rapid chemical weathering in which the desilication processes have decomposed all of the primary silicate and most of the secondary layered alumino-silicates. Weathering has progressed to a point where the amount of soluble silicate in the soil solution has been reduced to trace quantities. From previous work of McGeorge in the Islands, there is a suggestion that the application of soluble silicate to the soil would influence the uptake of phosphorus by plants. This study is a reinvestigation of these findings and its application to more recently acquired knowledge of the mineral composition of tropical soils.

Sodium silicate was applied to soil of the Wahiawa Family of the Low Humic Latosol Group and to the soil of the Honolua Family of the Humic Latosol Group at 0, 250, 500, 1,000, and 2,000 pounds per acre. No beneficial response in the growth of sudan grass was obtained from the application of sodium silicate to the Wahiawa soil. The Wahiawa soils are predominantly kaolin soils containing goethite and interstratified 2:1 layered alumino-silicates. The application of 1,000 pounds per acre of sodium silicate to the Honolua soil increased the yield of sudan grass threefold. The application of sodium silicate eliminated the typical phosphorus deficiency symptoms of the sudan grass.

The analysis of sudan grass grown on several latosolic and latosol soils receiving application of 500 and 1,000 pounds per acre of sodium silicate showed a direct relationship between the uptake of silicate by the plant to the concentration of phosphorus in the plant. The plants assimilated more phosphorus as the silicate intake by the plant increased. This relationship does not exist in soils having 2:1 layered alumino-silicate minerals.

G. DONALD SHERMAN, ADA C. CHU, AND CLARENCE M. SAKAMOTO

PARASITOLOGICAL STUDIES IN THE HASHEMITE KINGDOM OF JORDAN

Malaria and intestinal parasitism constitute important human health problems in Jordan. During a four months period, June to October, 1954, a study was carried out among 230 inhabitants of the village of Safut to secure further information on the efficacy of pyrimethamine (Daraprim) as a suppressant of malaria under field conditions. In this period, 110 persons were given Daraprim tablets (25 milligrams for adults and 12.5 milligrams for children under 15 years of age) once a week, and 120 other persons were given placebos once a week and served as control. Blood study for the presence of malaria among all these individuals was made at the beginning of the study, and thereafter repeated every 6 weeks. The results showed that at the beginning of the study 12 per cent of the 230 villagers showed malaria parasites (*Plasmodium vivax*) in the blood. By the end of the four months period none of the individuals who had received Daraprim developed malaria, whereas of the control group, 25 persons developed malaria. The results indicated that the individuals receiving the drug were effectively protected from malaria infection.

In addition to the above, the incidence of intestinal parasitism was determined among 125 persons from Jerusalem and 300 persons from Amman. The percentage prevalence of the most important parasites found was as follows: *Entamoeba histolytica,* 12.0 per cent in Jerusalem and 20.3 per cent in Amman; *Ascaris lumbricoides,* 77.6 per cent in Jerusalem and 51.3 per cent in Amman; *Trichuris trichiura,* 78.4 per cent in Jerusalem and 44.3 per cent in Amman. The indicated incidence of infection, especially that of the amoebas, between the two cities is not considered comparable because the survey in Jerusalem was conducted during the cooler portion of the year (April) and in Amman during the warmer months (August–October) when chance of parasite transmission is probably greater.

Of interest in the intestinal parasite survey was the apparent absence or rareness of hookworm infection. Furthermore, considering the generally poor sanitary conditions, abundance of flies during the summer months, and closeness of group and family associations characteristic of Arabic countries, the incidence of parasitism, especially that of the protozoa, is comparatively low. There is a possibility, however, that intense sunlight, drought, and dryness of the soil over several months of the year in that area present important factors in the destruction of many eggs, larvae, and cysts of the parasites.

JOSEPH E. ALICATA AND SA'EB W. DAJANI

IS MENTAL ILLNESS INHERITED?

It is widely reported that there is a specific genetic predisposition to schizophrenia and the affective disorders, both of which comprise the majority of hospitalized cases. However, a critical review of the available data fails to reveal convincing evidence of a specific genetic mode of inheritance to explain satisfactorily mental illness. This suggests the need for considerable caution in the advice we give to relatives of mental patients.

A serious shortcoming in current research into the biology of emotional breakdown may be the failure to accept a simpler hypothesis that would recognize two obvious facts, both of which are essentially environmental in origin. First, a growing child, under the unfavorable influences of living with an emotionally unstable parent, is likely to be conditioned along abnormal patterns of behavior and is subject to constant emotional trauma. The other observation, quite familiar to clinical psychiatry, is that the severity of a person's discomfort is almost invariably related directly to the degree of impact of environmental stress.

An alternate view, in keeping with clinical experience and not inconsistent with published research, would ascribe to multiple genes with additive effect, the inheritance of human general potential. The manner in which such potential is utilized, whether spent in normal adjustment or wasted in neurotic and psychotic modes of conflict, would depend upon the subtle influences of environmental pressures. The observed variability would describe a normal curve of distribution, similar to what we now accept for one aspect of this energy, namely, responses to tests of intelligence.

In the viewpoint expressed here, the personality structure is seen as responding to external stress or inner needs in a unique way. Human energy potentials are mobilized by the personality acting as an integrated whole, and the environment is likewise perceived as a total experience. There is thus created a state of delicate equilibrium between pressures, on the one hand, and a constantly changing personality structure, on the other. With shifts in this equilibrium, anxieties, tensions, and conflicts arise. Psychological mechanisms are employed to regain the subtle balance the personality seeks to maintain in effort to adjust, and indeed to survive. In this view there is little place for a fatalistic approach to mental illness.

In our fight against mental illness, research funds could profitably be invested in learning about the subtle environmental influences during the formative years.

SIDNEY L. HALPERIN

NEWER MODALITIES IN DERMATOLOGY

During recent years fantastic changes have occurred in dermatology. With the advent of penicillin the dermatologist and syphilologist lost one-half of his specialty, syphilis. No longer is the dermatologist concerned with the treatment of infestations or superficial infections. Even the eczemas are responding to the new steroids. With the changing nature of his practice, the dermatologist has explored newer methods of treating old diseases and has now entered the field of superficial remedial surgery. Two interesting developments are the use of low penetration radioactive substances and dermal abrasion.

Thorium X: This radioactive element, long used in Europe, is now available in United States and Hawaii. This element, having a half-life of 3.64 days and emitting mostly alpha particles, is useful in superficial skin conditions which respond to radiation. It is of particular value because of its limitation in effect to the epidermis and the upper portions of the dermis. As a consequence it can be used for long periods without danger of radiation sequelae. Its greatest value is in treating scattered lesions of psoriasis, some types of keratoses and warts, localized neurodermatitis, pruritis ani, and certain recalcitrant eczemas. It is one of the few modalities of some value in the treatment of the superficial birthmark, nevus flammeus.

Dermal Abrasion: One of the most exciting developments in recent years has been the introduction of abrasive methods for the treatment of acne and other scars. Early in the century Kromayer experimented with various abrasive techniques. Following World War II sandpaper was used in scar removal. More recently Kurtin introduced a method of skin planing using a rapidly revolving wire brush to plane skin frozen with ethyl chloride. This procedure can be carried out in the office surgery. This technique has its greatest value in removing the physically and psychologically devastating scars of acne. It is also of value in the removal of certain other types of scars, moles, keratoses, wrinkles, and other skin conditions.

SAMUEL D. ALLISON

RESEARCH PROGRESS IN CENTRAL AMERICA

In the region between the western frontier of Colombia and the Rio Grande, seven independent and proud nations are in business. In each the national government has recognized, to some degree, the value of research as a part of its program for economic development.

The effectiveness of research in this region seems to be associated with stability and nature of government, size of the country, physical resources, level of education, and availability of facilities for communication.

The dominant concern of certain governments is survival. In these countries, research receives little attention from national leaders, and morale among the research workers is low. Continuity of research is restricted.

In small countries, research is limited by the high cost per capita of investigation in specialized fields. This cost is magnified by the establishment of individual administrative agencies in each country which process, but do not produce, useful information. In the fields of nutrition and education, some progress has been made in decreasing costs through establishment of regional cooperative institutions.

Because of inadequate schools and colleges, the supply of trained nationals is too low to permit rapid establishment of sound research programs. The absence of trained research leaders is acute in some countries, but this problem has been solved to some extent by the establishment of United States aid programs.

Some countries are finding it difficult to get the results of applied research to the people because of poor roads and inadequate transportation. The absence of good means for interchange of research information is a serious barrier to progress.

Each nation provides a separate sample of the effects of political, sociological, and physical environment upon the effectiveness of research.

STERLING WORTMAN

WAIPIO VALLEY—AN EXAMPLE OF TODAY'S PROBLEMS IN LAND USE OF ISOLATED HAWAIIAN VALLEYS

PRESIDENTIAL ADDRESS, 1955

There are about ten valleys in the major islands of the Hawaiian chain, which in the pre-Captain Cook period supported large populations and provided food for even larger populations, that are today either totally deserted or only sparsely populated and cultivated. They all have a similarity of pattern in climate and geomorphology. They face the tradewinds (E to N to NW), annual rainfall ranges between 60 inches and 150 inches, sunlight is reduced by high precipitous valley walls and trade wind clouds. They are deeply cut into the mountain ranges with the arable valley floor lands mostly alluvial silt or clay loams of good fertility. They have an abundant firm irrigation water supply in dry seasons and in wet periods are beset with frequent devastating flash floods which pour down the 1,000- to 3,000-foot valley walls.

The total area suitable for cropping is about 1,900 acres. On the island of Hawaii the valleys of Waipio, Waimanu, Honopue, Honokane, and Pololu account for 1,500 of these acres, with Waipio the largest of 910 acres. On Molokai the valleys of Halawa, Wailau, and Pelekunu account for about 280 acres while on Kauai the valley of Kalalau and two very small ones account for 120 acres. They are all isolated from markets by normal means of transportation and all except two are entered only by steep trails or from the sea during periods of calm weather. This isolation is one of the most dominant factors in inhibiting the establishment of a rural population and the use of the lands for the production of crops requiring market outlets.

The pattern of land ownership in each valley is very similar. The major drainage of a valley is under one or two owners while the arable valley floors are a mosaic of many small individual holdings ranging in size from .1 to 4 acres each. They represent those farm and living areas of the commoners for which "Quiet Land Titles" were obtained under the Act of December 10, 1845, called the "Great Mahele." The consolidation of these many parcels into units associated with a single land class or drainage area so that the tools of modern agriculture can be used for crop production will be a monumental task of boundary surveys and purchase negotiations which, in many cases, will exceed the value of the land. This task has been compounded by changes in the courses of streams following floods. The lands of the "ahupuaa" or major valley area controlled by the chief were those on which the commoner did not obtain title, those used solely for the chief, or those which were stream beds or unused areas. These make up the foundation on which the small ownerships are laid.

The study of the land capability of Waipio as a prototype of these valleys disregarded the ownership problem. A series of Land Classes were established which had a similar pattern of soil, terrain, and factors affecting vegetative growth as evidenced by the resident vegetative communities. The economic potentials for a large number of crops suitable for each Land Class were studied with heavy weight being given to those crops which have a heavy water demand since the principle asset of the valleys is an abundance of cheap irrigation water. Crops suitable for the Land Classes and climate whose products do not demand a rapid transport to market are: taro, lotus root, ginger root, dasheen, passion fruit, macadamia nuts, and ti root for levulose. None of these crops are in "land short" supply for present existing market demands. The ti crop will be particularly suitable for these areas if success is attained in building up an agricultural industry around this plant for its levulose content because of the latitude (4 to 10 years) in harvesting the crop.

The value of the areas for tree plantations of species producing high value woods for cabinet and artifact use was examined. It is estimated that the investment per acre at harvest time would be from $700 to $900 per acre which would require a grower's stumpage percentage of 10 per cent of gross market value. Such a high percentage would be unlikely in such remote areas having exceptionally high transportation costs.

It is concluded that the lands of these valleys have little economic value at the present time because of the many problems enumerated.

COLIN G. LENNOX

PROJECT SHOWER

The general problems in cloud physics were discussed, a history of cloud physics research in Hawaii was related, and a description of "Project Shower," held from October to December, 1954, was given.

WENDELL A. MORDY, VINCENT SCHAEFER, E. J. WORKMAN, DUNCAN BLANCHARD, AND PATRICK SQUIRES

SOIL PUDDLING AND COMPACTION—AN HAWAII PROBLEM

(No abstract)

LEONARD D. BAVER

PLANT DAMAGE BY VOLCANIC FUMES

The eastern rift of Kilauea flared into activity in Puna on February 28, 1955, and continued until the middle of April. About March 6 and again about April 1 fume damage to vegetation was noted at various places within a radius of 50 miles of the source vents. Aside from the expected injury in the immediate vicinity of activity, the most severe effects were reported from Kulani and Kilauea Volcano areas, both roughly 30 miles from the source of fume and both backed by Mauna Loa. It is believed that during the two days of injury an inversion layer hung at about 6,000–7,000 feet and that fume, carried by kona weather currents, was trapped beneath this layer against the slopes of Mauna Loa so that Kulani at 5,200 feet and Kilauea at 4,000 feet were subjected to the gas-laden haze.

Fume constituents that could have caused the observed plant injury include sulfur dioxide, sulfur trioxide, and various hydrocarbons. It is impossible to identify the destructive agent with certainty until further observations and results of gas analyses and controlled studies are available.

Plant symptoms—variously described as similar to spray burn, sun scald, or lack of water—suggest a dehydration effect characteristic of exposure to the sulfur oxides or their hydrolysis products, sulfurous and sulfuric acids. Bleaching, browning, or curling of leaf tips or margins, defoliation, and fruit and flower bud drop, in varying degrees depending on plant species and location, were reported. In all cases, with the possible exception of a fern, normal growth resumed shortly after both periods of injury.

Sugar cane received a set-back over large areas of Olaa Plantation—a set-back described as comparable to the effect of 2 weeks of severe drought. Vegetable growers in the Kilauea Volcano area were able to salvage part of their lettuce and Chinese cabbage crops by removing "burned" outer leaves; but young cucumber and zucchini plantings were damaged to the extent that the crop will be much later than expected and considerable replanting will be necessary. Volcano and Kulani Methley plum trees dropped such a high percentage of young fruit that a very poor crop is expected this year. Guava leaves became russet-colored and dropped, leaving plants almost completely defoliated. Papaya plants in the Puna district appeared more susceptible to fume than to heat radiated from the lava flows. Leaves were severely affected, but fruit ripened, though somewhat impaired as to quality. A wide range of ornamentals was injured in varying degrees, and species in this group of plants showed striking varietal susceptibility. Passion fruit vines recovered rapidly after losing new growth on terminals. Coffee and citrus trees showed little effect. The plant most outstandingly resistant was ohia lehua, which showed no detectible evidence of injury, even in the Puna area.

JULIETTE WENTWORTH, CLARENCE LYMAN, HITOSHI KAMASAKI, A. M. HIERONYMUS, ROBERT S. NEKOMOTO, AND DAVID YOUNG

NECROLOGY

RALPH J. BORDEN

Ralph J. Borden was born in Fall River, Massachusetts, on June 1, 1892. After his graduation from Massachusetts Agricultural College in 1913, he joined the faculty of Kamehameha School as athletic coach and teacher of agriculture, which position he held for the ensuing eleven years. A charter member of the Hawaiian Football Officials Association, he retained his interest in sports throughout his lifetime.

In 1922 he received his M.S. degree from the University of Hawaii. From 1925 to 1926 he was Director of Agricultural Education at the Territorial Normal School. From 1926 to 1932 he was Director of the Chilean Nitrate Educational Bureau for Hawaii.

In 1932, Mr. Borden joined the staff of the Experiment Station, Hawaiian Sugar Planters' Association, as Associate Agriculturist. In 1934 he became head of the Agricultural Department of the Station in which capacity he served with distinction for the next sixteen years. In 1950 he was appointed head of the newly established Department of Experimental Statistics, which position he held until his death.

A prodigious worker, Mr. Borden's contributions to sugar cane agriculture were impressive. In addition to carrying on his demanding administrative and research activities, he played a leading role in developing a program of training for young men preparing to join the sugar industry. Many of the present leaders in the Hawaiian sugar industry received their initial training under his guidance.

For more than ten years Mr. Borden was a member of the Board of Judges of the Honolulu Star-Bulletin School and Home Garden contests. In 1935 he served as president of the Association of Hawaiian Sugar Technologists, and in 1938–39 as Councilor of the Hawaiian Academy of Science. With his untimely death on June 8, 1954, Hawaii lost an outstanding leader in the field of agriculture.

Errata

Proceedings, 29th Annual Meeting

Page 11, paper by Poole, column 1, line 3: *for* heridity *read* heredity.

Page 16, paper by Macdonald, column 2, line 18: *for* possibly a thousand *read* possibly thousand.

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Fong, Albert C.
Fong, Francis
Forbes, Fritz W.
**Forbes, John C.
**Forbes, Theodore W.
Fosberg, F. R.
Foster, Zera C.
Fox, Roy L.
Frodyma, Michael M.
Fryer, Elwood B.
Fryer, Eunice
Fujimoto, Giichi
*Fukuda, Mitsuno
Fullaway, D. T.
Furumoto, Brother Augustine
Gaston, John Zell
Gaylord, Donald
Geiger, William J.
George, Clarence A.
*Gilbert, Fred I.
Ginn, George W.
Glasgow, James H.
**Gortner, Willis A.
Gosline, W. A.
Goto, Wilfred T.
Gould, David
*Gowing, Donald P.
*Gray, Reed A.
Greenwell, Amy
Gregory, Christopher
**Gressitt, J. Linsley

Hagihara, Harold H.
Halperin, Sidney L.
*Halpern, Gilbert M.
Hama, Nobuo
Hamada, Dorothy K. I.
Hamilton, Richard A.
Hamilton, Roland K.
**Hamre, Christopher J.
Hance, John
**Handy, E. S. C.
Hansen, Violet
Hanson, Noel S.
Harada, M. B.
**Hardy, D. Elmo
Hargrave, Vernon E.
Harris, Anna E.
Harry, J. V.
*Hart, William E.
**Hartt, Constance E.
Hartwell, Alfred S.
Hashimoto, Shoichi
Hayashi, Chisato
*Heinicke, Ralph M.
*Helfrich, Philip
Henke, Louis A.
Herrick, Colin J.
Herschler, Louis H.
**Hiatt, Robert W.
Hieronymus, A. M.
Hinger, Brother Roland J.
Hinman, Frank G.
Hirokawa, Sueko H.
Holladay, Natalie
Holmes, Wilfred J.
Horan, John S.
Horner, Eugene
**Hosaka, Edward Y.
**Hosoi, Hiyoshi
*Hsiao, Sidney C.
Hu, Stephen M. K.
*Hudson, Loring G.
*Humbert, Roger P.
Hutchison, Freida May

Ihrig, Judson L.
Ikeda, Warren
Ikehara, Isaac I.
Inouye, Morris Hiroshi
Ishii, Mamoru
*Ito, Kiyoshi
*Iverson, Edwin S.
Iwanaga, Isaac I.

Jackson, Dean C.
Jacobson, Jettie
Jermann, Fred
Johnson, David
Johnson, Evelyne
Johnston, Elizabeth E.
Jones, Thomas A.
Jones, Thomas S.
Jorgensen, J. Paul
Jorgensen, Margaret K.
Joyce, Charles R.

* Member of the American Association for the Advancement of Science.
** Fellow of the Association.

Kagehiro, George
Kamai, Curtis P.
Kamasaki, Hitoshi
**Kamemoto, Haruyuki
Kanehiro, Yoshinori
*Kask, John Laurence
Katsuki, I.
Kaulukukui, Felice W.
Kawano, Henry
*Keawe, Arthur
Keiser, Irving
*Keller, Arthur R.
Kelley, Phillip T.
Kenda, William
Kent, Martha J.
*Kerns, Kenneth R.
Kho, Florence Y. Yee
Kimmich, Robert
*Kinch, D. M.
King, Joseph E.
King, Maurice V.
King, Will Norman
Kingsbury, Joe W.
Kiuchi, Marian
Klinkman, Helena
*Kobayashi, Clifford K.
Koenig, Mary Ann
Koike, Hideo
*Kondo, Yoshio
*Kopf, Kenneth
Korshover, Julius
Kortschak, Hugo P.
**Krauss, Beatrice H.
Krauss, F. G.
**Krauss, Noel L. H.

La Fon, Fred E.
Lam, Margaret M.
Lam, Robert L.
**Lamb, Alvin R.
*Lamberton, A. R. H.
*Lamoureaux, Charles
Larm, Edwin
Larrabee, L. M.
Larsen, Nils P.
Larsen, Norma
Larson, Harry W.
Lau, Howard K. S.
Leak, Howard S.
Lee, Hyun Moo
Lee, Violet Wongwai
*Leeper, Robert W.
*Lennox, Colin G.
Leong, Kam Choy
Le Sieur, Harold A., Jr.
**Levine, Max
Levine, Melvin L.
Lind, Andrew W.
**Livesay, T. M.
Lloyd, Mary Lou R.
Lo, Pershing S.
**Lohman, Marion L.
Loo, Mabel N. K.
Loo, Ruth O. T.
Look, William C.
Lord, Edith
Loucks, Burton J.
Loucks, Ruth B.
Louis, James L.
Louis, Lucille
Lum, C. K.
Lum, Mon Yet
Lum, Theresa W. T.
Lyman, Clarence
**Lyon, Harold L.
*Lytle, Hugh

*MacArthur, Lloyd W.
**Macdonald, Gordon A.
Mahon, Henry I.
*Manchester, Curtis A.
**Mangelsdorf, A. J.
*Mapes, Marion O.
Martin, Joseph P.
Martin, Robert T.
Masatsugu, Teruo
**Mason, Leonard
Masuda, Matsuko
Matsumoto, Walter M.
Matthews, Donald C.
Mau, Kong Tong
McAllister, William C.
McCleery, Walter L.
McGary, James W.
McGuire, Donald C.
McGuire, Thomas R. L.
*McKernan, Donald L.
McMorrow, Bernard J.
McMullen, Betty J.
Middleton, Charles R. III
Midkiff, Frank E.
Miller, Carey D.
Miller, Harvey A.
**Miller, Robert C.
Milnes, Marjorie B. R.
Mink, John F.
Mitchell, Donald
**Mitchell, James
Mitchell, Wallace C.
Miyake, Iwao
Miyasaki, Yuzo
Moe, Clayton R.
Moffat, Stanley
Moir, W. W. G.
Mordy, Wendell A.
Morgan, Edward J.
Morgan, William A.
Morita, Kiyoichi
Mottl, Joseph R.
*Mumaw, Charles
*Murakishi, Harry H.
Murphy, Garth I.

*Nagao, Wallace T.
Nakae, Haruko N.
Nakagawa, Susumu
*Nakamoto, Goichi
Nakamura, Eugene L.
Nakao, Harry
Natalie, Sister Mary
Naughton, John J.
**Neal, Marie C.
Newell, Irwin
Newhouse, Jan
Nicholson, James R.
Nickerson, Lydia C.
Nickerson, Thomas
Nishibun, Joe
*Nishida, Toshiyuku
Nitta, Asako N.
Noda, James
*Nordfeldt, Sam
Nutter, Ben E.

O'Dea, Katherine
Ohmstede, William D.
*Ohta, Ella Miyeko
*Okubo, Laura
Oliver, Robert
Orr, Kathryn J.
*Otsu, Tamio

*Palafox, A. L.
Palmer, Clarence E.
**Palmer, Harold S.
Parry, H. Dean
**Payne, John H.
**Pemberton, C. E.
Pen, Florence
Peters, Clarence D.
Pinkerton, F. J.
Poole, Charles F.
Porter, Paul H.
Potter, Colin
Powers, Howard A.
Price, Samuel
Price, Saul
Pyle, Robert L.

Quaintance, Donald C.
Quaintance, Evelyn

Ramsey, John D.
Rea, Jessica L.
**Reber, Grote
Riesenberg, Saul
Ripperton, J. C.
*Roberts, Joyce O.
Robinson, William A.
Rockwood, Paul C.
Rose, Brother Bernard
Rose, Stanley J.
Rosenberg, Morton M.
Rossier, Charles
*Royce, William F.
*Ruhle, George C.
Rusch, Kenneth H.

St. John, Harold
*Sakanashi, Helen H.
*Sakimura, K.
Samson, Walter H.
*Sanford, Wallace G.
Santoki, Saburo
Sayer, Brother John T.
Scheuer, Paul J.
Schmidt, Carl T.
Schmidt, Helen D.
*Schwartz, Herbert
Scott, Arlen M.
Seckel, Gunter R.
Seeley, De Los A.
Sekiguchi, Nao
**Sette, O. E.
Shaw, Thomas N.
Sher, S. A.
Sherk, Kenneth W.
**Sherman, G. Donald
*Shigeura, Gordon T.
Shimabukuro, Seichi
Shomura, Richard S.
Sideris, C. P.
Silva, James A.
Silva, Lawrence
*Simpson, Robert
Sinclair, Gregg M.
*Singleton, V. L.
Slattery, Mabel
Sloane, George E.
*Smith, Donald H.
*Smith, Elbert G.
**Smith, Madorah E.
Smith, R. Q.
*Smith, Vernon E.
Spalding, P. E.
**Spiegelberg, Carl H.
Spitzer, Blanche
Spoehr, Alexander
*Spooner, William M.
Stacey, Mary
Steiger, Walter R.
Steiner, Loren
Stokes, J. F. G.
Storey, William B.
Suehiro, Amy
Suzuki, F. T.

Takahashi, David
Takahashi, Makoto
Takasaki, Kiyoshi J.
Takazawa, Futoshi
*Tanimoto, Ralph H.
Tanimoto, Tyrus T.
Taylor, Keith L.
*Tester, Albert L.
Thecla, Sister Mary
Thomas, Ernest H.
Thorne, Marlowe D.
Tinker, Spencer W.
Titcomb, Margaret
Tom, Lorna
Trefz, Shirley M.
Trouse, Albert C., Jr.
**Tuthill, Leonard
Tyler, Arthur R.

Uohara, Mitsuko Sandra
Urata, Rokuro
Uyehara, George K.

Valenciano, Santos
Van Campen, Wilvan
Van Landingham, John William
*Van Weel, Pieter
**Van Zwaluwenberg, R. H.
Vernon, Mabel D.
**Vinacke, W. Edgar
Vinacke, Winifred R.
Voorhees, George

**Wadsworth, Harold A.
Wagoner, Howard Eugene
*Walker, Hastings H.
Wallace, George C.
Wallace, Keith K.
**Waring, Gerald A.
Warner, Bernice

*Warner, John N.
Warner, H. H.
Wassman, Rudolph Carl III
Watson, Leslie J.
*Wayman, Oliver
Weaver, Herbert
Weber, Leroy D.
*Weeth, Howard J.
Weller, D. M.
Welsh, Pearl Hageman
**Wentworth, C. K.
Wentworth, Juliette

*White, J. Warren
Whiton, Nat
Wilbar, Charles L.
*Wismer, Chester A.
Withington, Paul
Wong, Arthur G. H.
Wong, Erwin L. S.
Wong, Kenneth A.
Wong, Ruth E. M.
Woodside, David H.

Yamamoto, Earl S.
Yamanaka, Leslie
Yamasaki, Yoshio
Yamashita, Daniel T.
Yamaura, Teruko S.
Yanagihara, Iichi
*Yoshioka, Tad T.
Young, Hong Yip
Yuen, Heeny
Yuen, Quan Hong

Ziesel, Edward Loeling
*Zoebisch, Oscar C.

PROCEEDINGS OF THE

HAWAIIAN ACADEMY OF SCIENCE . . .

THIRTY-FIRST ANNUAL MEETING 1955-1956

Published by the University of Hawaii Honolulu, Hawaii, 1956

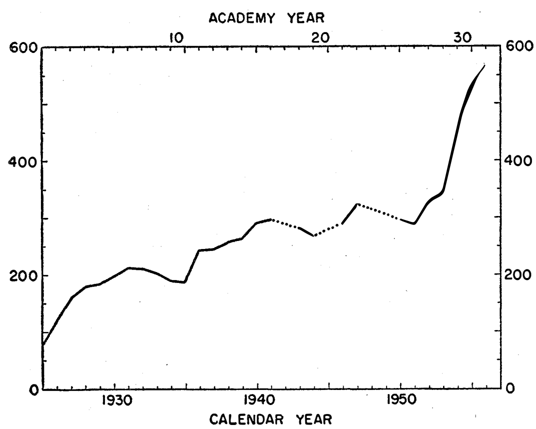
CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

ANNUAL REPORT 1955-56

The Hawaiian Academy of Science ended its thirtieth year with a membership of 534. The election of 37 new members in April, 1955, and 33 in November, 1955, and the reinstatement of two old members, together with losses of 27 through the non-payment of dues, 10 by resignation and 3 by death, have brought the membership to 566 as of the end of the thirty-first year. We record with regret losses by death of Frank G. Hinman, Walter Sykes, and George C. Wallace.

Changes in membership in the last three years suggest an approach toward a stable membership of about 600. However, the irregularities in the membership of the last 31 years, shown by the graph below, indicate that any prediction would be rash, and a prediction made at a time when there is the kind of vital concern for further definition, extension, and perhaps classification of membership that is expressed in some of the committee reports summarized below would be especially rash.



FINANCES

Balance on Hand April 12, 1955		$ 684.58
Receipts		
Dues	$630.10	
Interest on Savings & Loan Deposit	15.23	
AAAS Research Grant	38.50	
Miscellaneous	197.75	
Total	$881.58	
Expenditures		
AAAS-HAS Research Grant	$ 50.00	
Programs	49.50	
Stationery and Postage	174.02	
Dues Allocation to Hawaii Division	17.25	
Miscellaneous	176.09	
Total	$466.86	
Net Income		$ 414.72
Balance on Hand April 24, 1956		$1,099.30
Dues Collectible		$138.00
Dues Paid in Advance		$250.00
Net Assets, April 24, 1956		$987.30

MEMBERSHIP

During the past year, the Membership Committee reviewed the nominations of 67 nominees. All were accepted and recommended for membership. Thirty-three of the above have been voted into membership in the fall meeting of the Academy. The remaining 34 will be recommended for membership at the annual meeting.

The committee also undertook a study to define more clearly the eligibility of members. As a result of the study, the committee recommended to the Council the following:

All persons who have been nominated by three members of the Academy in good standing should be recommended for membership.

The Council should consider the establishment of three categories of members, one honorary, the other two to be differentiated on the basis of scientific interest and contribution.

Membership Committee

Iwao Miyake, Chairman

Samuel D. Allison	Garth I. Murphy
Giichi Fujimoto	Kathryn J. Orr
Donald P. Gowing	P. B. van Weel
Roger P. Humbert	Loren F. Steiner
Evelyne Johnson	Willis A. Gortner, ex officio
Charles Mumaw	Doak C. Cox, ex officio

AFFILIATION

In order better to coordinate programming between the Academy and its Associated Societies, the Affiliation Committee this year recommended to the Societies that their representatives be members of their respective program committees, and preferably be the chairmen of those committees. To a considerable extent the Societies have followed this recommendation. All of the Academy's special sessions held this year were sponsored jointly with one or more Associated Societies.

The Affiliation Committee recommended to the Council an AAAS-HAS Research Grant of $50 to Miss Allison Kay for photography in connection with a study of systematics of *Cypraeidae.* The grant was awarded to Miss Kay in the Fall Session.

Affiliation Committee

George O. Burr,* Willis A. Gortner, Chairmen

George O. Burr*, Ralph M. Heinicke — Amer. Chem. Soc., Hawaii Sec.

Z. C. Foster*, Karl Manke*, Arthur S. Ayres — Amer. Soc. Agron., Hawaii Chap.

Elizabeth Carr, Anthrop. Soc., Hawaii

* Resigned.

David Johnson* Geophys. Soc.,
John F. Mink Hawaii
D. Elmo Hardy, Hawaii. Ent. Soc.
Harold W. Civin, Hawaii Med. Assoc.
Herbert Weaver, Hawaii Psychol. Assn.
Charles Poole, Hawaii Bot. Soc.
Walter Carter* Society of Sigma Xi,
John J. Naughton Hawaii Chap.
O. E. Sette* ex officio,
Leroy D. Christenson Delegate to AAAS
Willis A. Gortner, ex officio, Pres. HAS
Beatrice Krauss* ex officio,
Doak C. Cox Secy., HAS
John Warner, ex officio, Program Chairman, HAS

AAAS REPRESENTATION

The Academy was represented at a distance on the Council of the American Association for the Advancement of Science, but was unable to find representatives who could attend the AAAS meetings at Atlanta, Georgia in December, 1955. We are to be honored by greetings from the AAAS delivered in person by L. H. Snyder, Association President-Elect.

A change in AAAS policy with respect to the Research Grants will require considerable change in the Academy procedure for handling them. Hitherto, the AAAS-HAS grants have been awarded for postgraduate research but the AAAS has specified that they are to be used henceforth for undergraduate and preferably high school research.

AAAS Delegate

L. D. Christenson

PROGRAM

The Thirty-First Annual Meeting was held in two sessions, one November 2 and 3, 1955, the other May 2 to 5, 1956. Ten papers were presented on a variety of subjects during the First Session, including an invitation paper contrasting immigrant adjustment in Jamaica and Hawaii. Nineteen more were presented during the Final Session, not including the Presidential Address scheduled following the annual dinner.

Four special sessions were co-sponsored with societies associated with the Academy to hear addresses on inflammation and stress, on the recent Puna eruption, and on heredity and modern life, and a panel discussion on North Pacific oceanography.

Business meetings were scheduled for both the First and Final Sessions.

Program Committee

John N. Warner, Chairman

Robert W. Hiatt	Albert J. Tester
Sidney C. Hsiao*	L. S. Wortman
Yoshio Kondo	Oscar C. Zoebisch*
Richard K. C. Lee	Willis A. Gortner, ex officio
Morton M. Rosenberg	Doak C. Cox, ex officio

* Resigned.

NOMINATIONS

The Nominating Committee prepared a slate of candidates for the following offices for 1956–57: President-Elect, Andrew W. Lind and Alexander Spoehr; Councilor, George O. Burr and Morton M. Rosenberg; Secretary, Doak C. Cox; and Treasurer, Beatrice Krauss; the latter two being incumbents.

Ballots were distributed and returned by mail for tally at the business meeting of the Final Session.

Nominating Committee

Colin G. Lennox, Chairman

Harry L. Arnold, Jr.	Albert L. Tester
L. D. Baver	Edith Townes
Kenneth P. Emory	Harold A. Wadsworth

Willis A. Gortner, ex officio

AUDIT

The Auditing Committee examined the Treasurer's report, summarized above under FINANCES, and found it correct and in order.

Auditing Committee

William M. Bush, Chairman
Hong Yip Young

SCIENCE TEACHERS

A series of meetings of the Science Teachers Committee held during the summer and fall of 1955 paved the way for the organization of a Science Teachers Association with the aim of improving the teaching of science in the high schools of Hawaii. On November 26, about 100 teachers and guests, visiting Coconut Island through the courtesy of the Marine Laboratory, approved the organization and elected officers. The first year or two of the new organization are likely to be difficult and critical, and it is hoped an Academy committee will be reappointed next year to help the Association until it is well established.

Science Teachers Committee

Ralph M. Heinicke, Chairman

Colin Herrick	Edith G. Townes
Teruo Masatsugu	Willis A. Gortner, ex officio
Bernard Rose	Doak C. Cox, ex officio

AAAS FELLOWS

The AAAS-Fellows Committee nominated ten members of the Academy and the AAAS for elevation to Fellowship in the AAAS. They have since been made Fellows. Members and Fellows are designated by special symbols in the membership list in the Proceedings of the Academy.

AAAS Fellows Committee

J. H. Beaumont, Chairman

Harold L. Lyon	Carl H. Spiegelberg
G. Donald Sherman	Leonard Tuthill

Herbert Weaver

PUBLICATION

The Thirtieth Proceedings are in press in an edition of 950 copies. As usual, the publication and 40 per cent of the cost are being handled by the University of Hawaii in return for exchange privileges. Very shortly, the Proceedings will be mailed to the Academy membership and to more than 200 institutions scattered over the world.

Publication Committee

Doak C. Cox, Chairman

Marion P. Goddard* — Lydia C. Nickerson
Beatrice Krauss* — Robert W. Sparks

Willis A. Gortner, ex officio

PUBLICITY

Radio and press publicity in connection with the regular and special sessions of the Academy was handled by the following:

Public Information Committee

Joyce O. Roberts,* Roy J. Leffingwell, Chairmen

Thomas Nickerson — Willis A. Gortner, ex officio
Edwin H. Bryan — Doak C. Cox, ex officio

MISCELLANEOUS REPRESENTATION

The Academy has been represented on other local organizations by the following persons:

Vernon L Singleton, Representative on the Inter-Agency Committee on Fluoridation

Doak C. Cox, Representative on the Conservation Council

* Resigned.

HAWAII DIVISION

The Hawaii Division, composed of 69 members, held two meetings in Hilo, one on February 24, 1956, at which Mr. J. W. Steiner spoke on local weather, and one on March 28, 1956, at which Mr. H. F. Clay spoke on horticulture in the Marshall Islands. At the second meeting, which was the annual meeting of the Division, the following officers were elected for the coming year: Chairman, William Bonk; Secretary-Treasurer, Pearl Hagemann Welsh; Council Representative, Chester K. Wentworth; Committee Members, Edward T. Fukunaga and Henri P. Minette.

Hawaii Committee

Fritz W. Forbes, Chairman
Pearl Hagemann Welsh, Secretary-Treasurer
Chester K. Wentworth, Council Representative
L W. Bryan — M. B. Harada
Wallace Nagao

OFFICERS

1955–1956

Willis A. Gortner	President
A. J. Mangelsdorf	President-Elect
Doak C. Cox	Secretary
Beatrice H. Krauss	Treasurer[1]
Colin J. Herrick	Councilor (2 years)
Vernon E. Brock	Councilor (1 year)
Colin G. Lennox	Councilor (ex officio)

1956–1957

A. J. Mangelsdorf	President
Andrew W. Lind	President-Elect
Doak C. Cox	Secretary
Beatrice H. Krauss	Treasurer
George O. Burr	Councilor (2 years)
Colin J. Herrick	Councilor (1 year)
Willis A. Gortner	Councilor (ex officio)

[1] Also Secretary pro tem for 5 months, 1955.

THE 31st ANNUAL MEETING 1955-56

Program

SPECIAL SESSION I

Sponsored jointly with the Hawaii Section, American Chemical Society

August 11, 1955, University of Hawaii, Honolulu

Henry Eyring: A Theory of Inflammation and Stress

SPECIAL SESSION II

Sponsored jointly with the Geophysical Society of Hawaii

September 30, 1955, University of Hawaii, Honolulu

Gordon A. Macdonald: The 1955 Eruption of Kilauea

FIRST SESSION

November 2, 1955, Experiment Station, HSPA, Honolulu

1. P. B. van Weel: Osmoregulation in *Tethys* (Aplysiidae, Mollusca). Preliminary Note
2. Carey D. Miller, Florence Pen, and Harold Gatty: The Nutritive Value of the Palolo
3. Howard Boroughs, Sidney Townsley, and Robert Hiatt: Further Studies on the Internal Distribution and Retention of Sr^{89} in Fish
4. Edward D. Stroup: Oceanography of the Central Temperate North Pacific
5. R. R. L. Guillard, M. S. Doty, and M. Oguri: The Productivity of Pacific Waters North of Hawaii as Determined by C^{14} Uptake
6. Everet C. Jones: Plankton: Living Drift Bottles for the Study of Water Movements in the North Pacific

November 3, 1955, Experiment Station, HSPA, Honolulu

Business Meeting

7. E. J. Britten: Effect of the Puna Eruption of 1955 on Plant Life
8. Donald P. Gowing and Robert W. Leeper: Induction of Flowering in the Pineapple Plant by Beta-Hydroxyethylhydrazine
9. Andrew W. Lind: Contrasting Patterns of Chinese Immigrant Adjustment in Jamaica and Hawaii
10. George O. Burr: Report on the International Conference on the Peaceful Uses of Atomic Energy

Exhibits

H. Banner: Marine Invertebrates Used for Food

Shirley Trefz and Bishop Museum: Hawaiian Artifacts from Marine Animals

SPECIAL SESSION III

Sponsored jointly with the Hawaii Chapter of the Society of the Sigma Xi and the Hawaii Medical Association

February 15, 1956, University of Hawaii, Honolulu

Laurence H. Snyder: Heredity and Modern Life

SPECIAL SESSION IV

Sponsored jointly with the Geophysical Society of Hawaii and the Hawaii Chapter of the Society of Sigma Xi

February 16, 1956, Experiment Station, HSPA, Honolulu

OCEANOGRAPHY OF THE NORTH PACIFIC

A Panel Discussion

1. Richard H. Fleming: The Indivisible Ocean
2. John P. Tully: NORPAC
3. Koji Hidaka: Japanese Cooperation in Pacific Oceanography
4. Roger R. Revelle: Oceanography in the Pacific during the International Geophysical Year

HAWAII DIVISION FIRST MEETING

February 24, 1956, Hilo

James W. Steiner: Local Weather Characteristics, and Meteorological Studies to be Conducted during the International Geophysical Year

HAWAII DIVISION SECOND MEETING

March 28, 1956, Hilo

Business Meeting

Horace F. Clay: A Horticulturist Visits the Marshall Islands

FINAL SESSION

May 2, 1956, Experiment Station, HSPA, Honolulu

1. Walter Steiger: The Hawaii Solar Flare Patrol for International Geophysical Year
2. John W. Little: Mt. Haleakala, Maui, as a Possible Site for Solar Corona Studies
3. A. L. Palafox and M. M. Rosenberg: Niacin Content of Blood and Feces as Influenced by Niacin and Tryptophan Intake
4. Arthur H. Jennings and Saul Price: The Unprecedented Kauai Rainfall of January 1956

5. Harold S. Palmer: Origin and Diffusion of the Herzberg Principle with Especial Reference to Hawaii
6. James C. Gilbert: The Inheritance of Resistance to Severe Root Knot from *Meloidogyne incognita* in Tomato

May 3, 1956, Experiment Station, HSPA, Honolulu

7. L. F. Steiner and L. D. Christenson: Potential Usefulness of the Sterile Fly Release Method in Fruit Fly Eradication Programs
8. J. W. Balock, G. O. Burr, and L. D. Christenson: Effect of Gamma Rays from Cobalt 60 on Immature Stages of the Oriental Fruit Fly (*Dacus dorsalis* Hendel) and Possible Application to Commodity Treatment Problems
9. T. Tanimoto and G. O. Burr: Withholding Irrigation to Control Flowering in Sugar Cane
10. John M. Digman and Daniel W. Tuttle: Statistical Analysis of Oahu's 1954 Election: Patterns Emerging from the Vote as Reported by Precincts
11. Alan J. Kohn and Philip Helfrich: Organic Productivity of a Hawaiian Coral Reef
12. Maxwell S. Doty, Mikihiko Oguri, and Robert Pyle: Aspects of Oceanic Productivity in the Eastern Tropical Pacific
13. Alan J. Kohn: Feeding in *Conus striatus* and *C. catus* (illustrated by movie)

May 4, 1956, Experiment Station, HSPA, Honolulu

14. Harry L. Arnold, Jr.: Augmentation of Skin Responses to Sunlight by Psoralen Derivatives
15. Joseph R. Mottl and K. Watanabe: Photoelectric Photometry in the Vacuum Ultraviolet
16. Austin Lowrey and K. Watanabe: Absorption Coefficient and Ionization Potentials of Ethylene Oxide
17. Kenneth D. Waldron: Variations in the Occurrence and Abundance of Skipjack in Hawaiian Waters
18. Joseph J. Graham: Albacore Migration in the North Pacific as Shown by Tagging Experiments
19. Harold M. Sexton: Important Factors Relative to the Production of a Safe Poliomyelitis Vaccine

May 5, 1956, University of Hawaii, Honolulu

Business Meeting

Greeting from AAAS, L. H. Snyder, Pres.-Elect, AAAS

Address of the Retiring President

20. Willis A. Gortner: Biochemical Paths to the Infinitesimal

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Abstracts

SPECIAL SESSION I

A Theory of Inflammation and Stress[1]

As is well known, living cells have a potential of about .1 volt across their enclosing membrane which is some 100 Angstroms thick. This potential arises from the pumping of sodium ions which have complexed with some neutral metabolite. We call this metabolite the pump substance. The pump substance is manufactured inside the cell, and its escape through the membrane is greatly facilitated by a sodium ion companion. When they arrive outside the cell, the pump substance unites with ground substance, being eventually transformed and made unsuitable for the return trip with sodium. The resulting charge separation provides the observed membrane potentials. This picture of active transport is not restricted to sodium ions, but happens to a variety of other ions and molecules under appropriate circumstances. There is, likewise, reason to expect a similar variety of pump substances.

Histamine is a reasonable suspect for sodium pump substance. Thus, it is widely distributed and is very active physiologically. It is presumably synthesized inside cells, and the amino group would be expected to complex with sodium ion—and later preferentially with the sulfuric acid groups in the ground substance. Living systems are known to synthesize and transform histamine. Whatever the identity of the pump substance may be, the integrity of cells will depend on the relative concentration inside and outside cells remaining high. If anything happens to critically increase pump substance outside the cells, a whole train of circumstances will be set in motion. Thus, the sodium will be able to migrate back into cells. This will decrease the membrane potential, causing the membrane to give up its close-fitting relatively impermeable structure and, thus, facilitate the rapid transmembrane migration of sodium, potassium, and other ions—at the same time giving the substrate access to enzymes which then synthesize metabolites. The metabolites restore the impermeable resting state of the membrane. However, the slower enzyme activity during the resting state may not provide sufficient pump substance inside the cell to long maintain this resting state against influx from without.

If the cells become too frequently active, they burst as a result of osmotic swelling, or as a result of sticking to phagocitic cells, and so add the contents of the

[1] See "Molecular mechanisms in inflammation and stress. I" by Eyring and Dougherty, *American Scientist*, 1955. 43:457–467.

broken cell to the already overburdened disposal system of the body. Thus, there is set off a destructive chain reaction. This destructive inflammatory process protects against infection but also makes one sick. Much remains to be established in this general picture, but it is proving to be a stimulating research guide.

HENRY EYRING
University of Utah
Salt Lake City, Utah

SPECIAL SESSION II

THE 1955 ERUPTION OF KILAUEA VOLCANO

A flank eruption of Kilauea began in east Puna on February 28, from vents along the east rift zone of the volcano. It was the first eruption in that area since 1840. The eruption was preceded by several months of earthquakes, gradually increasing in number to several hundred a day just before the outbreak. The initial vents, extending across the south slope of Puu Honuaula, remained active only 28 hours. On March 1 lava activity was replaced by steam clouds and mild phreatic explosions.

On March 2 a new series of earthquakes accompanied the opening of fissures and formation of fault scarps across the Kapoho road. Lava broke out on these cracks near Puu Kii at 2:15 p.m., and through the afternoon activity spread eastward past Halekamahina hill. Evacuation of Kapoho commenced on February 28 and was completed by March 3, during the evening of which lava erupted in the edge of the village and several houses were destroyed. The lava fountains near Puu Kii reached heights of 600 to 800 feet on March 4 and 5, and a flow from them crossed the beach road. Activity ceased on March 6.

On March 6 a new series of earthquakes commenced, originating near the Kalapana road, and a probable outbreak in that area was predicted. On March 12 lava broke out near Puu Kaliu, and on the 13th new vents formed near and across the Kalapana road. A lava flow entered the ocean on March 16, and on the same day new vents developed half a mile southwest of the Kalapana road. Other flows entered the sea on March 28 and April 2.

Activity ceased on April 7 but resumed weakly on April 24. A strong resurgence occurred on May 16, and new flows destroyed a village on May 19 and 26. The eruption ended abruptly on May 26.

The volume of erupted material was approximately 120,000,000 cubic yards. The flows covered an area of about 3,900 acres, of which 1,100 acres was under cultivation. Approximately 6.3 miles of public road, and many miles of canefield roads, were buried, and 21 houses were destroyed.

GORDON A. MACDONALD
Hawaiian Volcano Observatory
Hawaii National Park, Hawaii

FIRST SESSION

1. OSMOREGULATION IN *Tethys* (APLYSIIDAE, MOLLUSCA)
Preliminary Note

The integument of marine invertebrates is permeable to fresh water and since their blood (or body fluid) is isotonic to sea water, they will be subject to dilution of their blood as soon as they get into brackish water or, when living in shallow water or tide pools, the sea water becomes diluted by rain. We can subdivide them into 2 large groups: (a) the *osmo-adjustors,* which have no active mechanisms to get rid of the penetrating fresh water and which consequently swell to an extent given by the dilution, and (b) the *osmoregulators* which actively excrete the excess of fresh water and thus maintain the level of tonicity of their blood. Bethe (BETHE, A. 1929. *Pflügers Arch. f. die Gesam. Physiol.* 221: 344–362; 1930. *Jour. Gen. Physiol.* 13: 437–444; 1934. *Pflügers Arch. f. die Gesam. Physiol.* 234: 629–644) came to the conclusion that, notwithstanding the fact that *Tethys* (*Aplysia*) retained its original volume and weight after a stay of a few hours in 70 per cent sea water, it must be regarded as an osmo-adjustor: its epithelium is not only permeable to fresh water, but also to salts, be it to a lesser degree. A loss of salts from the blood by way of diffusion therefore occurs when staying in diluted sea water and because of this loss the animal retains its original volume.

Some of Bethe's results did, however, not fit into this picture and in some other respects his explanation seemed rather weak also. Therefore his experiments were repeated, using *Tethys grandis.* In these experiments not only the increase in weight and volume, and the changes in chlorinity of the blood were determined, but also the O_2-consumption after a stay (of varying length) in diluted sea water (15 pts. of S.W. : 4 pts. of fresh water). If Bethe's assumption, that *Tethys* would act as a "leaky osmometer" were true, that is, if osmotic adjustment would be purely physical, then no change in O_2-consumption should occur. However, it was found that a definite increase in O_2-consumption did appear during the first 2 hours, followed by a decrease. The latter may be satisfactorily explained by the dilution of the body fluids. The increase of O_2-consumption shows an increase of metabolic activity and since all environmental factors were kept constant, except for the salinity of the sea water, this suggests an increase in excretory activity by which the animal tries to get rid of the excess of entering fresh water. The fact that the salinity of the blood dropped at a slower rate than Bethe's figures show, seems to support this idea. However, the excretory activity is apparently not adequate to maintain the osmocity of the blood and the loss of salts from the blood, which does occur, enters into the picture also. We must therefore conclude, that *Tethys* is not merely an osmo-adjustor, but primarily an osmoregulator. Its regulating mechanism is, however, not adequate and so, but only secondarily, osmo-adjustion appears.

P. B. VAN WEEL
Zoology Department
University of Hawaii
Honolulu, Hawaii

2. THE NUTRITIVE VALUE OF THE PALOLO

The palolo (*Eunice viridis*), an annelid worm, rises to the surface of the ocean from the coral reefs of Samoa, Fiji, and some other tropical Pacific islands from October to December. A large swarming occurs on only one night in each of two months, with a smaller rising on one or two other nights preceding and/or following the main one. The time and the months are related to the phases of the moon. The natives have for generations been able to predict the time of its rise, but scientific observations have enabled one of us (H.G.) to make even more accurate predictions. It is estimated that the quantity of palolo during the two to three day rise amounts to thousands of tons. The natives consider it a great delicacy, gather as much as they can, and send it inland by runner as prized gifts to chiefs and friends. It is eaten in the raw and the cooked states.

Though the periodicity of its rise has interested scientists for years, to our knowledge no one has investigated its nutritive value. Palolo collected by H. Gatty was refrigerated at once, quick frozen after 24 hours, and shipped in the frozen state in a thermos jug by air from Fiji to Honolulu. Analyses showed the raw palolo to have the following composition per 100 grams: 76.2 gm. water; 15.1 gm. protein; 4.9 gm. fat; 2.4 gm. ash; 36.6 mg. calcium; 310.0 mg. phosphorus; 2.9 mg. iron; 514 I.U. vitamin A; 1350 μg carotene; 0.07 mg. thiamine; 0.59 mg. riboflavin; and 1.32 mg. niacin. These data indicate that palolo is a very nutritious food and a good source of protein, calcium, phosphorus, vitamin A, and riboflavin.

To our knowledge, *Eunice viridis* does not occur in Hawaii.

CAREY D. MILLER, FLORENCE PEN, AND HAROLD GATTY
Dept. of Foods and Nutrition
University of Hawaii Agr. Expt. Sta.
Honolulu, Hawaii

3. FURTHER STUDIES ON THE INTERNAL DISTRIBUTION AND RETENTION OF SR^{89} IN FISH

The results of experiments of feeding tracer doses of radioactive strontium to an omnivorous fish, *Tilapia mossambica,* have shown that the strontium follows the same general trend in this fish as was reported for the tuna. However, in *Tilapia* the rate of excretion of the isotope is less than that found in the tunas. After four days there is a levelling off in the amount of isotope retained.

The percentage of the total radioactivity found in the various organs also agrees with that found in the tunas, following in the order: skeleton, skin, gills, and muscle. Distribution of the isotope is practically completed within seven hours in the structural tissues of tuna, and at this time they contain about 95 per cent of the total radiostrontium in the body. *Tilapia,* on the other hand, require a longer time, but ultimately the structural tissues contain 95 per cent of the total radiostrontium present in the entire fish. There is a rapid disappearance of radiostrontium from the visceral organs of all the fish studied. This suggests that the degree of vascularization is important in the circulation of this element.

Daily feedings of Sr^{89} to *Tilapia* were made until each fish had received four times the dose of a single ingestion. Our data show that the percentage remaining in the organs of *Tilapia* is similar regardless of total dose, or of repetition, and that daily feeding of strontium for short periods does not increase the level of strontium retention after the "steady-state" condition has been reached.

Analysis of radiostrontium in fish, their aquarium water, and feces 24 hours after feeding shows that 55 to 80 per cent of the dose is excreted within this time. The amount remaining in the fish varies from about 2 to 20 per cent, and apparently very little is excreted by way of the feces (0.03 to 0.3 per cent of the dose). This suggests that most of the excretion of the isotope occurs by other routes, such as the skin, kidney, and gills.

Papio (*Carangoides ajax*) when kept in tanks in which the isotope had been excreted by other fish picked up less than 0.25 per cent of the available radiostrontium in 24 hours.

It has been possible to monitor the caudal fin of tuna with a G–M probe and predict the entire amount of Sr^{89} in the fish.

HOWARD BOROUGHS, SIDNEY TOWNSLEY, AND ROBERT HIATT
Zoology Department
University of Hawaii
Honolulu, Hawaii

4. OCEANOGRAPHY OF THE CENTRAL TEMPERATE NORTH PACIFIC

The Central North Pacific (25°–50°N., 140°W.–170°E.) has recently been the subject of physical and biological surveys by the Pacific Oceanic Fishery Investigations of the U. S. Fish and Wildlife Service. The descriptions of the physical and chemical environment are intended to aid in understanding the biology of the region.

The wind pattern resulting from the semi-permanent distribution of high and low atmospheric pressure over the North Pacific leads, through the wind stress on the sea surface, to an oceanic circulation in the central region which is generally toward the east, north of about 30°N. This easterly current is fed from the south by the warm, salty Kuroshiwo and from the north by the cold, relatively fresh Oyashiwo. The southern part of the central region is normally supplied with Kuroshiwo water alone, while north of this, starting at about 30°–40°N., is an area of mixing between the two water types. This region, extending northward nearly to the Aleutians, is characterized by relatively rapid and irregular changes in water properties with latitude. Just south of the Aleutians, a poorly defined current extends toward the west from the Gulf of Alaska. The entire system of winds and currents shifts southward during the winter.

In the south the warm, light surface water inhibits replenishment of nutrients from below into the zone of light penetration. In the north this effect is much less, even in the summer; in the winter the northern surface layer is completely broken down by mixing due to convective overturn and wind intensification, leading to marked enrichment.

The actual measured water motions in the central area are seen to be very complex, with eddies, regions of very low velocity, and with filaments having velocities much greater than indicated by the average picture. These motions may be of importance in inducing mixing and enrichment.

EDWARD D. STROUP
U. S. Fish & Wildlife Service
Honolulu, Hawaii

5. THE PRODUCTIVITY OF PACIFIC WATERS NORTH OF HAWAII AS DETERMINED BY C^{14} UPTAKE

The U. S. Fish and Wildlife Service vessel, "Charles H. Gilbert," cruised north from Hawaii to 40° 12′ N. lat. roughly along 160° W. long. during December 1954. During the cruise, in addition to other data collected, determinations of the rate of carbon fixation were made using as a technique, the measurement of the uptake of carbon fourteen in sea water samples.

North of 34°–35° the estimates of productivity made from these determinations of the rate of carbon fixation are sharply higher. Similarly, the sampling of the standing crop of zooplankton and the determinations of the phosphate-phosphorus concentration indicate higher values in the same northern waters although these values are neither as regularly nor as sharply higher to the north. Northern waters were greener in color and less transparent, presumably because of more dissolved and suspended matter.

Absence of a sharp thermocline north of about 36° was noted. This is accepted as evidence that deeper mixing of the water was taking place, which would raise nutrient material into the euphotic zone. If other factors are not limiting, this would result in an increase in the fertility of the water. Such an increase seems to be more accurately reflected by productivity determinations based on the use of carbon fourteen than by measurements of either the concentration of inorganic phosphorus or of the standing crop of zooplankton.

R. R. L. GUILLARD, M. S. DOTY, AND M. OGURI
Botany Department
University of Hawaii
Honolulu, Hawaii

6. PLANKTON: LIVING DRIFT BOTTLES FOR THE STUDY OF WATER MOVEMENTS IN THE NORTH PACIFIC

In January, 1955, a qualitative study of the copepods collected on three northern cruises of U. S. Fish and Wildlife vessels was begun. Oceanographic data show that the north-south transects of these cruises intercept a variety of conditions which indicate changes from warm subtropical water to cold northern water with areas of mixing in between. The purposes of the copepod census were to find indicator species or indicator populations which would be an aid in defining the various water masses and in studying their seasonal fluctuations and to seek plankton populations which might be associated with albacore.

About 120 species of copepods were identified. Their distribution was mapped and compared with the oceanographic data. Good agreement was found between the north-south changes in copepod populations and the changes in the physical nature of the water. A study of previous plankton work in the North Pacific added much information on the distribution of these copepods and helped to classify them as typically cold or warm water species.

Three principal types of cold water plankton were found. Their known distribution in the Arctic and coastal areas of Asia and North America gave clues to the possible source of these populations.

In addition to the copepods, a pelagic goose barnacle and its larvae were studied. Their distribution poses some unanswered questions.

The distribution of the larvae of clams and gastropods mollusks was mapped and indicates that the larval life of these shells must be much longer than it is generally considered to be. There is some evidence that these larvae may have originated as far away as the Ryukyu or the Bonin Islands south of Japan.

Evidence of a spatial association between a copepod, *Calanus finmarchicus* and troll caught albacore was found on three cruises.

Plants for future work include triple net hauls at three levels, inclusion of other animal groups in the study and identification and more critical study of the distribution of the mollusk larvae.

EVERET C. JONES
U. S. Fish and Wildlife Service
Honolulu, Hawaii

7. EFFECT OF THE PUNA ERUPTION OF 1955 ON PLANT LIFE

Of all the natural disasters which can strike man and his possessions, the action of a volcano is the most spectacular. It awes him visually and staggers him emotionally because it reveals profound instability in that which to him has been the symbol of stability—the very earth on which he builds his cities and grows his food.

Volcanic activity in Hawaii has not had a history of destruction. People farm its flanks and build hotels near its craters. In comparison with other disasters such as floods, losses from volcanic activity have not been great in the past. Rather, the assets, in terms of tourist attractions and production of new land, have outweighed the liabilities. Without volcanic activity there would be no Hawaii.

The eruption of the southeast rift of Kilauea from February 28 until May 26, 1955, was exceptional in the magnitude of its destruction. The area concerned was originally covered by a dense rain forest of ohia and tree fern. Part of this forest had been cleared for cultivation of sugar cane, vegetables and fruits. Part of it had become homesites. But a large part of the forest still remained. In such an area, damage could not help but be enormous. Estimates vary from one to three million dollars.

Damage to plant life may be considered in two categories, permanent and temporary. Plants in direct contact with the lava were felled, burned and buried. Such damage may be considered permanent, because the plants were not only killed, but the soil covered with lava. Many other plants in close proximity to the lava were killed by the heat. However, some survived, and, as the soil remains essentially intact, new plants may be grown to replace those lost. Remarkable recovery has been shown by plants which were near, but not covered by the lava flows. New leaves have already appeared, and growth has resumed. Heavy deposits of ash caused temporary damage to many plants. However, once the plants recovered from this damage, the new growth seemed to indicate a stimulation similar to that produced by fertilizer.

Perhaps the most interesting effect on plant life was that produced by fumes. Volcanic gases have been shown to contain quantities of sulphur gases. Great damage was done in the immediate area of the vents by fumigation. Large fields of partially mature sugar cane were destroyed, while very young cane was affected but little. Interesting too, was the damage, typical of sulphur dioxide fumes, in areas twenty and thirty miles from the eruption, while plants in the intervening areas were untouched. Two possible explanations involve the presence of an inversion layer which limited the gas in its escape, or the formation of clouds by the gas, which furnished condensation nuclei for water vapor.

The economic future of the Puna area has been drastically altered. Fields of sugar cane which were not damaged permanently have been cut off by lava flows which make machine handling of the crop impossible. However, replacement by other crops can be anticipated. Recovery of lands covered by new lava will be relatively rapid because of the high rainfall.

Experiments in reclamation of this land, such as the planting of plants which give off large amounts of acid, should be undertaken.

E. J. BRITTEN
University of Hawaii Agr. Expt. Sta.
Honolulu, Hawaii

8. Induction of Flowering in the Pineapple Plant by Beta-Hydroxyethylhydrazine

Some years ago, A. G. Rodriguez showed that ethylene could induce pineapple plants to flower, and acetylene was later found by W. A. Wendt to "force" differentiation also. With these exceptions, the chemical materials reported to induce flowering in the pineapple have had the chemical structure characteristic of plant growth regulators, and have given positive results in the various tests for such properties (stimulation of cell elongation, initiation of roots, etc.). Such flower-inducing chemicals as 2,4-dichlorophenoxyacetic acid, 1-naphthaleneacetic acid, and 2-naphthoxyacetic acid have a ring system nucleus, a double bond in the ring, a side chain containing a carboxyl group (or structure readily converted to it), and, presumably, the necessary spatial relationship between the ring and the carboxyl group. They are also active in the split-pea-stem test proposed by F. W. Went.

Beta-hydroxyethylhydrazine, $H_2NNHCH_2CH_2OH$, has given no activity in the split-pea-stem test or in the *Avena* test, and has none of the structures associated with plant growth regulator activity. However, it has induced early flowering in two tests at different seasons in the pineapple, *Ananas comosus*, (L.) Merr. variety smooth Cayenne.

DONALD P. GOWING AND
ROBERT W. LEEPER
Pineapple Research Institute
Honolulu, Hawaii

9. Contrasting Patterns of Chinese Immigrant Adjustment in Jamaica and Hawaii

A comparison of the adjustment of the Chinese immigrants in Hawaii and Jamaica affords an opportunity to test the validity of prevailing theories of race relations, especially those associated with the name of Robert E. Park. The transmutation of the struggle for survival at the biological and economic levels into a struggle for status and social position has followed somewhat different patterns in the two comparable colonial areas. In both areas the Chinese have figured initially as plantation labor groups, but have subsequently acquired a higher economic position in various commercial pursuits and particularly as small tradesmen.

By virtue of their situation as immigrant aliens, the Chinese in both areas have been particularly well suited to play the part of tradesmen, being freed from ties of either local sentiment or of personal obligation to friends and neighbors. The effect, however, of the effective intrenchment in a supposedly lucrative occupation on the part of the Chinese, but recently assigned to unskilled plantation labor, was to draw bitter resentment toward the invaders in both Jamaica and Hawaii. In Hawaii, however, the arrival of equally aggressive competitors from other ethnic backgrounds have compelled the Chinese to find occupational outlets in numerous other fields and has thus spared them from the continued abuse, to which their distant cousins in Jamaica have been subjected because of their alleged monopoly of a critical industry. The Jamaican Chinese have made significant advances in the economic life of the Island, but their very success as small tradesmen has served to perpetuate the critical attitudes toward them and has delayed their political and social assimilation.

The pronounced differences between the two areas, with respect to class consciousness and the tradition of contact across ethnic lines have unquestionably contributed to the greater degree of cultural assimilation of the Chinese in Hawaii than in Jamaica. A major hypothesis emerging from the study is that the hostility encountered by immigrants as they push upward on the economic ladder may be partially mitigated if various channels of advancement rather than only one are utilized and that the ultimate assimilation is thereby facilitated.

ANDREW W. LIND
Sociology Department
University of Hawaii
Honolulu, Hawaii

10. Report on the International Conference on the Peaceful Uses of Atomic Energy

The Geneva Conference was a direct outgrowth of President Eisenhower's speech before the United Nations in December 1953.

On February 1, 1955, the Secretary General of the United Nations invited States Members of the United Nations or of the specialized agencies to participate in the Conference. Within the short intervening period 72 nations arranged for 1,260 representatives and advisers to assemble in Geneva for the opening session on August 8, 1955.

For the next 12 days sessions were divided into General; Physics and Reactors; Chemistry, Metallurgy, and Technology; and Biological, Medical, and Radioactive Isotopes.

English, French, Russian, and Spanish were the official languages of the Conference. Other languages could be employed provided the speaker himself provide for interpretation into one of the four languages.

The material reviewed briefly in this report has been chosen from a broad range of subject matter to illustrate what has been accomplished in the first decade of peaceful uses of newly created radioactive materials. Already, numerous valuable technological applications are in use, and many details of photosynthesis, respiration, nutrition, and other chemical reactions have been clarified.

Optimistic predictions were made for the development of nuclear power, food sterilization by radiations, useful genetic mutations, and initiation of new chemical reactions. The scope of the meetings was encyclopedic.

GEORGE O. BURR
Experiment Station, HSPA
Honolulu, Hawaii

SPECIAL SESSION III

Heredity and Modern Life

The growth and development of that branch of genetics which deals with man has led to cooperative research with many of the areas of human studies, including anthropology, psychology, sociology, law, and medicine. The philosophical and academic fruits of the liaisons have been of the greatest scientific interest, and in addition, practical applications in these various fields have emerged.

The anthropologist is concerned with the distribution of physical and cultural characteristics in populations. For physical traits, at least, this distribution is directly bound up with the frequencies of the various genic alleles. Progress is being made in the analyses of cultural traits in regard to any genetic bases which may be involved. The genetic data are of some aid in the classification of races.

The psychologist and sociologist are cooperating with the geneticist in the search for significant genetic variation which may underlie human behavior. The lawyer is able to use genetic knowledge in the identification of individuals by their blood types, and in determination of disputed paternity.

The physician finds many applications of the newer knowledge of human genetics. Among these are the clinical detection of the genetic carriers of disease. The search for methods of detection is one of the most actively investigated areas of medicogenetic research at present, and currently several dozen hereditary diseases may be recognized in superficially normal heterozygotes. The methods of detection range through chemical, grossly and microscopically morphological, physiological, immunological, electrophoretic and electronic.

As a result of such detection, genetic prognosis, which is one of the important fuctions of the physician, is greatly enhanced. Moreover, such detection facilitates the search for the early, preclinical signs of genetic disease. As a result of discovering preclinical laboratory manifestations, it has become feasible and important to institute proper therapeutic and preventive measures against many deviations from normal health, and to do this on a genetic basis far earlier than would otherwise be possible.

Diagnosis is on occasion facilitated by a knowledge of the family history, coupled with the employment of precise genetic technics. In recent months this facility has been greatly extended by the application of biochemical and electrophoretic methods to the genetically-determined enzyme dysfunctions which result in many of the hitherto obscure anemias involving defective hemoglobin, and to the series of hemorrhagic diatheses resembling hemophilia. The combination of genetic methods with laboratory technics has opened the way to the understanding of the complicated sequence of steps involved in the clotting of blood, and in the formation of hemoglobin. Much of our understanding of normal metabolism and its pathological deviations rests on such combinations of laboratory technics and genetic observations.

The genetic analysis of the many blood antigens (currently more than 40 are known) which make up the blood groups (about a trillion can occur in man) has been of paramount importance in the clarification of maternal-foetal incompatibility and its effects on health. Genetics is now an essential hand-maiden of medicine.

LAURENCE H. SNYDER
University of Oklahoma
Norman, Oklahoma
Visiting Professor, Zoology Department
University of Hawaii
Honolulu, Hawaii

SPECIAL SESSION IV

OCEANOGRAPHY OF THE NORTH PACIFIC

A Panel Discussion

1. The Indivisible Ocean

Unity in space, unity in time, and unity in subject matter characterize the great intercommunicating body of salt water that we call the ocean.

The unity in space means that all investigators are concerned with the same basic problems and that it is essential to develop full international cooperation. The success of Operation NORPAC is a convincing demonstration of the value of such joint efforts. It is only in the existing ocean that we are able to study the processes affecting and controlling the distributions of physical, chemical and biological properties and to develop quantitative relationships. However, these theories are essential if we are to properly interpret the history of the earth that is written in the marine sediments and to learn to predict the variations in such complex phenomena as the ocean currents and the distribution and abundance of fishes.

Operation NORPAC has provided us with the first quasi-synoptic picture of a large portion of the ocean. In a period of intense specialization it is important to recognize the unity of subject matter in oceanography. No aspect of the oceans, whether it be physical, chemical, geological or biological, is without its influence on all other features. By international cooperation of a large group of investigators skilled in the various phases of oceanography, much will be learned that is of practical value as well as of scientific importance. The ocean is an indivisible unit. It cannot be properly studied in small segments, by scattered surveys, nor by isolated subjects.

It is hoped that Operation NORPAC marked the beginning of an evergrowing program of international science that will extend far beyond the scope of the International Geophysical Year.

RICHARD H. FLEMING
Department of Oceanography
University of Washington
Seattle, Washington

2. NORPAC

In July, August and September, 1955, agencies of Japan, United States and Canada cooperated in a synoptic survey of the Pacific Ocean north of 20°N. latitude which was the greatest project of its kind ever undertaken. Twenty vessels occupied about one thousand oceanographic stations according to an agreed plan. Not only were the sea operations carried out successfully but records of all the data, with preliminary processing completed, were exchanged by all the agencies at this meeting in February, 1956—less than five months after the field work was over. The magnitude of the project and the spirit in which it was carried out, demonstrate on a larger scale than ever before what can be achieved by international cooperation in oceanographic research.

The project was originally proposed in informal discussions between research agencies interested in the oceanography of the Pacific. It called for a considerable departure on the part of the Japanese agencies from their ordinary, scheduled operations. That it was possible in the short time available to alter and replan these operations was due to the assistance and cooperation of Dr. Suda. Its purpose was to obtain oceanographic data simultaneously over the whole northern part of that ocean, thus giving a more complete picture of the properties and dynamics of the water masses than was available from the piecemeal investigations of the past. The importance of the project to the many fields of applied oceanography helped to enlist the necessary support to carry it out.

The Conference marked the completion of the first phase of the NORPAC project—the collection and preliminary processing of the data. In addition to the exchange of data records representatives of each agency presented the results of such further analysis as had been possible in the short time available. The conclusions reached were necessarily of a preliminary nature but when combined already demonstrate the effectiveness of the project and the great value of the picture which is emerging. The characteristics of the water masses and water movements in particular areas can now be delineated. The discussions emphasized, however, the need for information on the whole oceanic system if any of the parts are to be fully understood. The experience and the information obtained through NORPAC makes it possible to plan more effectively for further work in neighboring regions and in parts of the NORPAC area itself.

The Conference noted the many ways in which the results of the NORPAC surveys assist in discovering and understanding the distribution and movements of commercially valuable fishes and marine mammals. In the north, for example, conditions were revealed which influence salmon distributions. Farther south lie other important populations of fish in the high seas, some of which support highly developed industries such as the Japanese and American albacore fisheries, the Japanese and Hawaiian skipjack fisheries, and the intensive fisheries for herring-like species on both sides of the North Pacific. In addition, many areas not now fished support what appear to be dense stocks of valuable fishes. NORPAC is an important forward step in the development of new fisheries and the extension of old.

JOHN P. TULLY
Pacific Oceanographic Group
Fisheries Research Board of Canada
Nanaimo, B. C., Canada

3. Japanese Cooperation in Pacific Oceanography

Cooperative oceanographic research between the United States and Japan was first considered by Dr. Thomas W. Vaughan about 1930, when he was director of the Scripps Institution of Oceanography, La Jolla. He proposed that American oceanographers should operate in the eastern side of the international date line, while the Japanese should observe the western part. Due to the political difficulties present during that period this plan did not materialize. Since the termination of hostilities, several oceanographical expeditions have been carried out in the Pacific, including five significant ones sent by the Scripps. During this period, Japanese oceanographers had very little to contribute to the cooperative exploration of the Pacific which is close to our people.

It was a great pleasure for us to be able to cooperate at last in the NORPAC expedition with the United States and Canada. We are grateful to the American authorities for providing us with the opportunity of meeting delegates from these nations in Honolulu, in order to discuss future and past cooperative oceanographic plans.

KOJI HIDAKA
Geophysical Institute
University of Tokyo
Tokyo, Japan

4. Oceanography in the Pacific during the International Geophysical Year

The earth is a unique planet—it has oceans. What lies beneath their surface is largely unknown, but cooperative investigations would greatly increase our knowledge. Such cooperative investigations are the purpose of the International Geophysical Year. The oceanographic program for the International Geophysical Year has gradually developed into a most elaborate and far-reaching one. Nearly 75 research vessels from many different countries will each spend many months at sea.

Of special interest in the oceanographic studies will be that of the slow circulation of the water from deep down to the surface, bringing up nutritive material to the surface where it can become food for the organisms we can see and use. Study of the deep water and its properties may tell us about the life of long past eras, and make it possible to predict future conditions. This slow circulation will become increasingly important in connection with future disposal of radioactive waste materials.

From the standpoint of future human welfare, one of the most important parts of the IGY oceanographic program in the Pacific will be an attempt to obtain the exact amount of carbon dioxide in the atmosphere and the rates and mechanism of carbon dioxide interchange between the sea and the air; these measurements will furnish a base line for determining future additions of carbon dioxide to the atmosphere from fossil fuel combustion, which may have a profound effect on Earth's climate during the next century.

ROGER R. REVELLE
Scripps Institution of Oceanography
La Jolla, Calif.

HAWAII DIVISION FIRST MEETING

Local Weather Characteristics

No abstract available

JAMES W. STEINER
U. S. Weather Bureau
Hilo, Hawaii

Meteorological Studies during the International Geophysical Year

No abstract available

JAMES W. STEINER
U. S. Weather Bureau
Hilo, Hawaii

HAWAII DIVISION SECOND MEETING

A Horticulturist Visits the Marshall Islands

No abstract available

HORACE F. CLAY
University of Hawaii Agr. Expt. Sta.
Honolulu, Hawaii

FINAL SESSION

1. The Hawaii Solar Flare Patrol for the International Geophysical Year

A solar flare is a very bright eruption of gas from the sun's surface, or chromosphere, which bursts forth suddenly, reaches a maximum brightness in a few minutes, and then slowly subsides. It is now an accepted fact that the occurrence of solar flares is correlated with a number of terrestrial phenomena such as radio fade-outs and geomagnetic disturbances. One of the objectives of the International Geophysical Year program is to obtain more information on the occurrence of solar flares and their relationships to terrestrial phenomena. To fulfill this objective, solar flare observing stations are being located all over the world so that the sun will be under continuous observation. Such observing stations are called Solar Flare Patrols. A flare patrol station in Hawaii will fill a very important gap in the information needed on the sun.

The flare patrol instrument is essentially an ordinary telescope with a special red filter built in and a 35mm movie camera attached to the eyepiece end. The red filter has a very narrow band pass so that most of the brilliant light of the sun is filtered out and only that light emitted by hydrogen is allowed to pass. In this light the flares stand out clearly.

The telescope must be so mounted and driven that it follows precisely the motion of the sun. This is accomplished by means of a photoelectric guider which detects any drifting of the telescope away from the sun and drives a correction motor to bring the telescope back into proper position.

The camera is connected to a timing mechanism which automatically snaps the shutter and winds the film at prescribed intervals, the normal interval being 2 minutes. Each picture is precisely timed by radio signals from the Bureau of Standards time signal on station WLW. At the end of each day the film is removed from the camera and processed. The finished film is studied in a microfilm projector and the observer records the time of occurrence, duration, intensity, area, and location of all the observed flares for that one day. The data thus recorded will then be transmitted by radio to a data collecting center.

A suitable site for the Hawaii Flare Patrol has been found at Makapuu Point where the clear sky offers a good view of the sun much of the time. Negotiations are underway to obtain the use of this site.

WALTER STEIGER
Physics Department
University of Hawaii
Honolulu, Hawaii

2. Mt. Haleakala, Maui, as a Possible Site for Solar Corona Studies

Observation conditions similar to those present at the time of a total solar eclipse can be produced by an instrument known as a Coronagraph. This instrument is so designed as to allow the disk of the sun to be obscured from view and permitting only that light from the region immediately surrounding the sun to be observed. With the Coronagraph it is possible to observe the prominences, spicules, and certain regions of the corona.

The principle disadvantage of this particular apparatus is that the location where it is to be used must meet somewhat rigid requirements as to atmospheric conditions. The atmosphere must be sufficiently clear of water vapor and particle contamination that the bright halo around the sun, produced by light scattered by this contamination, have a brightness less than 60 millionths as bright as the sun itself. This brightness can be determined with an instrument known as a sky-brightness photometer, which allows a direct visual comparison of the sky brightness and sun brightness. For a site to be suitable, the sky must meet the brightness requirements for 50 per cent of the daylight hours on 20 per cent of the days of the year. This also means that the sun must be unobscured by clouds during this time.

On the basis of rough, preliminary tests, it was felt that Mt. Haleakala, Maui, would be a suitable site for establishing a Coronagraph. To determine the suitability of the site's atmosphere, a program was inaugurated wherein daily determination of sky brightness and hours of clear sky would be made. The program started in June 1955 and will continue until June 1956.

An evaluation of the data taken so far indicates that of the 212 days of observation, 106 of them (50 per cent) are suitable for coronagraphic work. For those times when the sun was unobscured by clouds, it was found that the average sky brightness was 9.88 millionths of the sun's brightness. Whenever the sky brightness is 10 millionths or less, coronagraphic work of the highest quality is possible.

This evaluation indicates that Mt. Haleakala is definitely suitable for coronagraphic work and on the basis of information obtained pertaining to sites in the United States, Mt. Haleakala seems to be superior to these in terms of the number of consecutive hours of cloud-free sky having brightnesses less than 10 millionths as bright as the sun. This is a consideration of major importance since continuous observations of solar activity produce the most valuable data.

JOHN W. LITTLE
Physics Department
University of Hawaii
Honolulu, Hawaii

3. Niacin Content of Blood and Feces as Influenced by Niacin and Tryptophan Intake

Niacin is a water-soluble vitamin required both by chicks and laying hens. A deficiency of this vitamin in the chick's diet results in "black tongue," a condition characterized by inflammation of the tongue and mouth cavity. Retarded growth is also caused by a niacin deficiency. Tryptophan, on the other hand, is one of the essential amino acids required by chicks and laying hens. It is found in seeds of legumes and in fish and meat products. It is needed in the diet of chicks for efficient feed utilization.

Because contrasting views have been reported to account for the interchangeability of niacin and tryptophan in the nutrition of various animal species, tests were undertaken to study the niacin contents of blood and feces of chickens as influenced by niacin and tryptophan intake.

In part 1 of this study, 3 laying hens were fed a niacin-free diet for a period of 7 days, following a low-niacin diet during a period of 20 weeks. These showed blood niacin levels ranging from 3.73 to 6.25 mcg. per ml. The differences in values were attributed to individual bird variation. When bird No. 1 was placed on a low-niacin diet for 24 hours, the blood niacin level rose from 3.73 to 6.28 mcg. per ml. Bird No. 2, when placed on the low niacin plus tryptophan diet for 24 hours, showed a change in the blood niacin level from 5.33 mcg. per ml. to 9.46 mcg. per ml. Similarly, the third bird had a blood niacin level of 6.25 mcg. per ml. when placed on the niacin-free diet which was increased to 18.16 mcg. per ml. when fed the low-niacin diet plus niacin. It is significant that bird No. 2 fed tryptophan showed an increase in the blood niacin level of 1.58 mcg. per ml. of blood after 24 hours on the experimental diet.

The difference between the amount of niacin ingested and later voided in the feces was not a good indication of how much was absorbed in the blood. Bird No. 1 fed a low-niacin diet retained 70.7 per cent of the ingested niacin but the blood niacin was only 6.28 mcg. per ml. Bird No. 2, fed the low niacin plus tryptophan basal, retained 36.4 per cent of the ingested niacin but showed a blood niacin level of 9.46 mcg. per ml. The difference in the concentration of niacin in the blood was probably attributed to tryptophan because it has been reported that tryptophan is a precursor of niacin. On the other hand, bird No. 3 retained 90.2 per cent of the niacin intake and the blood niacin level rose to 18.16 mcg. per ml. Apparently, synthetic niacin fed in capsules was more available to the birds than the niacin found in the natural ingredients of the basal diet.

In trial 2, three groups of laying hens were analyzed for blood niacin level. Groups 1, 2, and 3, each containing 3 birds, were fed a low-niacin basal diet B, B plus tryptophan, and B plus niacin, respectively. There was a significant difference between treatments. The birds fed the low-niacin basal alone showed a blood niacin level of 10.3 mcg. per ml.; those fed the basal plus tryptophan, 12.1 mcg. per ml.; and those fed the basal plus niacin, 15.3 mcg. per ml. The average blood niacin level of the birds fed the basal diet plus tryptophan was higher than that of chickens fed the basal diet alone but this difference was not statistically significant.

A. L. PALAFOX AND
M. M. ROSENBERG
Department of Poultry Science
University of Hawaii
Honolulu, Hawaii

4. THE UNPRECEDENTED KAUAI RAINFALL OF JANUARY 1956

During the winter of 1955–1956 an unusually large number of torrential rains occurred in various parts of the Hawaiian Islands. The most spectacular of these, and certainly the most damaging, was that in northern and eastern Kauai toward the end of January 1956.

The center of heaviest rain was in Kilauea Plantation, where 43.5 inches fell in 48 hours. The deluge—6 inches fell within a single half hour—was described by witnesses as "absolutely incredible" and "beyond knowledge or comprehension of man." Of the total rainfall, nearly 40 inches occurred in less than 24 hours. This amount, and others for shorter intervals during the same period, appears to exceed all previous records for Kauai and the other Hawaiian Islands, and to approach closely the heaviest known world rainfalls. For all of northeastern Kauai it was the greatest rain of record.

This extraordinary rain appears to have resulted from the intensification by local topography of a larger scale rain-producing system. A weather front from the northwestern Pacific was loitering just north of Kauai. Even over the open sea, the broad currents of air converging from either side of this front had been generating cloud and rain. Northern Kauai lay within a strong flow of moist, unstable air from the east-southeast. One can surmise that the Anahola Range split this current into two. One branch proceeded on its way relatively unaffected; the other, deflected, funnelled as a southerly stream through the notch between the Anahola and Makaleha Mountains. Just over Kilauea Plantation the two met again, nearly at right angles, producing strong, even violent, upthrusts of air. This was the site of the heaviest rain.

Very much the same thing seems to have happened in November 1955 when all previous rainfall records for the Kilauea area were broken.

Does the exceptionally wet winter of 1955–1956 presage a trend to similar winters? No more than the severe drought of 1952–1953 meant that winter rains had gone for good. Such effects could proceed only from changes in the world-wide atmospheric circulation, and there is no clear evidence of this.

It is more likely that unusually wet and unusually dry seasons are part of the ordinary variability of the weather, and that each can be expected to occur in the future with about the same frequency as in the past.

ARTHUR H. JENNINGS AND
SAUL PRICE
U. S. Weather Bureau
Honolulu, Hawaii

5. ORIGIN AND DIFFUSION OF THE HERZBERG PRINCIPLE WITH ESPECIAL REFERENCE TO HAWAII

Great interest was aroused in 1879 when the first artesian well in Hawaii was sunk at Honouliuli, Oahu. The role of the cap rock in causing artesian head was described by an unnamed writer in Thrum's Annual for 1882. Schuyler and Allardt in 1889 saw that the Pearl Harbor Springs and the artesian wells depended on the same great body of ground water. In 1899 H. P. Baldwin and H. F. A. Schussler found that fresh water extended far under the Maui isthmus.

Clear understanding of the roles of the water-bearing lavas, of the cap rock, and of the relative densities of fresh and salt water was first had in Hawaii by Carl B. Andrews in 1909. His work was done independently but was not circulated widely, unfortunately, for it was a typescript of but few copies. He also was the first to see that impermeable, deeply weathered lava formed the sealing layer of the cap rock and not some submarine deposit of clay.

Understanding had advanced meanwhile in other regions. Though the first publication of the Herzberg principle seems to have been made in Holland by Badon Ghyben in 1889, his paper had little influence for it was unclearly written and was published in a journal of small circulation. Herzberg, working on Norderney, hit on the principle of flotation of fresh water of denser salt water in 1889, or as early as 1886. His 1901 presentation was well written and illustrated and had a wider circulation, and therefore more influence.

American geologists working on the Atlantic and Gulf coasts made but little progress, though Matson and Sanford in 1913 came very close to the principle in their Florida work. Spear, an engineer, knew in 1912 of some of the European work and applied the principle in forecasting the behavior of wells at certain places on Long Island, but his report to the New York Board of Water Supply seems to have been missed by American geologists. Similarly, Pennink's paper on the topic, before the 1904 World Congress of Engineers in St. Louis, and Keilhack's German textbook on ground waters did not come to the attention of geologists.

Brown's studies in 1919 on the Connecticut shore lead him to search the Dutch literature and resulted in an excellent small paper in 1922 in the American Journal of Science and a U. S. Geological Survey report in 1925. These really alerted American geologists to the Herzberg principle. It was first applied in full to Hawaii in 1926 by Palmer, and has since been of great value not only in Hawaii but also in many coastal areas and many islands.

At first one spoke of the "Herzberg principle," but when it was realized that the Hollander had published before Herzberg, the usage became "Ghyben-Herzberg principle." This was used until it was realized that the Hollander had a double family name, so one had to use "Badon Ghyben-Herzberg principle," which is awkward. It is suggested that we revert to "Herzberg principle," and its cognate "Herzberg lens," not only for the sake of simplicity but especially because Herzberg seems to have been the first to hit on and use the principle.

HAROLD S. PALMER
Honolulu, Hawaii

6. The Inheritance of Resistance to Severe Root Knot from *Meloidogyne incognita* in Tomato

An interspecific cross between *Lycopersicon esculentum* and a root knot resistant *L. peruvianum* was reported by Smith (University of Calif., Davis, 1944). Commercial type gall resistant tomatoes have now been obtained in Hawaii from this cross through six generations of backcrossing and selecting. It was apparent that resistance was highly dominant but the number of genes involved was not readily determined because of difficulties in the classification of plants in segregating lines as well as apparent inconsistencies between tests. Plants are tested in the seedling stage by growing them in soil inoculated with chopped roots of tomato plants heavily infected with root knot nematodes. It has now been shown that the inconsistencies between tests were due primarily to differences in the strength of the inoculum. In some tests a considerable degree of intermediate galling of genetically resistant plants occurred with exceptionally strong inoculum. The existence of species or races of nematodes capable of producing some galls on *L. peruvianum* has been demonstrated and this may also have been a factor in these tests.

The use of resistant as well as susceptible controls in each test has largely solved the problem of inter-test variability. The resistant controls are taken from lines which have been examined enough in previous tests to serve as familiar standards of resistance. Whenever these two sets of controls indicate a clear separation of resistant and susceptible plants in a seedling test or whenever mature plants are scored against *M. incognita,* monogenic inheritance of resistance to root knot has been suggested.

F_2 tests since 1953 totaled 2,786 resistant to 958 susceptibles while backcross tests showed 565 resistant to 574 susceptible. Progeny tests of phenotypically resistant plants in the segregating lines showed one out of three such plants to be homozygous for resistance when the entire group of resistant appearing plants was progeny tested. When only the earlier maturing and better looking horticultural selections were tested, only 12 selections out of 211 turned out to be homozygous for resistance. This strongly suggests linkage between the gene for resistance (gene symbol Mi) and several loci affecting horticultural worth. Recent selections in resistant lines have shown several early maturing, comparatively crack free segregates, however, and the suspected adverse linkage problems do not appear insurmountable.

Backcross tests with marker stocks have placed the Mi gene in tomato linkage group IV with about 40 per cent recombination between "mi" and "c" (potato leaf).

JAMES C. GILBERT
University of Hawaii Agr. Expt. Sta.
Honolulu, Hawaii

7. Potential Usefulness of the Sterile Fly Release Method in Fruit Fly Eradication Programs

Research to evaluate the usefulness of the gamma irradiation and sterile fly release method for tephritid fruit fly control or eradication was prompted by the successful eradication of the screw-worm, *Calletroga hominovorax* (Cqrl.) from the island of Curacao, A. H. Baumhover, *et al.,* (Baumhover, A. H., A. J. Graham, B. A. Bitter, D. E. Hopkins, W. D. New, F. H. Dudley, and R. C. Bushland. 1955. Screw-worm control through release of sterilized flies. *Jour. Econ. Ent.* 48(4): 462–6). This was accomplished by releasing adult flies made sterile by gamma irradiation in numbers far exceeding the natural fly population and on a rigid schedule through several generations. The screw-worm female mates only once. Copulation with a sterile irradiated male prevented subsequent fertilization by normal males so that the population was steadily depressed until eradication was complete.

The oriental fruit fly (*Dacus dorsalis* Hendel), the Mediterranean fruit fly (*Ceratitis capitata* Wied.), and the melon fly (*Dacus cucurbitae* Coq.) females were found to mate frequently. Sexually mature sterilized males required approximately 10 days of exclusive access to virgin females to effectively prevent subsequent fertilization by normal males. Sterile males were unable to substantially reduce fertility in normal females originally mated with normal males. The degree of sterility in male flies from pupae irradiated with cobalt 60 in the late pupal stage at dosages ranging from 2,500 to 10,000 Roentgens was proportional to the dosage. Female flies lost their capacity to produce eggs as the dosage was increased. Although dosages of 8,400 to 10,000 r were required to effect complete sterility and prevent all egg-laying, male effectiveness in inseminating females was in inverse ratio to the dosage. The most practical dosage was in the range of 6,700 to 8,400 r. Lesser dosages might permit too much egg-laying and excessive sting damage to host crops. Higher dosages increased mortality and left the male too ineffective in competition with normal males. Dosages of 8,400 r or less permitted a substantial loss of sterility in males after 30 to 50 days, a factor not encountered in the short-lived screw-worm adult. Despite multiple mating and loss of sterility, tests of populations containing various ratios of irradiated and normal flies indicated that under laboratory conditions the resultant egg fertility was proportional to the ratio of sterile and normal flies present.

The nature of the effect of gamma irradiation on fruit flies has not been determined. In addition to the presumed production of a high percentage of dominant lethals in the motile spermatozoa, there appeared to be some reduction in the motile sperm-producing capacity. Despite the unfavorable factors encountered along with the problem of vastly larger populations to be suppressed, than were encountered in the screw-worm experiments, the method has promise of being a useful eradication tool against isolated fruit fly populations.

Recent improvements in fruit fly mass production techniques and the pending acquisition of a cobalt 60 source capable of producing 25,000 r per hour per 2 liters will make possible large-scale pilot tests with each of the Hawaiian fruit flies. If justified, eradication experiments may subsequently be undertaken on suitable isolated infested islands in the western Pacific.

Radioactive cobalt used in these experiments was made available through the cooperation of Dr. George O. Burr, Hawaiian Sugar Planters' Association Experiment Station.

L. F. STEINER AND L. D. CHRISTENSON
Entomology Research Branch
Agr. Res. Serv., U.S.D.A.
Honolulu, Hawaii

8. Effect of Gamma Rays From Cobalt 60 on Immature Stages of the Oriental Fruit Fly (*Dacus dorsalis* Hendel) and Possible Application to Commodity Treatment Problems

A one-curie cobalt 60 source located at the Hawaiian Sugar Planters' Association Experiment Station was used to test the effect of gamma rays on eggs and larvae of the oriental fruit fly, *Dacus dorsalis* Hendel.

It was found that young eggs up to 6 hours old were killed by dosages of approximately 4,000 r. Twenty-four hour old eggs in which embryonic development was about 50 per cent complete were much more resistant and hatch was unaffected by irradiations up to 36,000 r. It was reduced approximately 24 per cent by 60,000 r and 46 per cent by 120,000 r. Larvae hatching from irradiated eggs were placed in a carrot rearing medium to measure latent effects of irradiation through their ability to develop through the larval, pupal, and adult stages. Complete development from irradiated egg to adult was possible with a dosage of approximately 2,000 r, and the resulting adults mated and produced normal progeny. Dosages in the range of 7,500 to 60,000 r permitted puparial development but this was greatly reduced at 30,000 and 60,000 r at which levels the pupation was only 0.5 of one per cent. A dosage of 120,000 r permitted development from irradiated egg to third-instar larva but prevented puparial formation. Third-instar larvae exposed to irradiations varying from 15,000 to 240,000 r survived and from 37 to 70 per cent formed puparia but were unable to develop to the adult stage.

These results indicate promise for irradiation as a quarantine treatment for fresh fruits and vegetables infested by fruit flies and possibly other insects. Although the lethal effects are not immediately apparent with dosages up to 300,000 r, the complete development of irradiated eggs and larvae to the adult stage is prevented by dosages of 7,500 and 15,000 r. With proper equipment these dosages could be administered rapidly and with little likelihood of causing deleterious effects to the commodity.

J. W. BALOCK AND L. D. CHRISTENSON
Entomology Research Branch
Agr. Res. Serv., U.S.D.A.
Honolulu, Hawaii
GEORGE O. BURR
Experiment Station
Hawaii. Sugar Planters' Assn.
Honolulu, Hawaii

9. Withholding Irrigation to Control Flowering in Sugar Cane

Field tests on Hawaiian plantations have shown that increased yields of sugar are obtained by controlling the tasseling of sugar cane, especially in the first tasseling season. This commercial importance has added incentive to study the problem of flower control which has long been of interest to the plant breeder.

Flower bud initiation in the Hawaiian commercial sugar cane varieties takes place within a 10-day period about the middle of September. This fact simplifies the study of flower control. If initiation is prevented during this crucial short period, flowering will not occur until the following September.

Sugar cane behaves as a short-day plant requiring a long day pre-illumination. Hence it falls within the intermediate class of Allard with a requirement of day length between 12 and 13 hours. Flowering may be prevented by interrupting the dark period or changing the day length. Initiation may also be prevented by removing the top blades or burning the leaves with caustic sprays, by the application of hormone-like chemicals, or by changing temperatures. Although sugar cane is not very sensitive to changes in major nutrients, high nitrogen reduces the flowering tendency.

Flower bud initiation is favored by high moisture content or low moisture tension. Hence, cloudy moist locations tend toward heavy tasseling. This relationship between moisture and flowering is the subject of the present communication.

The effect of certain irrigation practices on tasseling and growth of the cane stalk has been under study for a number of years. The following conclusions can be drawn from the results of this investigation.

(1) Flower bud initiation can be prevented by withholding irrigation for a 6- to 7-week period ending September 23. The September 23 date insures with safety that bud initiation time is over and any treatment after this date to field cane will not cause initiation until the following year.

(2) A 7-week drying off period causes growth stress the last three weeks resulting in two short joints elongating during this time. This stress period must occur during the first 20 days of September.

(3) A 7-week drying off period ending even 4 days before September 20, or a 7-week period beginning too late to get optimum stress in the cane stalk will cause adverse growth. Census of stalks after such treatments will reveal only a few normally tasseling stalks, but a large number of slow growing stalks with flags or bunch tops.

(4) Normal or better than normal stalk growth is re-established soon after irrigation is resumed. There is often a marked improvement in stalk size and top growth in cane that has been dried off.

(5) The drying off treatment to control tasseling will mean a big saving in water during the hot August-September months. Normally, a field of cane that is due to flower in the first fall season is at its boom growth stage. Such fields got more water, more often, by the old plantation irrigation practice. Now, by withholding irrigation from such fields, not only is water conserved for other fields, but better crops with more sugar are obtained at harvest time.

T. TANIMOTO AND
GEORGE O. BURR
Experiment Station
Hawaii. Sugar Planters' Assn.
Honolulu, Hawaii

10. Statistical Analysis of Oahu's 1954 General Election: Patterns Emerging from the Vote as Reported by Precincts

The 1954 general election in Hawaii furnished many surprises. This was particularly true on Oahu, where voters seemingly abandoned traditional patterns. Consequently, more than usual interest developed in the identification of factors responsible. The study here reported sought to identify some of these factors.

The particular method used was multiple factor analysis, a technique which has repeatedly served the field of psychology by bringing order into areas of vague relationships. Of the 40 candidates involved in the Fourth and Fifth Districts, 36 were selected for study. Four candidates, each involved in a race with a single opponent, were eliminated for technical reasons. Returns for each candidate, for each precinct, were first converted into per cent of total vote scores. As an index of relationship between candidates, product-moment correlation coefficients were computed, within each district, between all pairs of candidates. From the resulting two correlation matrices factors were extracted by a variety of the centroid method of factor analysis known as the multiple group method.

For the Fourth District two factors were uncovered. Factor I was clearly a "party affiliation" factor, dividing candidates into two distinct groups of Democrats and Republicans. Factor II was called an "ethnic affiliation" factor, as it split candidates, regardless of party, into two groups—one composed, with one exception, of candidates of Japanese ancestry; the other, candidates of other extractions. Of the two factors, party affiliation appeared to be somewhat the stronger.

In the Fifth District three factors were isolated. The first two were those found in the Fourth District —factors of party and ethnic grouping. In the Fifth these factors appeared to be of about equal strength. Factor III, a residual factor of less importance, seemed ambiguous in meaning. At the moment, due to insufficient background information on the candidates, this factor has been left undefined.

Whether there were additional elements in the election, determining the choices made by individual voters, is unknown, so far as this study is concerned. It may well be that there were other factors, which were, however, lost in the mass action of the precinct return, the basic unit of the study.

The study, in summary, offers evidence that various ethnic groups in Hawaii, as elsewhere, lend support to candidates representative of their respective groups. The study does not, however, give a final answer on the general question of bloc voting with all its many facets.

JOHN M. DIGMAN
Psychology Department
DANIEL W. TUTTLE
Government Department
University of Hawaii
Honolulu, Hawaii

11. Organic Productivity of a Hawaiian Coral Reef

Primary organic productivity was determined by measuring changes in oxygen concentration of sea water flowing over a reef at Kapaa, Kauai. Prevalence of a rather strong, unidirectional current facilitated use of this method.

Net production and consumption over a 24-hour cycle were about equal, indicating that the reef is in a steady state.

Gross production was calculated to be 3000 g. carbon/m.^{2}/yr. This is in impressive agreement with data obtained by Sargent and Austin (1954) on Rongelap Atoll (1500 g./m.^{2}/yr.) and Odum and Odum (1955) on Eniwetok Atoll (3500 g./m.^{2}/yr.). These are the only previous measurements of coral reef productivity.

All three figures are considerably higher than determinations of productivity of open ocean waters. The authors attribute this difference to photosynthesis by benthic algae on the coral reef platform.

ALAN J. KOHN AND PHILIP HELFRICH
Hawaii Marine Laboratory and
Department of Zoology and Entomology
University of Hawaii
Honolulu, Hawaii

12. Aspects of Oceanic Productivity in the Eastern Tropical Pacific

During several crossings of the equator on two cruises of the U. S. Fish & Wildlife Service vessel "H. M. Smith" water samples were collected for determination of photosynthetic carbon fixation as an index of potential productivity using the carbon-fourteen method. This method involves placing sample water in bottles, adding an inoculum containing carbon fourteen and incubating this under uniform light conditions. All the data from these two cruises, completed this spring, have not been analyzed but the following seemingly significant relations have been revealed.

Analysis of about 75 pairs of samples, taken from the surface and from 20 meters, reveals a high degree of correlation between the carbon fixing potential of water from these two depths. If this holds true in other regions, sampling other depths near the surface may be unnecessary.

For the most part, samples were collected only near 0800 and 1900. Assays of the carbon fixing rates in these samples indicates that the successive morning and evening samples fixed carbon at rates differing by a factor of 5.6. In every case the evening productivity was the lower of the two.

High productivity was noted for the waters in the vicinity of the equator, where upwelling would bring nutrient rich waters to the surface. In subtropical waters, away from the region of upwelling, the productivity falls off, reaching a minimum value, about 1/7 that found in the equatorial region, in the vicinity of the Hawaiian Islands. Surface samples were taken in the vicinity of a frontal zone. The carbon fixation rate on the warm side of the front was found to be about 1/3 that on the cold side of the front.

To test the hypothesis that there was a daily periodicity in photosynthesizing ability of the phytoplankton an experiment was carried out on a second cruise to these waters. Surface water, both from a 5 gallon carboy filled at the start of the experiment and from the surface alongside the ship as it cruised, was sampled at intervals of 2 hours over a 24-hour period. After processing these samples it was found that apparently there is a daily rhythm in photosynthesizing ability of the phytoplankton. The variation seems to be asymmetric with the maximum at perhaps 1000 to 1200 and the minimum around 1900 to 2200.

MAXWELL S. DOTY, MIKIHIKO OGURI,
AND ROBERT PYLE
Botany Department
University of Hawaii
Honolulu, Hawaii

13. Feeding in *Conus striatus* and *C. catus*
Illustrated by movie

At least three species of marine snails of the genus *Conus* feed primarily, and probably exclusively, on live fishes. A paralyzing venom is injected into the prey organism by means of a highly modified radula tooth.

Cinematography of the feeding process elucidated the following sequence of events: 1) upon introduction of a suitable prey organism into a tank with the snail, the latter becomes active and extends its proboscis toward the prey; 2) upon contact of the tip of the proboscis with the prey, the radula tooth and venom are injected and the prey impaled on the barbed radula tooth; 3) the mouth of *Conus* expands from a few millimeters in diameter to about 2 cm. (in *C. striatus*) in order to receive the meal; 4) the paralyzed fish, still impaled, is withdrawn into the mouth by rapid contraction of the proboscis; 5) engulfment is completed by expansion of the buccal cavity around the fish.

The feeding process in *C. striatus* and *C. catus* is essentially similar. Both species are able to feed on fishes whose length is about equal to the shell length of the predator.

Some selection occurs in feeding. *C. striatus* attacks members of the families Blenniidae, Mullidae, Mugilidae, and Kuhliidae, but not Holocentridae or Pomacentridae.

Recently, remains of fishes have been found in alimentary tracts of a third species, *C. halitropus*. The feeding process has not yet been observed in this species.

ALAN J. KOHN
Hawaii Marine Laboratory
University of Hawaii

14. Augmentation of Skin Responses to Sunlight by Psoralen Derivatives

Psoralen (furo-coumarin) derivatives extracted from *Ammi majus* (Linn.) and several other plants have long been used in crude form in Egypt to induce repigmentation in areas of acquired depigmentation of the skin known as vitiligo.

Two of these derivatives, 8-methoxypsoralen ("8-MOP") and 8-isoamyleneoxypsoralen ("8-IOP") have been isolated and given in doses of 5 to 30 milligrams, by mouth, singly or in combination, to experimental animals and to hundreds of patients with this disorder. The toxicity of the drugs in the doses used is negligible. Their effect on the disease is good, but so slow that it is quite inadequate for most extensive cases. In less extensive cases they can be used in solution, painted on the white areas, instead of being given orally.

Of greater interest in the past year or two has been the observation that they augment all the skin responses to sunlight—sunburn, horny-layer thickening, melanin formation (i.e., tanning), and (in mice, receiving very large injected doses and excessive irradiation) skin cancer formation.

Experiments are reported in which some of these effects were demonstrated in a roughly quantitative way.

It seems probable that most persons who tan poorly—and therefore run a risk of developing multiple skin cancers—may be helped by the use of either or both of these drugs to acquire a good protective tan. This would presumably protect them, not only against sunburn now, but also against skin cancer formation in the future.

HARRY L. ARNOLD, JR.
Straub Clinic
Honolulu, Hawaii

15. Photoelectric Photometry in the Vacuum Ultraviolet

A photoelectric technique for quantitative intensity measurements in the vacuum ultraviolet was developed in order to avoid the uncertainties of photographic photometry. Application of this technique to the study of molecular spectra, photoionization, and solid state physics in the comparatively unexplored spectral region below 2500A has proved to be very fruitful. However, the resolution obtained by previous investigators has been limited to about 1A which is inadequate for the study of fine structures in molecular spectra. The present investigation employed a one-meter vacuum monochromator to obtain linear dispersion of radiation from a hydrogen discharge tube. The spectrum was scanned automatically and the output of the detector, a photomultiplier coated with sodium salicylate, was recorded on a Speedomax recorder. Attempts were made to overcome some of the experimental difficulties and it was possible to obtain a resolution of 0.2A. This was accomplished as follows: (a) the optical efficiency was improved by employing a specially blazed concave grating which showed high reflectance but low scattered light, (b) the 1P21 photomultiplier was replaced by a EMI 6262 tube, and (c) the slit width was reduced from 50 micron to 8 micron. Thus, now it is possible to resolve some rotational structures in molecular spectra and to determine the ionization potential of various molecules to within about 0.002 electron volt.

JOSEPH R. MOTTL AND
K. WATANABE
Department of Physics
University of Hawaii
Honolulu, Hawaii

16. Absorption Coefficients and Ionization Potentials of Ethylene Oxide

The electronic absorption spectrum of ethylene oxide was studied in the spectral range from 1050–1800 A by a photoelectric method. The pressures of the gas sample ranged from 0.049 to 4.41 mm. Hg. Absorption coefficients were determined for approximately 300 wavelengths. Ionization coefficients were obtained by a photoionization method in the range from 1050 to 1190 A.

It was found that the major part of the spectrum may be explained by a Rydberg series converging to 1173.4 A (10.56 ev) which fits the formula $\nu_n = 85225 - R/(n + 0.94)^2$ $n = 2, 3, 4 \ldots$ This series is accompanied by a vibrational companion series converging to 1157.3 A (10.71 ev) fitting the formula $\nu_n = 8647 - R/(n + 0.94)^2$ $n = 2, 3, 4 \ldots$ The convergence limits agree quite well with the ionization potentials obtained by photoionization (10.56 and 10.70 ev). Our results, however, do not confirm the value of 10.81 ev reported by Liu and Duncan.

The separation of each member of the series and its vibrational counterpart, and the separation of the two observed ionization potentials are consistent with the infrared vibrational frequency of 1151 cm.[1] which is reported by Herzberg as being a bending or rocking motion of a CH_2 group.

In addition to the discrete part of the spectrum, there appears to be two or more continua underlying the bands extending from about 1600 A to 1050 A. These may be interpreted as being due to repulsive electronic states of the molecule leading to dissociation.

AUSTIN LOWREY AND
K. WATANABE
Department of Physics
University of Hawaii
Honolulu, Hawaii

17. Variations in the Occurrence and Abundance of Skipjack in Hawaiian Waters

The skipjack, *Katsuwonus pelamis,* supports an important fishery in Hawaiian waters. Between 1948 and 1955 the annual landings in the Hawaiian Islands fluctuated between 7 and 14 million pounds. A cooperative program was initiated in 1955 to determine the relationship between environmental changes in the waters around Oahu and fluctuations in the fishery in the same area. Two major problems were considered: (1) What environmental factors are associated with the seasonal occurrence of skipjack in

Hawaiian waters, and (2) what environmental factors influence the distribution of skipjack when they are present in Hawaiian waters. Environmental factors considered important in this study were water temperature, salinity, phosphates, currents, and zooplankton. The area of study extended 20 miles offshore around Oahu, except on the north and west, where the area was extended to 40 miles offshore.

The cooperating organizations, and the areas from which they collected data were as follows: (1) Pacific Oceanic Fishery Investigations, detailed environmental surveys encircling Oahu and monitoring surveys at monthly intervals to the north and west of Oahu; (2) Territory of Hawaii Division of Fish and Game, monitoring surveys at monthly intervals to the west of Oahu; (3) University of Hawaii Marine Laboratory, monitoring surveys at bi-weekly intervals to the east of Oahu; (4) commercial fishermen of Oahu, who turned in reports of their skipjack catches to the Division of Fish and Game throughout the year.

By May 1956 data from one survey in November 1955 had been partially analyzed. These data showed the water northeast of Oahu to be colder and more saline than to the west, and the average November skipjack catches were higher in the warmer, less saline water. Plankton and phosphate data for November did not show significant relationships.

A study of the seasonal occurrence of skipjack in Hawaiian waters involved the use of wind data supplied by another cooperating organization, the United States Weather Bureau. It was found that when there was a high percentage of northeast winds during February to April, the skipjack catch in the subsequent season was low, and when the percentage of such winds was low, the skipjack catch was high. More information concerning the oceanography of the area is needed to explain this wind-skipjack-abundance relationship.

The information needed in studies of this type can be obtained more readily, and more information can be obtained, through the cooperation of several organizations, as described for this program.

KENNETH D. WALDRON
U. S. Fish and Wildlife Service
Honolulu, Hawaii

18. Albacore Migration in the North Pacific as Shown by Tagging Experiments

There are two major albacore fisheries in the North Pacific Ocean; the Japanese winter fishery, which extends from the Japanese coast eastward to the proximity of Midway Island, and the west coast summer fishery of North America, which extends roughly from Queen Charlotte Island to the middle of Baja California. The former is chiefly a longline or subsurface fishery but also involves pole-and-line fishing, especially during the spring. However, it does not extend as far out from the coast as the longlining. Both large and small fish are taken in the winter fishery. Only small fish are taken in the west coast summer fishery, and these by trolling and live bait fishing. Pacific Oceanic Fishery Investigations, or POFI, of the Fish and Wildlife Service has been conducting albacore surveys in the intervening area between these two fisheries.

According to the data available to us at the present time, it appears that the migration of albacore through these fisheries is roughly as follows: In the spring the winter fishery off Japan breaks up and a segment, composed of small fish (below 90 cm. in length), moves east across the North Pacific reaching lower California and Baja California in commercial numbers by June. They then move up the coast providing a commercial fishery in Canadian waters during the fall. By late fall they are moving back across the ocean toward the Japanese winter fishery, a movement perhaps begun in the late summer. By early winter the Japanese fishery is again in production.

To ascertain this migration POFI and other organizations, chiefly Division of Fish and Game, California, have been carrying out tagging programs which have netted some results. Two fish have been tagged and recovered by POFI and five by California Fish and Game. The recoveries suggest that the albacore require about six months to make the North Pacific crossing and perhaps make at least two round trips to the California coast and back during their lifetime.

To attempt to answer these and similarly important questions, POFI has initiated a cooperative tagging program with the Japanese, who will tag fish in the spring fishery. In addition, cooperative programs will be initiated by POFI with other U. S. Fish and Wildlife and Canadian agencies, who will carry out tagging of albacore in conjunction with their salmon investigations in the northeastern Pacific.

JOSEPH J. GRAHAM
Fishery Research Biologist
U. S. Fish and Wildlife Service
Honolulu, Hawaii

19. Important Factors Relative to the Production of a Safe Poliomyelitis Vaccine

The primary objectives in the production of the poliomyelitis vaccine are that it be safe and that it be antigenically potent.

Poliomyelitis virus is of three types which have very definite physical, chemical, and immunological characteristics. Antigenicity and pathogenicity are not related characteristics.

Poliomyelitis virus is used in the manufacture of the vaccine. These are treated with chemical agents (primarily formaldehyde) or irradiated with ultra violet to decrease pathogenicity, but retaining their antigenic properties.

Tissue culture methods are used for testing safety as well as antigenic activity.

Types of inactivation methods are discussed as well as factors bearing on the success of the inactivation process.

Testing procedures in use include the use of tissue culture and cortisonized monkeys.

There has not been a single case of poliomyelitis following inoculation with poliomyelitis vaccine since the fall of 1955.

HAROLD M. SEXTON
Straub Clinic
Honolulu, Hawaii

20. Biochemical Paths to the Infinitesimal
Presidential Address, 1956

Modern biochemistry has moved into the study of ultra micro constituents of the cell, such as vitamins, hormones, enzymes, and trace minerals. Almost infinitesimal amounts of these materials may serve as keys to metabolism. For example, the eye contains less than a millionth of a gram of the vitamin derivative necessary for vision in dim light. Blue-green algae require cobalt, but optimal growth is obtained from cobalt (in the form of vitamin B_{12}) to the extent of only four parts in 10,000 billion parts of water.

One important new technique that has revealed these traces is paper chromatography, discovered in 1944 and recognized with the Nobel prize in 1952. The method is simple, rapid, micro, and inexpensive. Its principle utilizes the differential migration of different compounds in an extract when applied to filter paper and subjected to wicking of a solvent. Very closely related compounds can be separated on the filter paper strips by choice of suitable solvent mixtures. The technique has replaced earlier crude methods for the separation and identification of amino acids. Additional simple measurements make the method semi-quantitative. Biochemists now have adapted the procedure to the study of almost every conceivable type of chemical found in natural products.

Radioactive tracers have offered another new technique for the biochemist to study trace constituents. Energy release from a radioactive molecule can easily be detected to one part in one million billion, enabling the biochemist to trace ultra-minute quantities of materials tagged with isotopes. This technique has provided the answer to why systemic insecticides work on some plants but not on pineapple, has proved the efficiency of feeding the plant nutrients through the leaf, and has enabled one to trace the minute secretions of a few mealy bugs feeding on the pineapple leaf down through the plant and into the roots.

Microbiological assay methods provide another simple path to probe the minute. A micro-organism requiring a particular nutrient for growth can be used for its assay. One need only determine the extent of growth in a basal medium deficient only in the particular nutrient and to which is added known amounts of the extract to be assayed. Turbidity or acidity may be a simple measure of growth, and growth is proportional to the amount of nutrient. The method allows quantitative determination of vitamins at extreme dilutions—for example, biotin in a concentration of one part in 100 billion.

These methods are all fairly new, are broadly applicable, and have contributed to the rapid progress of biochemistry in recent years. The future holds a fascinating view as scientists travel these pathways to the infinitesimal.

WILLIS A. GORTNER
Pineapple Research Institute
Honolulu, Hawaii

NECROLOGY

FRANK G. HINMAN

While hiking with the Oahu Trail and Mountain Club on November 27, 1955, Frank G. Hinman, member of the Academy since the spring of 1950, and Research Entomologist at the U. S. Department of Agriculture's Fruit Fly Laboratory in Honolulu, fell 150 feet to his death. A portion of the trail along a ridge near the Crouching Lion at Kahana Bay gave way and there was nothing he could reach to save himself.

Mr. Hinman was born in Bozeman, Montana, December 9, 1907. After graduating from Montana State College in 1929 he obtained his Master's degree at Washington State College in 1930. Mr. Hinman entered the federal entomological service at Wenatchee, Washington in 1931. Except for a period of active duty with the Army in World War II, Mr. Hinman was continuously engaged in pea weevil investigations from 1932 to 1948 with headquarters at Corvallis, Oregon until 1934 and then at Moscow, Idaho. He was transferred to the U. S. Department of Agriculture Fruit Fly Laboratory in Honolulu in 1948, his affiliation at the time of his death.

Mr. Hinman served overseas with the 7th Field Hospital from 1942 to 1945 as a dental technician. This field hospital was awarded a unit citation for meritorious service in Normandy, northern France, Rhineland, and central Europe.

At the time of his death Mr. Hinman was engaged in fruit fly commodity treatment studies, paying special attention to fumigant screening and application of fumigant materials to fruit fly-infested commodities in aqueous dips. Well read and possessor of broad scientific interests, last summer he visited laboratories in Europe, Canada, and eastern United

States, where ionizing irradiation is being investigated as a food sterilization method, to gather ideas that might be beneficial in his commodity treatment investigations in Hawaii. Mr. Hinman was the author, or collaborated in authorship, of a number of articles on the pea weevil, oriental fruit fly, and fumigation which appeared from 1932 to 1953.

Although quiet and unassuming, Frank Hinman made many close friends in his profession and outside of it. Capable, cooperative, and conscientious in his research, he was a good companion, and loyal friend.

WALTER ELDRED SYKES

Walter Eldred Sykes was assigned to Hawaii as Territorial Conservationist by the Soil Conservation Service, U. S. Department of Agriculture, in October of 1946. His duties were to reestablish the services of this important branch of the federal government, providing Hawaii, thru its legislature, enacted a legal framework for the creation of self-governing Soil Conservation Districts. It was only thru his unobtrusive but forthright explanation of the operation of the national program in the 48 states that some local resistance was overcome and Act 191 was passed by the legislature in 1947. During the next seven years he assisted with the formation of 13 Soil Conservation Districts which covered nearly 2,300,000 acres of Hawaii's agricultural lands. He worked assiduously to increase the staff of technicians and agricultural scientists to give full service to the ranches and farms in this rapidly increasing program of soil conservation and management. At the time of his transfer to California in 1954 a technical service of great value to Hawaii's land resources was in full operation.

Walter Sykes was born at Brent Harbor, Michigan on February 7, 1900. He obtained his B.S. degree from the University of Southern California in 1924 and a M.B.A. degree in commerce from the same institution in 1925. He joined the Soil Conservation Service in 1935 and during his first years was business office manager for the Service in the state of California and then Washington. With his assignment to Hawaii he became closely associated with the technical phases of soil conservation field work.

During his years in Hawaii he was an active member of the Hawaiian Academy of Science and helped in the formation of the Conservation Council of Hawaii. He entered all projects in a spirit of friendly cooperation.

Mr. Sykes died in California on September 11, 1955.

GEORGE CURTIS WALLACE

George C. Wallace who died in Madrid, Spain, on November 27, 1955, will long be remembered for the energetic and inspiring leadership which he applied to Honolulu's great post-World War II sewer construction program which will be recorded as one of the greatest public works achievements in the modernization of the city.

Mr. Wallace was born in Ohio, October 13, 1906, received his early education there in the Bedford school system, and graduated with a Bachelor of Science degree in Civil Engineering from Cornell in 1931.

For the next ten years he was resident engineer on many sewer and water projects (his specialty during college years) and in 1936–1937 he took a post graduate course in design at Stevens Institute of Technology.

From October 1942 until September 1945 Mr. Wallace served as a civil engineer officer in the "Seabees" of the Navy. Assignments gave him wide experience in design and construction at Maui, Guam, Saipan, and Tinian.

After the war he was employed by Austin and Towill, consulting engineers, in the design of sewer and water systems for the City and County of Honolulu and, in May 1947 he was appointed engineer in charge of the Division of Sewers of the City and County.

He resigned in July 1954 to accept a position with Metcalf and Eddy, consulting engineers of Boston, working on world-wide assignments. At the time of his death he had just been designated chief civil engineer of a group organized by Metcalf and Eddy and other consultants to design and direct vast air base construction in Spain under the U. S. Navy for the U. S. Air Force.

Mr. Wallace introduced thorough in-service courses for junior engineers in the City and County government and he also gave unsparingly of his time in many community projects particularly in the Civil Defense Program. A varsity football and lacrosse player at Cornell, he did a great deal to inspire athletic programs in Honolulu.

His other activities included the organization of Construction Battalion units in the Naval Reserve in which he was Commander. He was a past president of Hawaii Section, American Society of Civil Engineers, a member of Sigma Alpha Epsilon and an enthusiastic worker in many other organizations.

MEMBERSHIP

MAY, 1956

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*Akamine, Ernest K.
Akamine, Ralph Norio
Akers, Ernestine
Albee, William
Aldrich, W. W.
Alexander, Henry Arthur
Alexander, W. P.
**Alicata, J. E.
Allison, Samuel D.
Amioka, Shiro
**Anderson, Earl J.
Anderson, Eleanor S.
Aona, Jr., Francis K.
Apple, Russell A.
Applegate, T. S.
Appleton, Vivia B.
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Arakaki, Harry Y.
Arkoff, Abe
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**Atherton, J. Ballard
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†Baldwin, Robert I.
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Bartz, Ellwood L.
**Baver, L. D.
*Beardsley, John Wyman, Jr.
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*Bowers, Neal M.
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**Carter, Walter
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Christenson, Leroy D.
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Chun, Sing K.
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*Cushing, Robert L.
†Custer, Charles C.

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*Davis, Dan A.
Davis, Walter E.
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Defibaugh, Betty Lou
Degener, Otto
*Deibert, Austin V.
Denison, Harry L.
Digman, John
Doi, Mitsugi
*Dole, Arthur A.
**Doty, Maxwell S.
Doty, R. E.
Dow, Alfred J., Jr.
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Duncan, Richard A.

*†Eaton, Jerry P.
Eber, Laurence
**Edmondson, C. H.
*Edwards, Donald K.
Eguchi, George
Ehret, William F.
*Ekern, Paul C.
*Eller, Willard H.
Emery, Byron E.
Emory, Kenneth P.
*Emory, Tiare
*Enright, James R.

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Fankhouser, Adolph
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Feldwisch, W. F.
Felton, George
Fennel, E. A.
Finch, Ruy H.
*Fine, Jules
Fong, Albert C.
Fong, Francis
*Forbes, Fritz W.
*Forbes, John C.
**Forbes, Theodore W.
**Fosberg, F. R.
Foster, Zera C.
Fox, Roy L.
Frodyma, Michael M.
Fryer, Elwood B.
Fryer, Eunice
Fujimoto, Giichi
*Fukuda, Mitsuno
*Fukunaga, Edward T.
Fullaway, D. T.
Furumoto, Augustine

Gaston, John Zell
Gaylord, Donald
*Gilbert, Fred I.
*Ginn, George W.
Girolami, Guido
Glasgow, James H.
Godfrey, Mary Lynne
**Gortner, Willis A.

* Member, American Association for the Advancement of Science.
** Fellow, A.A.A.S.
† Member, Hawaii Division, H.A.S.

Gosline, W. A.
Gould, Davis
**Gowing, Donald P.
Greenland, Thomas C.
†Greenwell, Amy
Gregory, Christopher
**Gressitt, J. Linsley
Guillard, Robert

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*Halpern, Gilbert M.
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Hamilton, Roland K.
**Hamre, Christopher
Hance, John
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*Hansen, Violet
Hanson, Noel S.
*Harada, M. B.
**Hardy, D. Elmo
Hargrave, Vernon E.
Harris, Anna E.
Harry, J. V.
Hart, William E.
**Hartt, Constance E.
Hartwell, Alfred S.
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Hawkes, M. F.
*Hayashi, Chisato
**Heinicke, Ralph M.
*Helfrich, Philip
Henke, Louis A.
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Herschler, Louis H.
*Hewitt, Loren
**Hiatt, Robert Worth
Hieronymus, A. M.
Hilton, H. Wayne
*Hind, Robert L., Jr.
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Holladay, Natalie
Holmes, Wilfred J.
Holmes, William John
**Hosaka, Edward Y.
**Hosoi, Hiyoshi
Howe, Guy L., Jr.
*Hsiao, Sidney C.
Hu, Stephen M. K.
*Hudson, Loring G.
**Humbert, Roger P.
†Hutchison, Frieda May

Ihrig, Judson L.
Ikeda, Warren
Ikehara, Isaac I.
†Inouye, Morris Hiroshi
Ishii, Mamoru
*Ito, Kiyoshi
*Iversen, Robert T. B.
Iverson, Edwin S.
Iwanaga, Isaac I.
†Iwane, John Y.

Jackson, Dean C.
†Jacobson, Jettie
Jermann, Fred
Johnson, David
Johnson, Evelyne
Johnston, Elizabeth E.
Jones, Everet C.
Jones, Thomas A.
Jones, Thomas S.
*Jorgensen, J. Paul
Jorgensen, Margaret K.
Joyce, Charles R.
Judd, Mary Stacey

†Kadota, Shizuto
†Kagehiro, George
†Kamai, Curtis P.
Kamasaki, Hitoshi
**Kamemoto, Haruyuki
Kanehiro, Yoshinori
*Kask, John Laurence
Katsuki, I.
*Kau, Geraldine W.
Kaulukukui, Felice W.
Kawano, Henry
Kay, Alison
*Keawe, Arthur
Keiser, Irving
*Keller, Arthur R.
Kelly, Philip T.
Kent, Martha J.
*Kerns, Kenneth R.
Kimmich, Robert
*Kinch, D. M.
King, Joseph E.
King, Maurice V.
King, Will Norman
Kingsbury, Joe W.
Kiuchi, Marian
*Klemmer, Howard W.
Klinkman, Helena
Knaus, John M.
*Kobayashi, Clifford K.
Koenig, Mary Ann
*Koike, Hideo
Kondo, K. C.
*Kondo, Yoshio
*Kopf, Kenneth
Korshover, Julius
Kortschak, Hugo P.
Koshi, James H.
**Krauss, Beatrice H.
Krauss, F. G.
**Krauss, Noel H.

La Fon, Fred E.
Lam, Margaret M.
Lam, Robert L.
*Lamberton, A. R. H.
Lamoureaux, Charles
Lange, Arthur H.
Larm, Edwin
Larrabee, L. M.
Larsen, Nils P.
Larson, Harry W.
Lau, Howard K. S.
Leak, Howard S.
Lee, Hyun Moo
Lee, Richard K. C.
Lee, Violet Wongwai
**Leeper, Robert W.
Leffingwell, Roy J.
*Lennox, Colin C.
Leong, Kam Choy
Le Sieur, Harold A., Jr.
**Levine, Max
Levine, Melvin L.
Lind, Andrew W.
Lloyd, Mary Lou Rothwell
Lo, Pershing S.
**Lohman, Marion L.
†Loo, Mabel N. K.
Look, William C.
†Loucks, Burton J.
†Loucks, Ruth Baker
Louis, James L.
Louis, Lucille
Lum, C. K.
Lum, Theresa W. T.
†Lyman, Clarence
**Lyon, Harold L.
*Lytle, Hugh

McAlister, William C.
MacArthur, Lloyd W.
MacBride, Helen N.
McCleery, Walter L.
**†Macdonald, Gordon A.
McGary, James W.
*McGuire, Donald C.
McGuire, Thomas R. L.
*McKernan, Donald L.
McMorrow, Bernard J.
†McMullen, Betty J.
*Manchester, Curtis A.
**Mangelsdorf, A. J.
Mapes, Marion
Martin, Joseph P.
Martin, Robert T.
Masatsugu, Teruo
**Mason, Leonard
Masuda, Matsuko
Matsumoto, Walter M.
Matthews, Donald C.
Mau, Kong Tong
Meeker, Harvey H., Jr.
**Mees, C. E. K.
Midkiff, Frank E.
Midkiff, John H., Jr.
Middleton, Charles R., III
**Miller, Carey D.
Miller, Harvey A.
*Miller, Robert C.
Milnes, Marjorie B. R.
†Minette, Henri P.
Mink, John F.
†Mitchell, Donald
Mitchell, James
Mitchell, Wallace C.
Miyake, Iwao
Miyasaki, Yuzo
Moe, Clayton R.
Moir, W. W. G.
Momeyer, Kenneth W.
Mordy, Wendell A.
Morgan, Edward J.
Morgan, William A.
Morita, Kiyoichi
Mottl, Joseph R.
*Mumaw, Charles
*Murakishi, Harry H.
Murphy, Garth I.

†Nagao, Wallace T.
Nagasawa, Larry K.
Nakae, Haruko N.

†Nakagawa, Susumu
*Nakamoto, Goichi
*Nakamura, Eugene L.
Nakao, Harry
Nakasone, Henry Y.
*Narikawa, Stanley
Naughton, John J.
**Neal, Marie C.
Newhouse, Jan
Nicholson, James R.
Nickerson, Lydia C.
Nickerson, Thomas
Nishibun, Joe
*Nishida, Toshiyuku
†Nitta, Asako N.
†Noda, James
*Nordfeldt, Sam
Nutter, Ben E.

O'Dea, Katherine
Oguri, Mikihiko
Ohmstede, William D.
*Ohta, Ella Miyeko
*Okubo, Laura
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Orr, Kathryn J.
*Otagaki, Kenneth K.
Otsu, Tamio

*Palafox, A. L.
Palmer, Clarence E.
**Palmer, Harold S.
Parry, H. Dean
**Payne, John H.
**Pemberton, C. E.
Pen, Florence
†Penhallow, Richard
Pinkerton, Forrest J.
**Poole, Charles F.
Porter, Paul H.
Powers, Howard A.
Price, Samuel
Price, Saul
Pyle, Robert L.

†Quaintance, D. C.
†Quaintance, Evelyn

Randall, John E., Jr.
Rea, Jessica L.
**Reber, Grote
Riesenberg, Saul
Rinkel, Murice O.
Ripperton, J. C.
Roberts, Joyce O.
Robinson, William A.
Rockwood, Paul C.
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CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

SCIENCE AND DEMOCRACY[1]

A. J. MANGELSDORF[2]

When our program chairman called several weeks ago to ask me for the title of my paper, I was still somewhat uncertain as to what I might venture to discuss with you. My first concern then was to find a title that would be broad enough to permit some freedom of choice. It has since become increasingly evident to me that the title which I selected gives me too much latitude.

I regret that my acquaintance with science is limited to so narrow a sector, and that even within this narrow sector, it is hardly more than a nodding acquaintance. However, a plant breeder is, or should be, interested in the problems of evolution; as Darwin realized a century ago, we may observe in any effective plant or animal breeding program an accelerated and man-guided epitome of evolution.

With your permission, then, I shall strike out "Science" from our title, and substitute "Evolution." It will then become our task, first, to review some of the aspects of the concept of evolution, second, to glance somewhat hurriedly at our own species in the light of this concept, and third, to enquire whether the concept can help us in appraising certain of the problems of our democracy.

Darwin and Wallace

In 1858, Charles Darwin and Alfred Russell Wallace published their theory of evolution through natural selection, which each had developed quite independently of the other. The mechanism which they envisioned as accounting for the origin of different species from a common ancestry was simple and direct. Living organisms vary and some of these variations are heritable. A given variation may be beneficial in one environment, but not in another. Those variations which favor survival and reproduction will increase in frequency while the "less-improved" forms will tend to be eliminated. Thus through the sifting action of natural selection, the population will gradually become better adapted to its environment. Thus too, through geologic time, new species will develop from pre-existing species.

The searching scrutiny which this simple concept has undergone during the past ninety-nine years has served to establish its soundness.

Throughout his lifelong study of evolution, Darwin was keenly aware of the ignorance of his time in matters of heredity. In "The Origin of Species" he writes, "The laws governing inheritance are quite unknown; no one can say why the same peculiarity in different individuals of the same species and in individuals of different species is sometimes inherited and sometimes not so; nor why the child often reverts in certain characters to its grandfather or grandmother or other much more remote ancestor."

Gregor Mendel

Even as Darwin was deploring the prevailing state of ignorance, the kindly, patient priest, Gregor Mendel was at work on the problem. In the monastery garden at Brünn in Austria, he grew generation after generation of garden peas from crosses painstakingly executed with his own hands. In 1866 he published his findings, the simple rules of segregation and recombination that were destined to provide the foundations of a new science.

Mendel knew of Darwin's work. It was Darwin's misfortune, and the world's, that no one during Mendel's lifetime grasped the significance of his discoveries. It was not until 1900, sixteen years after Mendel's death, that three European biologists, Correns, Tschermak and de Vries, working independently, found in Mendel's paper the explanation of their own breeding data.

Once the door had thus been thrown open, the new science of genetics developed rapidly. Morgan and his associates found the fruit fly, *Drosophila melanogaster*, to be an excellent species for laboratory breeding. Their brilliant work, together with the contributions of hundreds of other investigators working with many forms of plants and animals, including man, have confirmed and extended Mendel's findings.

Genetics and Evolution

Let us now list some of the facts of genetics that bear upon the concept of evolution through natural selection:

1. Heritable traits are transmitted from parents to offspring through particulate units which we now call genes.

2. Each gene is situated at a definite locus on a particular chromosome.

3. Fertilization involves the union of a maternal and a paternal germ cell. All cells derived by cell division from a fertilized egg contain two sets of chromosomes, one set from each parent. Each gene in each of the chromosomes contributed by the mother thus has an homologous but not necessarily identical mate, its allele, in a corresponding chromosome contributed by the father.

4. When sexually mature, the individual will produce germ cells of its own through a process called meiosis or reduction division, as a result of which

[1]Delivered at Final Session, April 27, 1957.

[2]Experiment Station, HSPA.

the germ cell, egg or sperm, receives only a haploid number of chromosomes, that is to say only one member of each chromosome pair. A haploid egg fertilized by a haploid sperm develops into a diploid individual which when sexually mature will in turn produce haploid germ cells.

5. During meiosis, the two members of a pair of chromosomes may exchange genes or groups of genes through a process known as "crossing-over."

6. Genes are transmitted intact from parent to offspring. The two alleles of a pair of genes, however different from each other, and even though maintained in hybrid combination with each other for many generations, maintain their integrity; neither becomes "contaminated" by its mate.

7. Since a haploid germ cell receives only one member of each pair of genes, it follows that a parent transmits to each of its offspring only a randomly sampled half of its own inheritance, subject, however, to the restriction that each such sample, each normal germ cell, must contain one member of each pair of genes.

These basic rules of heredity have been found to prevail among all sexually-reproducing forms of plants and animals thus far investigated. They are equally valid for maize, for mice, and for man. We can imagine with what satisfaction Darwin and Wallace would have welcomed this evidence in support of their belief in the kinship of all forms of life.

Sex and Evolution

The success of sex in the scheme of things may be deduced from its ubiquity among both plants and animals. The secret of its success apparently lies in the prosaic fact that it is effective in providing the genetic diversity that is needed for evolutionary progress. As we have seen, germ cell formation entails the segregation and recombination of the genes which an individual has received from his parents. The union of two such germ cells produces new combinations of genes for the sieve of natural selection.

An example may help us to appreciate the efficacy of sexual reproduction in providing new gene combinations. Two alleles at each of ten loci afford opportunity for the formation of 2^{10} or 1024 different kinds of gametes. The various possible combinations among 1024 kinds of gametes would yield 3^{10} or 59,049 different kinds of offspring. If we add one new mutation to the population we will have 11 heterozygous loci instead of the original ten. The number of possible kinds of gametes now becomes 2^{11} or 2048, and the number of possible kinds of offspring becomes 3^{11} or 177,147. Thus we see that the addition of each new pair of alleles triples the number of possible genotypes.

Vast Achievements—Endless Frontiers

During the past half century, geneticists have studied the mode of inheritance of thousands of genes in hundreds of species of plants and animals, genes affecting a broad spectrum of anatomical, physiological and mental differences. They have "mapped" many of these genes, that is to say, they have ascertained, by breeding tests, the position of the genes on their respective chromosomes relative to other genes on the same chromosome.

The pioneers in this new science were quick to appreciate the need for distinguishing between the genetic and the environmental components of variation. They also learned early that while some traits, such as blood groups in man, are wholly gene-determined and thus unaffected by environment, other traits, such as skin color, can readily be modified by environmental differences. In no instance has convincing evidence been found in support of the belief recently revived in Russia, but long outmoded elsewhere, that environmentally induced effects can be transmitted from parent to offspring. So far as we know, acquired characters are not inherited.

While we still have much to learn about the riddle of differentiation, and about the biochemical processes by which genes exert their effects, good progress is being made in this field. We are still in the dark, however, as to the physical and chemical differences between a mutant gene and its normal allele.

We still have much to learn also about the genesis of the naturally occurring mutations upon which natural selection acts to promote evolutionary progress. In 1927 Muller, working with fruit flies, and Stadler, with barley, demonstrated that irradiation with X-rays could induce a many-fold increase in mutation rate. Ultraviolet light, gamma rays, neutrons, chemicals such as mustard gas, and even high temperatures approaching lethality have since been found to increase mutation rates in a wide diversity of organisms ranging from bacteria to mice. The mutations thus induced comprise a multiplicity of effects suggestive of randomness, but it is still uncertain whether these artificially induced mutations are quite analogous with those which appear in nature without human intervention, and which provide the variations that contribute to evolutionary progress. The crucial problems in genetics today are those concerned with the nature of the gene and with the phenomenon of mutation.

Beginnings of Organic Evolution

We have now examined rather sketchily the mechanism by which heritable traits are transmitted from one generation to the next. But how did life originate?

In contrast with the credulity of our forefathers who apparently had little difficulty in accepting the idea of spontaneous generation of living organisms as a natural concomitant of fermentation and putrefaction, many of us today labor under an extreme skepticism which recoils from the suggestion that life could have come into being as a result of chance chemical reactions among nonliving organic compounds.

We are indebted to Muller and to Beadle for tentative sketches of the early stages of organic evolution. It is postulated that before life began, the earth's atmosphere was rich in methane, ammonia, water vapor and hydrogen, which under the impact of electrical discharges and other sources of energy could yield amino acids and other complex molecules. In the absence of living organisms to destroy them, these organic compounds would slowly accumulate. Among the countless chemical reactions that would occur under such conditions, a fortuitous sequence is presumed to have led to the formation of a nucleo-protein molecule possessing two unique traits: (1) the ability to synthesize replicas of itself from simpler compounds in the surrounding medium, and (2) the capacity to undergo changes in the details of its chemical structure while retaining its ability to reproduce. Such a nucleo-protein molecule would be, in essence, a free-living gene. The primitive viruses of today lend credence to such an hypothesis.

Some of the spontaneous mutations arising from accidental changes in the chemical configuration of our free-living gene would surely be deleterious or even fatal. Occasionally, however, random mutation might lead to improvement in the ability of the gene to produce replicas of itself from the unorganized materials in its environment, thus conferring a reproductive advantage.

It appears that nucleic acids do in fact exhibit the two properties which a heredity-bearing material must possess, namely self-duplication and mutability. Moreover, the investigations of Watson and Crick suggest that the molecular structure of desoxyribonucleic acid, found in the chromosomes of all of the higher plants and animals thus far examined, is that of a double helix of great length. This would be consonant with the findings of geneticists that throughout the plant and animal kingdoms a linear configuration of genes on the chromosomes is the prevailing and perhaps the universal pattern.

Aggregation of several or more free-living genes together with subsequent mutation would provide variation upon which the sieve of natural selection could act. Beadle speculates that the course of evolution from a single free-living gene to organisms as complex as the single-celled green algae may have required a thousand million years or more.

Once the cell stage was reached, a bifurcation in the line of descent provided two branches leading to what we know today as plants and animals. Members of the plant line became increasingly competent in their utilization of simple compounds and even certain elements as building blocks in the self-replicating process. Members of the animal line became increasingly mobile, increasingly predatory, and increasingly dependent upon plants as sources of building materials for their own self-replication.

A salient feature in the evolution of the animal line is to be found in the increasing complexity of the system of tissues which we call the nervous system, a development which reaches its culmination in the brain of man.

A Working Hypothesis

We may object that natural selection acting as a sieve upon spontaneous and random mutation is much too simple and crude a mechanism to explain the evolution of such a fearful and wonderful creation as the human species. In wrestling with our skepticism, we may remind ourselves of R. A. Fisher's observation that natural selection is an effective mechanism for generating a high degree of improbability. We may remind ourselves also that a scientific "law" lays no claim to finality. It is no more than a tentative formulation based upon available evidence, to be revised if and when new evidence warrants revision.

Whatever the shortcomings of the natural selection concept, a more acceptable alternative has yet to be devised. Meanwhile, the Darwin-Wallace concept affords a stimulating hypothesis in the light of which an erstwhile state of confusion in the life sciences is giving way to a rational order.

Man a Culture-amassing Animal

By what route did our own species arrive at its present state of development? Like all other living organisms, man is presumably the result of natural selection acting upon the heritable variations which mutation has produced from time to time. Man's basic physiology is strikingly like that of other mammals; like them he experiences hunger and thirst, pain and pleasure. But we are especially curious as to how man differs from his nearest relatives in mental endowment. We learn from studies in comparative psychology that the differences are differences of degree rather than of kind. Other animals are endowed with curiosity, but man's curiosity ranges further, and with greater persistence. Like other animals, man is endowed with inherited instincts, but he is less rigidly bound by his instincts; his behavioral responses thus enjoy greater plasticity. Other animals can communicate with their fellows, but none can approach man in wealth of vocabulary. Other animals are endowed with memory, and can thus profit from experience. Man is endowed with a prodigious memory; moreover, he can reinforce his memory by utilizing symbols to record his thoughts. He is thereby enabled to profit, not only from his own thoughts and experiences, but also from the thoughts and experiences of others. Other animals teach their young; man teaches teachers to teach his young. The anthropoid apes make purposeful use of tools in pursuing their urges, but in comparison with man, their tool-using abilities are rudimentary. Man's tool-making and tool-using abilities are today developing at a prodigious rate, while those of other animals show little if any improvement from one generation to the next.

This brings us to the crucial difference between man and other animals. Man's phenotype, his individuality, is the resultant of the multifold interactions of his genotype with his environment. Like other animals, man inherits his genotype from his ancestors. In addition, however, man inherits from his ancestors and conveys to his offspring, the wealth of tools, products, techniques and concepts which issue from the practice of his arts, his sciences, his daily living, all of which we lump together under the term "culture." It is his capacity to acquire and transmit culture that makes man a unique animal.

Man still has far to go in perfecting the earliest and proudest of his cultural innovations, the use of words as symbols to express his thoughts. How ludicrously, how tragically do we confuse ourselves and each other with the ambiguity of our symbols.

The word "culture" is a case in point. To the social anthropologist, culture means the sum-total of all that a society practices, produces and believes. To the social dowager, culture is what her hated rival lacks. Perhaps we should stipulate that throughout this discussion the term "culture" is intended to convey the social* anthropologist's and not the social* dowager's meaning of the symbol.

Man's biological evolution proceeds so slowly as to be scarcely perceptible. From this we may deduce that man's genotype differs but little from that of his ancestors of a thousand years ago. His cultural evolution, however, is proceeding at an ever-accelerating rate. Even in its primitive beginnings man's culture helped him to modify his environment and to compensate for some of his biological limitations. Like the wings of a bird, culture became for man an aid to survival. Without the support of his culture, he could never have attained his present numbers nor his world-wide distribution.

Since man's capacity to survive depends not only upon his genotype, but also upon his culture, it follows that the evolution of cultures must likewise be subject to natural selection. A cultural innovation that can contribute to the survival of the group will, in the long run, persist and spread. All others are doomed to ultimate extinction.

Impending Doom?

We are fated, it seems, to live our lives in a sequence of crises. On the one hand we are told that our surface soil and other natural resources are being rapidly dissipated, while the world's population is increasing at the rate of 30 million annually. We may well be alarmed at a rate of increase which each year amounts to more than fifty times the total population of these Islands. Concern over the population crisis finds expression in a flood of Neo-Malthusian books and articles under such titles as "Standing Room Only," "Prevalence of People," "Human Fertility" and "Mankind at the Crossroads."

On the other hand there are those who see the human species on the brink of suicide by way of nuclear warfare. Woe is us, for we are indeed undone when we are obliged to contemplate two such seemingly contradictory crises at the same moment. Unhappily for our peace of mind, the two are not quite mutually exclusive. The stresses that result from mounting population pressures have in the past predisposed mankind to warfare and they may do so again. While even all-out nuclear warfare could hardly destroy the whole of mankind, it would surely devastate his cultural resources. As a corollary to this threat of nuclear warfare, we face the possibility that radioactive fall-out may raise the human mutation rate to a burdensome level. Even more ominous, perhaps, is the threat inherent in the capacity which viruses, bacteria and other potential plant, animal and human pathogens possess for rapid multiplication of more virulent mutants. Such organisms are admirably equipped to exploit the increased mutation rates that would result from increased radioactivity.

*We see in these two uses of the term "social" another example of ambiguous symbolism.

The Cold War

We see the world dividing itself into two hostile ideological camps, each competing for the allegiance of the uncommitted remainder. We see our own camp, the so-called free world, as righteous and honorable, and our adversaries, the dictatorships, as evil and corrupt. It disturbs us to find that the uncommitted nations do not regard us with unqualified admiration nor our adversaries with complete distaste. Rather they appear to see the two camps as differing in shades of grey. In all candor, we should have to admit that intolerance, witch-hunting and corruption are not peculiar to the dictatorships alone. Perhaps we should be devoting less effort to advertising our virtues and more to correcting our shortcomings.

Surely, however, an objective observer would have to concede that the two ideologies differ substantially in viewpoint and emphasis. Unless we are grossly misinformed, the present Communist dictatorship, in spite of its gestures toward relaxation, would make the military government which these Islands experienced during World War II seem liberal by comparison.

The Communist dictatorship has been guilty of many errors, but indifference to science and technology is not among them. It is obvious that the Communists recognize full well the potentialities of research as a tool for expanding their economy and strengthening their military power. In exploiting this tool, a dictatorship has certain advantages. It can take steps to select from among its younger generation those who are most highly gifted. On the basis of aptitude evaluations, it can direct those whom it selects into fields of study of its own choosing. It can take steps to ensure that those of its young people who are best qualified to benefit will receive advanced training in their respective disciplines. The Russian oligarchy is said to be pursuing just such a course, and to good effect. We could take satisfaction in the remarkable progress which Russia is making in training its youth for careers in science and technology were it not for the announced determination of the Communist leadership to impose its way of life upon the rest of us.

Evolutionary Implications of Freedom

What can we learn from evolution that may help us to see our world in truer perspective? H. B. Phillips, emeritus professor of physics at M.I.T., in his paper "On the Nature of Progress" has this to say. "Progress is the greatest thing there is; progress is going forward. Yet there is serious doubt whether the way forward is known, and doubt even whether beyond a very brief interval any forward direction is determinate. What should be done about it?

"This is not a new problem. Nature faced this problem millions of years ago, when it involved the improvement of the species. The mechanism used was mutation and cross-fertilization, and the problem was to utilize these processes to develop the best product. Nature solved the problem by leaving both processes to chance. If there had been a better way it seems certain that some species would have found it and used it for its own benefit. The fact that after millions of years this remains nature's way is strong evidence that there is no better way.

"Translated into the realm of human affairs this means that progress is made by trial and error. In any process of trial and error the probability of a favorable result is proportional to the number of trials. If we would find the conditions most favorable to progress, the conditions under which the greatest number of things will be tried should be sought. The advances of which I am speaking are all mental. Such advances will be most frequent when the number of independent thought centers is greatest, and the number of thought centers will be greatest when there is maximum individual liberty. Thus it appears that maximum liberty is the condition most favorable to progress.

"Throughout history orators and poets have extolled liberty, but no one has told us why liberty is so important. Our attitude toward such matters should depend on whether we consider civilization as fixed or as advancing. In a fixed society there ought to be best methods of doing things. Experts should be more capable of finding these methods than ordinary people, and, for the good of all the people, these methods should be put into effect by collective action. In such a society the practical problem is to obtain the best rulers; there is no need for individual liberty.

"In an advancing society, however, any restriction on liberty reduces the number of things tried and so reduces the rate of progress. In such a society freedom of action is granted to the individual, not because it gives him greater satisfaction but because if allowed to go his own way he will, on the average, serve the rest of us better than under any orders we know how to give."

Had Professor Phillips chosen to enlarge upon this view, he might have pointed out that progress is a function not only of the number of independent thought centers but also of the communications climate, whether conducive or not to the cross-fertilization of ideas. The dependence of progress upon freedom of expression is self-evident.

Our instinctive craving for freedom of action and freedom of expression may well stem from the importance of these freedoms for the survival of the species. From the viewpoint of evolution, the ultimate criterion of progress is enhanced ability to survive and reproduce. The world's population statistics bear witness to the survival value of cultural progress. If freedom conduces to cultural progress, it follows that freedom conduces to survival.

We may paraphrase Professor Phillips' conclusions by saying that on familiar terrain a totalitarian state may operate to advantage. It may for example, teach its young effectively and it may apply standardized production techniques efficiently. However, in an atmosphere of fear the pioneering spirit in science can hardly be expected to flourish.

In Conclusion

Let us now list such observations and deductions as we may be able to derive from our rather sketchy survey of the evolutionary history of our species.

In the face of a threatening future, we may find reassurance in recalling that we represent a line of descent which goes back to the very beginning of life, a line which has survived the vicissitudes of this planet for more than a thousand million years, and which is apparently well-equipped with fortitude, adaptability and intelligence with which to meet the problems of survival as they arise.

Now that Darwin and Wallace have taught us what to look for, we can see evolution in action on every hand. We see new and more virulent races of rust attacking erstwhile resistant varieties of wheat. We see insects developing resistance to insecticides, or more precisely, we see insecticides acting as a sieve to eliminate susceptible individuals while permitting those which are more resistant to survive and multiply. We see the principle of "survival of the fittest" operating to develop herbicide-resistant strains of weeds, and antibiotic-resistant strains of bacteria.

We learn from our study of evolution that progress is fostered by freedom, freedom not only to agree but also to dissent, freedom to defend unorthodox views without fear of reprisal, freedom for criticism to move upward as well as downward, freedom for those who are best qualified to rise to the top in every sector of the economy, freedom for trial and error; in a word, freedom for natural selection to operate.

Evolution teaches us also the advantages of diversity. A society consisting entirely of Einsteins would soon flounder. In a highly technological society such as ours, many kinds of aptitudes are needed. Undue pressure toward conformity discourages innovation and impedes progress.

For future progress in science we must look to those of our young people who are endowed with intelligence, imagination, curiosity and the urge to explore and experiment. The survival of our democracy may depend upon our effectiveness in identifying those who possess these gifts and in providing them with a favorable intellectual climate in which to exercise their talents for the benefit of all.

We can begin to understand the crucial role which our system of education has to play in the transmission of our culture. In the rural life of a few generations ago, children absorbed the culture of their times by participating in the activities of their elders. Our youth are now being deprived of such participation by child labor laws and by urbanization. Not only is our culture becoming more complex, but we are tending more and more to delegate its transmission to the teaching profession. We are now confronted with the possibility that a shortage of competent teachers may impose a bottleneck upon the future progress of our culture.

In closing, let us ask ourselves how the Academy can most effectively serve science and the community.

It can invite to membership and encourage the active participation of all who share its interests and objectives.

It can help the community to understand the extent to which the well-being of our democracy depends upon continued progress in science.

It can help to stimulate an interest in science among our youth, by fostering science clubs and science fairs, by promoting the circulation of science films and science libraries, by aiding in career guidance, and by helping teachers to familiarize themselves with special fields of science.

I am confident that an alert and dedicated membership will respond to the challenge which the growing responsibilities of science will place before it in the years ahead.

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ANNUAL REPORT 1956-57

The Hawaiian Academy of Science ended its thirty-first year with a membership of 566. The election of 34 new members in May 1956, 127 in November 1956, and 106 in February 1957, and the reinstatement of 4 old members, together with losses of 18 through non-payment of dues, 15 by resignations, and 4 by death, have brought the membership to 800 as of the end of this thirty-second year. Already 24 members have been elected by the Council for the thirty-third year.

We record with regret the names of those lost by death:

Ruy Finch	James W. Glover
Zera C. Foster	Fred Ohrt

The net increase in membership by 234 is by far the largest in the history of the Academy. Continued growth of the membership has made possible the retention of a $1.00 per year dues rate of thirty-one years' standing, by reducing unit costs. However, the per-member expenses of the Academy in recent years have exceeded the dues rate, and with the rapid increase in membership the slim reserves were threatened, so that the Council has recommended for acceptance at the Final Session a dues rate of $2.00 per year. A new Constitutional provision permits the remission of dues for members over 65.

The Council has also recommended annual rates of $10.00 for individuals and $50.00 for organizations desiring the status of contributors under a newly adopted Constitutional provision. The income from contributions and the margin of the new dues rate over current expenses will permit the Academy to give some financial support to such projects as the proposed Science Fair, for which a special inter-society committee has been organized, and travelling science libraries for schools, which a special committee of the Academy has been instrumental in getting started.

Nominations of new secretaries and treasurers of the Academy have been facilitated by a Constitutional amendment permitting single nominations for those offices.

Doak C. Cox, Secretary

FINANCES

Balance on hand April 24, 1956		
Cash (deposited May 3, 1956)	$ 4.00	
Bank of Hawaii deposits (balance)	759.08	
First Federal Savings & Loan account	518.98	
	$1,282.06	
Less uncashed checks	178.76	
		$1,103.30
Receipts		
Dues	$ 895.00	
Anonymous and named donations, special fund	125.00	
Sale membership list to Chemical Rubber Co.	10.18	
Reprints sold	111.20	
Annual dinner—86 reservations	215.00	
Dividends, First Federal Savings & Loan	17.01	
		$1,373.39
		$2,476.69
Expenditures		
AAAS-HAS research grant	$ 50.00	
Printing of Proceedings (1954–55, 55–56)	723.58	
Printing of programs (3 times)	116.10	
Reprints of abstracts from Proceedings	150.85	
Stationery and office supplies	186.84	
Postage	154.73	
Annual dinner—86 reservations	215.00	
Donation to AAAS Academy Conference	6.00	
Donation to projectionist (meetings)	7.59	
		$1,610.69
		$ 866.00
On hand April 27, 1957		
Cash (deposited April 22 & 24, 1957)	$ 8.00	
Bank of Hawaii deposits (balance)	417.80	
First Federal Savings & Loan account	535.99	
	$ 961.79	
Less uncashed checks	95.79	
		$ 866.00

Comparative status of dues at end of period	April 1957	April 1956
Dues paid in advance	$ 295.00	$ 250.00
Dues in arrears	85.00	138.00

Beatrice Krauss, Treasurer

MEMBERSHIP

During the current year, 257 applicants have been elected to membership. One hundred twenty-seven new members were elected at the fall meeting, 106 at the winter meeting and 24 by action of the Council on March 6 and April 24.

The Membership Committee, acting on suggestions from the Secretary, recommended an increase in membership dues, election of new members by the Council, the establishment of Contributors for the purpose of increasing the income of the Academy for special projects, omission of dues of members of 10 years standing upon reaching retirement, and that no additional classes of membership be established. These recommendations have been adopted. The Committee suggests that a broad membership policy consistent with the objectives of encouragement of scientific interest and endeavor and dissemination of knowledge be maintained.

Membership Committee

E. J. Anderson, Chairman

J. H. Beaumont	Donald Matthews
E. H. Bryan	Saul Price
Jules Fine	Rudolph Wassman III
Fred Gilbert	A. J. Mangelsdorf, ex officio
E. C. Jones	Doak C. Cox, ex officio
Hideo Koike	

AFFILIATION

The H.A.S. Affiliation Committee 1956–57 year has been directed to the launching of a science fair for the Territory of Hawaii. A committee representing eight of the ten scientific societies affiliated with the Hawaiian Academy of Science was designated to work with Dr. Michael Frodyma, of the Hawaii Section of the American Chemical Society, as chairman. Plans are proceeding for the staging of such a fair sometime during 1958.

The Affiliation Committee has been requested by the Council of the Academy to assist in the counselling of high school students throughout the Territory, who may be interested in pursuing careers in science. Further developments in this area await the channelling of requests from the D.P.I. and high school teachers.

During the year, two evening lectures were sponsored jointly by the Academy and one of the Associated Societies.

Ten scientific societies have been affiliated as Associated Societies of the Hawaiian Academy of Science during the past year, their representation on the Affiliation Committee being as follows:

Affiliation Committee

Andrew W. Lind, Chairman

L. J. Rhodes, Amer. Chem. Soc., Hawaii Sec.
Amer. Soc. Agron., Hawaii Chap.
Richard Takasaki, Amer. Statis. Soc., Hawaii Chap.
Robert Lane, Anthrop. Soc. Hawaii
John Beaumont, Paul Weissich — Hawaii. Bot. Soc.
D. Elmo Hardy, Hawaii Ent. Soc.
Saul Price, Geophys. Soc. Hawaii
Homer Benson, Hawaii Med. Assoc.
George F. Harding, Hawaii Psychol. Assoc.
George W. Chu, Society of Sigma Xi
A. J. Mangelsdorf, ex officio; Doak C. Cox, ex officio; Sterling Wortman — Hawaii. Acad. Sci.
L. D. Christenson, ex officio, AAAS Delegate

AAAS REPRESENTATION

The Academy was represented on the Council of the American Association for the Advancement of Science both at a distance and through personal attendance at the New York City AAAS meeting held December 26–30, 1956, inclusive.

At Academy conference meetings major attention was devoted to development of coordinated programs for attracting young people to careers in science. Many of the Academies have successful Junior Scientist programs underway which, in general, are coordinated through the school system. These and science teaching improvement programs, which may include work shops, institutes, grants for research, awards and other recognition by Academies, scholarships or bonuses for taking additional work in science, etc., already appear to be providing tangible results in some areas. In a panel discussion on "What could the Federal government do for the Academies of Science," strong objections to give-away programs were voiced. Doubt was expressed that federal funds would become available for underwriting fundamental operations of Academies or for financing executive secretaries.

At its Council meeting on December 30 the AAAS expressed willingness to assume greater social responsibility for utilization of new facts of nature and use of scientific observations for guiding public decision, than in the past, and to increase its efforts to help solve problems of society raised by recent scientific progress.

The AAAS has reversed its recent stand on grants and these may now be made for any research need but the preference is still for their application at the high school or junior college level.

A report presented at the Council meeting called attention to the unbalanced growth of science, inadequate progress in basic research, and growing difficulties in scientific communication.

Informal inquiry revealed it would not be practical for AAAS to advise us of prominent scientists planning to visit Hawaii sufficiently in advance of their arrival so that our program committee might plan lectures or special meetings.

AAAS Delegate

L. D. Christenson

PROGRAM

The Thirty-Second Annual Meeting was held in three sessions.

The first session, on November 1 and 2, 1956, included a symposium on the subject "Need for Scientists and Opportunities in Science." Participating in this symposium were James H. Shoemaker, Robert W. Hiatt, Robert L. Cushing, and Leonard D. Baver. During the second evening four volunteer papers were presented following a business meeting. Titles of two others were read.

During the second session on February 12 and 13, 1957, ten volunteer papers were presented, and in addition Dr. Hans Pettersson presented the invitational paper "Cosmic Components in Deep-Sea Deposits."

In addition to these regular meetings, two special sessions were co-sponsored with the Society of the Sigma Xi for the purpose of hearing lectures by Dr. George Beadle and Dr. Curt Stern.

During April and May 1957, the Academy cooperated with the Department of Public Instruction in arranging a series of six lectures by members of the Academy for the teachers of Honolulu. About 200 teachers attended each of the session at Agee Hall. Lectures were presented by George Burr, Walter Steiger, Garth Murphy, Harold St. John, Agatin Abbott, and E. J. Anderson.

Business meetings were scheduled for all three sessions.

Program Committee

Sterling Wortman, Chairman

George Felton	Alexander Spoehr
Robert W. Hiatt	John Warner
Andrew W. Lind	A. J. Mangelsdorf, ex officio
Morton M. Rosenberg	Doak C. Cox, ex officio

NOMINATIONS

The Nominating Committee prepared a slate of candidates for the following offices for 1957–58: President-Elect, Doak C. Cox and Robert L. Cushing; Councilor, Ralph M. Heinicke and Alexander Spoehr; Secretary, Sterling L. Wortman; and Treasurer, Eleanor S. Anderson.

Ballots were distributed and returned by mail for tally at the business meeting of the Final Session.

Nominating Committee

Willis A. Gortner, Chairman

J. H. Payne	H. W. Civin
R. W. Hiatt	Herbert Weaver

A. J. Mangelsdorf, ex officio

AUDIT

The Auditing Committee examined the Treasurer's report, summarized above under FINANCES, and found it correct and in order.

Auditing Committee

William M. Bush, Chairman   Chester A. Wismer

SCIENCE TEACHERS

The Science Teachers Committee directed its efforts this year to helping the newly organized Oahu Science and Mathematics Teachers Organization. It was agreed that to realize the objectives of the committee an active and stimulated organization of this nature was basic.

In spite of difficulties due to the departure from the islands of key officers of the Organization, two meetings were held and a third is planned, and four excursions to research and industrial plants were organized.

Science Teachers Committee

Teruo Masatsugu, Chairman

Ralph Heinicke	Edith Townes
June Johnson	Mitsuko Uohara
George Kagehiro	A. J. Mangelsdorf, ex officio
Bernard Rose	Doak C. Cox, ex officio

AAAS FELLOWS

The AAAS Fellows Committee nominated ten members of the Academy and of the AAAS for elevation to Fellowship in the AAAS. Members and Fellows are designated by special symbols on the membership list in the Proceedings of the Academy.

AAAS Fellows Committee

G. Donald Sherman (resigned),
Walter Carter, Chairmen

E. J. Anderson	J. L. Gressitt
J. H. Beaumont	H. L. Lyon
G. O. Burr	Herbert Weaver

PUBLICATION

The Thirty-first Proceedings, in an edition of 1,000 copies, were distributed in December 1956, to the Academy membership and to more than 200 institutions scattered all over the world.

As usual, the University of Hawaii, in return for exchange privileges, handled the publication of the Proceedings, and defrayed 40 per cent of the cost.

Publication Committee

Lydia C. Nickerson, Chairman

Marion P. Goddard	A. J. Mangelsdorf, ex officio

Doak C. Cox, ex officio

PUBLICITY

Radio and press publicity in connection with the regular and special sessions of the Academy was handled by the following:

Public Information Committee

Roy J. Leffingwell, Chairman

Edwin H. Bryan, Jr.	A. J. Mangelsdorf, ex officio
Thomas Nickerson	Doak C. Cox, ex officio

TRAVELING LIBRARIES

A special committee has investigated the AAAS traveling libraries for high schools, has arranged for the securing from the AAAS of one such library for four small high schools on Hawaii, recommends the support of the Academy for the acquisition of 19 more such libraries for high schools on other islands individually or in groups, and encourages the use of the AAAS Traveling High-School Library program in the Institute for Science Teachers to be held at the University of Hawaii.

AAAS Library Committee

Robert W. Clopton, Chairman

Shiro Amioka	Daniel Dever
Carolyn Crawford	Teruo Masatsugu

Dan Noda

INDEX

A special committee was appointed this year, to recatalog the interests and skills of members of the Academy, and other pertinent information including age so that the new Constitutional provision for remission of dues of those over 65 may properly be administered. A study has been made of suitable indexing methods, but the questioning to obtain the necessary information has not been begun.

Index Committee

Eleanor S. Anderson, Chairman
Colin Herrick A. J. Mangelsdorf, ex officio
Doak C. Cox, ex officio

MISCELLANEOUS REPRESENTATION

The Academy has been represented on other local organizations by the following persons:

Doak C. Cox, Representative on the Conservation Council for Hawaii

Andrew W. Lind, Representative on the Science Fair Executive Committee

Vernon L. Singleton, Representative on the Inter-Agency Committee on Fluoridation.

HAWAII DIVISION

The Hawaii Division held meetings in Hilo during the year including an annual meeting in April 1957. The following officers were elected for the coming year: Chairman, John Easley, Jr.; Secretary-Treasurer, Sister Mary Natalie; Council Representative, Chester K. Wentworth; Committee Members: for West Hawaii, Chisato Hayashi, and for East Hawaii, Ruth L. Wong.

Hawaii Committee

William Bonk, Chairman
Pearl Hageman Welsh, Secretary-Treasurer
Chester K. Wentworth, Council Representative
Edward T. Fukunaga Henri P. Minette

OFFICERS

1956–1957

A. J. Mangelsdorf	President
Andrew W. Lind	President-Elect
Doak C. Cox	Secretary
Beatrice H. Krauss	Treasurer
George O. Burr	Councilor (2 years)
Colin J. Herrick	Councilor (1 year)
Willis A. Gortner	Councilor (ex officio)

1957–1958

Andrew W. Lind	President
Doak C. Cox	President-Elect
Sterling Wortman	Secretary
Eleanor S. Anderson	Treasurer
Alexander Spoehr	Councilor (2 years)
George O. Burr	Councilor (1 year)
A. J. Mangelsdorf	Councilor (ex officio)

THE 32nd ANNUAL MEETING 1956-57

Program

HAWAII DIVISION FIRST MEETING

April 27, 1956, University of Hawaii, Hilo

Laurence Snyder: Human Genetics

SPECIAL SESSION I

Sponsored jointly with the Hawaii Chapter of the Society of the Sigma Xi

August 23, 1956, Experiment Station, HSPA, Honolulu

Curt Stern: Human Genetics and the Y Chromosome

SPECIAL SESSION II

Sponsored jointly with the Hawaii Chapter of the Society of the Sigma Xi

September 24, 1956, University of Hawaii, Honolulu

George W. Beadle: Genes and the Nature of Living Systems

FIRST SESSION

November 1, 1956, Punahou School, Honolulu

THE NEED FOR SCIENTISTS AND OPPORTUNITIES IN SCIENCE

A Symposium

1. A. J. Mangelsdorf, Moderator: Introduction
2. James H. Shoemaker: Meeting Our Need for College-trained People
3. Robert W. Hiatt: Our Need for Scientists and Engineers
4. Robert L. Cushing: What Scientists Can Do to Meet the Need
5. Leonard D. Baver: How the Community Can Help Our Young People

November 2, 1956, Experiment Station, HSPA, Honolulu

Business Meeting

6. Maxwell S. Doty: Natural Population of the 1955 Puna Lava Flows
7. Alfred S. Hartwell: Kauai Heart Survey
8. Lucile F. Adamson: The Biological Synthesis of Cholesterol
9. Herbert B. Weaver: Motivation Research in the Tourist Industry
10. W. Edgar Vinacke: A Comparison of the Rosenweig P-F Study and the Brown Interracial Version*
11. Howard Boroughs, Sidney J. Townsley, and Robert W. Hiatt: Uptake of Calcium^{45} in Solution by *Tilapia mossambica**

Exhibits

Hawaiian Sugar Planters' Association: How Sugar Grows

Bishop Museum: Museum in Miniature

HAWAII DIVISION SECOND MEETING

January 21, 1957, University of Hawaii, Hilo

Ukichiro Nakaya: Snow Crystal Project on Mauna Loa

SECOND SESSION

February 12, 1957, Experiment Station, HSPA, Honolulu

Business Meeting

1. Hugo P. Kortschak, Constance E. Hartt, and George O. Burr: PGA and Photosynthesis in Sugarcane
2. Donald C. McGuire: The Search for Tomatoes Resistant to Tobacco Mosaic Virus
3. J. Linsley Gressitt: The "Dawn Redwood," *Metasequoia,* and its Native Environment
4. John A. Easley, Jr.: A Pedagogical Device for Clarifying the Concept of Genetic Drift
5. Oliver Wayman: The Use of Sex Hormones in Livestock Feeding

February 13, 1957, Experiment Station, HSPA, Honolulu

6. Doak C. Cox: The Possible Eruption in the Kauai Channel in May 1956
7. John M. Digman: Statistical Analysis of Oahu's 1954 General Election: II. Patterns Emerging from Sample Ballots
8. Abe Arkoff and W. Edgar Vinacke: Coalitions in the Three-Man Group
9. Nils P. Larsen: Observations on Different Causes of Sudden Death in Japan vs. Hawaii
10. P. B. van Weel: Observations on Osmoregulation in *Alplysia juliana*

Invitational Paper

11. Hans Pettersson: Cosmic Components in Deep-Sea Deposits

HAWAII DIVISION THIRD MEETING

April 18, 1957, University of Hawaii, Hilo

Business Meeting

John A. Easley, Jr., Maurice Tatsuoka, and Philips Carroll: The Earth Satellite

*Presented by title only.

FINAL SESSION

April 25, 1957, Experiment Station, HSPA, Honolulu

1. Hajime Sakai, John Little, and K. Watanabe: A New Method for Determination of Ionization Potentials
2. Alison Kay: New Concepts of Molluscan Systematics Illustrated by a Study of *Cypraea caputserpentis* Linn
3. Howard Boroughs and Della Reid: The Role of the Blood in the Transportation of Strontium 90-Yttrium 90 in Fish
4. Sidney Hsiao and Howard Boroughs: The Uptake of Radioactive Calcium by Sea-Urchin Eggs
5. Philip Helfrich and Alan J. Kohn: Organic Productivity in Marine and Terrestrial Environments
6. Donald W. Strasburg: Some Aspects of the Biology of the Central Pacific Great Blue Shark

April 26, 1957, Experiment Station, HSPA, Honolulu

7. Kenneth K. Otagaki, K. Morita, S. Oshita, and C. Tamura: Digestibility Studies on Some Hawaiian Feedstuffs
8. Abe Arkoff: Resolving Conflicts
9. George C. Ruhle: The Authorized City of Refuge National Historical Park at Honaunau, Hawaii
10. H. Dean Parry: Tornado-like Storms in the Hawaiian Islands
11. Harold M. Johnson: Dermal Abrasion for Acne Scars and Other Skin Defects

April 27, 1957, University of Hawaii, Honolulu

Business Meeting

Address of the Retiring President

A. J. Mangelsdorf: Science and Democracy

Abstracts

HAWAII DIVISION FIRST MEETING

Human Genetics[1]

LAURENCE H. SNYDER
University of Oklahoma
Norman, Oklahoma
Visiting Professor
University of Hawaii, Honolulu

SPECIAL SESSION I

Human Genetics and the Y Chromosome

No abstract available

CURT STERN
University of California
Berkeley, California

SPECIAL SESSION II

Genes and the Nature of Living Systems

The gene is a unit of inheritance transmitted from one generation to another by rules that are reasonably well understood. An example of such a unit in man is the gene that has to do with the properties of the protein component of hemoglobin. Several forms of this gene are known, each associated with a specific hemoglobin. In man there are probably several thousand other genes that control development and function.

Genes are submicroscopic and are located in linear order in chromosomes. It is now a widespread belief that genes are primarily segments of nucleic acid chains. The nucleic acids are long chainlike molecules made up of units or building blocks of four kinds. The orders of these in the chain constitute molecular messages. The probable structure of the nucleic acid of higher organisms has been worked out within the past few years. This structure provides important clues as to how genes are multiplied, how they mutate and how they function.

For many genes it has been established that specific proteins are key intermediates in function. Proteins are long chain molecules built of some twenty kinds of amino acid building blocks. Their specific properties depend to a large extent on the sequence of these amino acids and they, like the nucleic acids, may be said to carry biological information. The nucleic acid code consists of four symbols; that of protein has twenty symbols. An important problem of present-day genetics grows out of the question as to the relation between the two codes. This is in fact the central problem of gene function.

It seems a reasonable assumption that a self-duplicating mutable molecule like deoxyribonucleic acid was ancestral to all present day living systems.

([1]*See* Heredity and Modern Life. *Hawaii, Acad. Sci. Proc.* 1955-56:12.)

An early development might have been a protein-nucleic acid structure not unlike the viruses of today. By aggregation of such primitive one-gene systems, followed by mutation, multigenic systems could have evolved by known processes. Finally, cellular and multicellular systems presumably arose through mutation and natural selection.

GEORGE W. BEADLE
California Institute of Technology
Pasadena, California

FIRST SESSION

THE NEED FOR SCIENTISTS AND OPPORTUNITIES IN SCIENCE

A Symposium

1. Introduction

The shortage of scientists and engineers is becoming increasingly acute. Although the number of graduates in science and engineering is growing steadily, the demand has grown more rapidly than the supply.

Science and technology have advanced at a more rapid rate during the past half century than ever before in the history of mankind. A single generation has witnessed the ending of the horse and buggy era and the advent of the atomic age.

Our Western civilization looks to science and technology to provide ways and means of making life more livable. However, many regions of the world, the so-called underdeveloped regions, have as yet benefitted but little from the scientific advances of the past half century.

Until the Communist revolution, Russia was a typical example of an underdeveloped nation. The Communist dictatorship in Russia has been guilty of many errors, but indifference to the potentialities of science is not among them. Russia's rate of progress during the past generation has been rapid, even more rapid than our own.

The long term success of any form of government will depend to a considerable degree upon the extent to which it is able to ensure that highly competent persons will rise to the top in every sector of its economy. In this respect a dictatorship possesses certain advantages. It can establish a goal, as Russia has done, and embark forthwith upon a program of identifying its gifted students and evaluating their particular aptitudes. It can then proceed, by edict and directive, to have these gifted people educated along chosen lines.

Where does our own nation stand in this matter? We have come to depend heavily upon science and technology to provide the basis for the continuing growth of our economy and for the strengthening of our defenses. We are now finding that our rate of progress is being impeded by a shortage of well-trained scientists and engineers. But we have as yet no nationwide program aimed at identifying among our high school students those who are best qualified to benefit from college training. We have as yet no nationwide program aimed at ensuring that none of our most highly qualified high school graduates will be prevented by lack of motivation or lack of funds from going on to college.

If the Communist dictatorship continues to pursue its program of providing its talented young people with advanced training while we continue to let matters take their course in the hope that our problem will somehow work itself out, our future as a free nation may be jeopardized.

At present, nearly half of our best qualified high school graduates fail for one reason or another to enter college. This represents a dissipation of potential ability which the nation can ill afford under any circumstances. The Communist threat merely emphasizes the urgency of a problem that has long deserved more attention than it has received.

Hawaii is fortunate in having among its high school students a better than average proportion of first-class college material. This is our most valuable resource. What can we do to foster its full development? Our four speakers on this evening's panel are to consider various aspects of this problem.

A. J. MANGELSDORF, Moderator
Experiment Station, HSPA
Honolulu, Hawaii

2. Meeting Our Need for College-Trained People

In spite of the fact that there is no lack of prospective college students graduating from high schools in Hawaii, there is a lack of well trained personnel in the proper numbers to meet Hawaii's needs.

Organizations interested in employing college-trained people require, as a basic minimum, three qualifications, personal integrity, a reasonable command of language, and the ability to organize and present ideas. Although our college graduates possess the first of these qualifications, in all too many cases they lack the second and third. The apparent reasons for this are: (1) the difficulty in English language training resulting from the rapidly changing cultural pattern; (2) inadequate "mental discipline" in our schools; (3) a tendency to omit mathematics and other subjects requiring mental discipline; and (4) a lack of knowledge on the part of students as to the prospective demand for trained personnel and a tendency toward "prestige professions" already overcrowded.

The problem does not lie exclusively in the "supply" of trained persons flowing into employment. The "demand" aspects create problems because the pattern of the demand for technical and professional skills in Hawaii is changing rapidly. The continuance of three basic trends affecting the pattern of employment may be assumed: (1) increasing mobility of employment as between Hawaii and the Mainland.

(One out of eight 1952 high school graduates now employed is employed on the Mainland); (2) changing emphasis from commodity production to the production of services; and (3) increasing mechanization. Other prospective changes in the demand resulting from new technical developments, are unpredictable.

Actually the number of high school graduates who go on for university or other specialized training is rising sharply (from 47 per cent of the class of 1952 to 55 per cent of the class of 1956). The numerical percentage is rising even more rapidly. The three primary factors in this trend appear to be a rise in family incomes, a recognition of the increasing necessity for training, and the lack of sufficient jobs for full employment of high school graduates.

In dealing with the problem we face, we have, first, a more than adequate amount of "raw material," healthy Hawaiian young people with fully adequate native abilities, and second, a growing knowledge about what is happening to high school and college graduates, what is happening to our economy, including its employment trends. Using this knowledge we can compare the pattern of training with the pattern of prospective needs for trained persons in Hawaii and derive some reasonable answers as to the modifications in training that are required to meet our needs.

Additionally, however, we need: (1) better coordination between educational institutions, the Territorial Legislature and the business community; (2) a deeper insight into the significance of education for the long-range future; (3) a better advice to Hawaiian students attending mainland schools; (4) better orientation and counselling on employment opportunity; and (5) sufficient scholarship funds.

The greatest waste in Hawaii today is a waste of the inherent but undeveloped abilities of our young people. This in turn is reflected in a failure to fully develop the Hawaiian potentials for high levels of living. The future cultural, political, and economic developments of Hawaii are more dependent on this one factor than on all other factors combined.

JAMES H. SHOEMAKER
Bank of Hawaii
Honolulu, Hawaii

3. Our Need for Scientists and Engineers

Recent surveys by the National Science Foundation show the supply of scientific manpower at all levels to be far below current needs, with a critical shortage in categories requiring more experience and training. A severe shortage of science teachers occurs, especially at the secondary school level. Although the number of scientists increased proportionately greater than the total population of the United States during the past half century, the proportional rise will have to be far greater in the next two decades to keep abreast of anticipated technological developments. Opportunities for scientists in industry are now greatest in the field of chemistry, with physicists, geologists, mathematicians, and biologists ranking lower.

Reasons for the scientific manpower shortage are diverse. College and university enrollments have just passed their lowest point since 1940. Inadequate training and motivation, especially at the high school level, where most future scientific careers are fixed; "fear" of science as a difficult subject in both high school and college; unrealistic restrictions on certification for teaching; and a serious imbalance of college and university requirements in liberal arts curriculums where required science courses represent but a small fraction of the total requirements contribute in considerable measure to the shortage. Perhaps a more important contributor to the shortage than has been heretofore realized is the apparent reaction against so-called "materialistic and antihumanistic" science. A tendency for intellectual separation between scientists and humanists reflects an imperfect relationship of scientists to society and in society's estimate of the scientists. The true spirit of liberalism must be a symbiotic relationship between the great fields of learning; thus the liberal arts cannot be liberal if they reject or subjugate science and technology. If science can thus appear in its true colors we will attract enough first-rate minds to maintain our place in a world of vigorous and advancing technology.

ROBERT W. HIATT
University of Hawaii
Honolulu, Hawaii

4. What Scientists Can Do to Meet the Need

As we have known in a general way, and as the previous speakers have shown in detail, we are not training as many scientists and engineers as we need. I shall consider only the ways in which scientists can interest the right kind of students in preparing themselves for a career in science.

There are some things we can do as individual scientists, others we can do through our scientific organizations, and others we can do through our employer or as employers of scientists.

As Individuals

We must try to let non-scientists know what science *is* and what it is *not.* Many capable students do not become scientists because they do not know what science is and they do not know what its opportunities are. We must also combat any development of a general anti-intellectual or antiscientific attitude.

How can individual scientists do this?

One way is by accepting every chance we get to talk to young people about science, and we should make opportunities to do this.

Another way would be for practicing scientists to help in vocational counselling. This could be done by letting school counselors know that scientists would be ready at any time to discuss science as a life's work and to advise students on their preparation for science.

We should also use every available method for letting the general public, who have all benefited greatly from science even if they do not understand it, know what science is, and we should tell them about the doings, the findings and the methods of science.

Through Scientific Organizations

There are many things being done nationally to interest and encourage students in science. The Hawaiian chapters or branches of national professional societies may help greatly by applying national programs locally so that opportunities provided by national programs will not be missed in Hawaii.

Hawaiian chapters or branches of professional societies could help high school teachers and others present information about science to students. Demonstrations, lectures, movies, science fairs, etc. would be desirable activities for the Hawaiian chapters to sponsor.

There could well be a Territorial advisory committee on science education, to work with officials of the Department of Public Instruction in identifying, stimulating and helping young people interested in science. Such an advisory committee has worked well in the field of economic education.

Through Employer or as an Employer

Many scientists became interested in science as a career through part-time employment in high school or college. There is a real opportunity for the places in Hawaii that use scientists to help meet the need for scientists by offering part-time employment while students are in training. Such employment could guide students into scientific careers; it could help students get the right kind of training; and it could help employers by providing a pool of scientifically trained people.

There is a basic problem that will require the efforts of all scientists as individuals and through their scientific organizations. This is the problem of adequate preparatory school training in basic subjects like mathematics and English. We must use our influence to see that students are adequately prepared to study science. We must insist that teaching has substance and not just method.

All of these things require more than talk. They require planning, organization and some money. It seems to me that it would be appropriate for the Hawaiian Academy of Science to provide the leadership and the organization.

ROBERT L. CUSHING
Pineapple Research Institute
Honolulu, Hawaii

5. How the Community Can Help Our Young People

A community consists of a wide variety of individuals—parents, educators, business and industrial people, children. The community has many obligations to discharge. It has to provide budgets for many public services. One of the major questions that it should ask itself is, "What is the status of our intellectual budget?"

In developing and balancing any kind of budget, the following factors must be considered.

1. Ascertain the requirements to do the job.
2. Look for sources of funds.
3. Plan on means for getting the funds from the sources at hand.
4. Conserve funds for maximum efficiency.

Applying these criteria to the intellectual budget of the modern community, we find

1. America requires scientists, of all kinds, engineers, physicists, chemists, etc. to help develop a rapidly growing nation with increased world responsibilities.

2. There is no shortage of intellectual talent. The source of scientists and engineers is found in the young people of the community. Unfortunately, too many young people with exceptional intellectual ability never achieve an education that fully exploits their abilities. Moreover, in too many cases specific talents and skills are not adapted to the specific area in question.

3. The community can capitalize on this vast fund of potential intellectual wealth by

a) Developing the right atmosphere for the motivation of intellectual talent to pursue scientific fields. This involves

1. *The home,* where discipline is needed to call attention to youth's responsibilities and to the character-building aspects of work, to help develop the mind, to assist in guidance and encouragement.

2. *The community as a whole,* where it is essential to recognize ability rather than a diploma, to give support to hard intellectual labor (the intellectual tax of the community), to understand science and its importance to society, to insist upon a secondary school system that stimulates the brighter students, to develop strong public opinion against the wasting of scientific talent in the Armed Services.

3. *The educators,* who should develop curricula that will entice intellectual students, develop teachers who know how to "shoot the science gun, not just aim it," condemn the student attitude against the so-called "brain," sponsor a science week at local institutions, should advise the humanists to come out from under the smog of tradition and prejudice and recognize that science and engineering are not incompatible with the classics, romance languages, etc.

b) Providing financial assistance for youth with top talent through

1. College scholarships
2. Working assistantships at the University
3. Joint programs with industry which combine both study and experience as part of the training.

LEONARD D. BAVER
Experiment Station, HSPA
Honolulu, Hawaii

6. Natural Population of the 1955 Puna Lava Flows

Beginning in June, 1955, periodic observations of the same sites on these lava flows have been made. In reviewing this series of observations a sequence of events is revealed the time element of which is shorter on land in wetter areas, and in the sea in areas where there is less black sand. As yet little correlation with elevation on land or type of surface has been revealed. Experimental studies have revealed neither a chemical nor a physical difference in the surfaces which at the different places are now populated differently. This applies both to the terrestrial and intertidal environments. As might be expected in both environments the pioneer and present inhabitants are not species that are common in what might be called climax situations to either side of the recent flows under study.

MAXWELL S. DOTY
Botany Department
University of Hawaii
Honolulu, Hawaii

7. Kauai Heart Survey

The Kauai Heart Survey was carried out under the auspices of the Hawaii Heart Association with the cooperation of the Department of Public Instructions the parochial schools and the Territorial Board of Health. The purpose of this survey was to gain some idea of the amount of heart disease in children between 8 and 12 years of age in predominantly rural areas.

It was decided to pick the fourth grade, as this would make the children old enough to have acquired their first rheumatic infection and yet young enough to avoid the time consuming task of examining adult females. A group of six doctors consisting of M. E. Berk, T. S. Min, M. Hasegawa, A. Ishii, K. Kurumoto and A. S. Hartwell, chairman, performed the examinations on November 30 and December 1, 1955. A total of 611 children were examined. There were three teams of two doctors each, who went from school to school. The heart and lungs were listened to, and the foot vessels of every child were palpated. When an electrocardiogram or chest X-ray was thought to be necessary, arrangments were made with the local hospitals on Kauai to have these done.

Results: Of the 611 children examined, 40, or 6.54 per cent, were considered to have a heart murmur suspicious enough to warrant further study. Of these 40 children, 21, or 3.4 per cent of the total, were found to have either heart disease or lung disease. Two of the children had purely pulmonary disease and heart disease was excluded. Of the remaining 19, or 3.1 per cent of the total, 8 were positively diagnosed as rheumatic heart disease and 5 had murmurs and findings so suspicious that they were considered strongly to have rheumatic heart disease and further follow-up was indicated. This was a total of 2.1 per cent of all the children examined. There were 6 with definite congenital heart disease.

A discussion of ages and the heart conditions found will be presented in greater detail. Dr. Peter Kim, of the Samuel Mahelona Hospital, was kind enough to follow through and examine the few children who were ill or did not show up at the time the survey was done, so that we were able to get a complete coverage of the fourth grade students on the island of Kauai.

ALFRED S. HARTWELL
Straub Clinic
Honolulu, Hawaii

8. The Biological Synthesis of Cholesterol

Cholesterol occurs in all animal cells. Some of its functions are known, but the major purpose for which it is used in the body is probably still unknown.

In the attempt to discover what factors control the amount of cholesterol in the blood and what relationship, if any, there is between cholesterol and the causes of certain diseases which are characterized by high levels of blood cholesterol, various aspects of cholesterol metabolism are being studied.

One such field of study is the mechanism by which animal tissues synthesize cholesterol from acetic acid. From the study of other biochemical syntheses, it has been deduced that during the formation in living tissues of a given complex molecule from more simple ones, the synthesis always proceeds in the same specific stepwise manner. The route of synthesis of cholesterol from acetate is still incompletely known, although a few of the steps have been described.

The author was able to study some of the earlier steps of this synthesis in the laboratory of Dr. David N. Greenberg. Four alternatives which appeared possible in describing the first part of the pathway from acetate to cholesterol were as follows:

1 HOAc → AcOAc → HMG → BMG → DMA → Cholesterol
2 HOAc → AcOAc → HMG → HIV → DMA → Cholesterol
3 HOAc → AcOAc → HMG → BMG ——————→ Cholesterol
4 HOAc → AcOAc → HMG → HIV ——————→ Cholesterol

(HOAc = acetic acid;
AcOAc = acetoacetic acid;
HMG = β - hydroxy - β - methylglutaric acid;
BMG = β - methylglutaconic acid;
DMA = β, β - dimethylacrylic acid;
HIV = β - hydroxyisovaleric acid.)

By the use of radioactive carbon and of isolated rat liver preparations, evidence was found which supports alternative number 3 and opposes numbers 1, 2, and 4. This evidence and the experimental methods by which it was obtained are described.

LUCILE F. ADAMSON
Agricultural Experiment Station
University of Hawaii
Honolulu, Hawaii

9. Motivation Research in the Tourist Industry

The tourist industry is basically "psychological" in nature. The sugar industry produces tangible bags of sugar and the pineapple industry cans of pineapple, whereas the tourist industry produces a psychological state of satisfaction in visitors. Although the product is intangible, it is nonetheless real, and the industry prospers to the degree that it produces lots of satisfaction.

Essential to the orderly development of tourism are scientific procedures for measuring the product. Unless there is adequate "feedback" from visitors regarding their satisfactions (and dissatisfactions), the industry must operate blindly. Methods of psychological measurement and evaluation may therefore be expected to make a key contribution to the visitor industry.

Although the direct question method has value for some purposes, it often fails to reveal people's true feelings because of such factors as politeness, reticence, and unconscious influences. Psychologists have devised various indirect methods which are more likely to get at the real state of affairs by virtue of being more subtle or disguised. This paper is an exploration of the usefulness of indirect methods in determining the attitudes and reactions of visitors to Hawaii.

The following series of techniques was tested on visiting mainland students at the University of Hawaii Summer Session:

1. Sentence completion: The first words of sentences (such as "To me, Waikiki . . .") are presented, and respondents asked to complete them with the first thought that comes to mind.

2. Word association: Respondents give the first word they think of when stimulus words such as "Lurline," "tourist," etc. are presented.

3. Picture association: Respondents tell what pictures of Hawaiian scenes make them think of.

4. Picture story: Respondents make up as dramatic a story as possible about pictures of people in Hawaiian settings.

5. Picture completion: Pictures portray two people in various settings, one speaking via a filled "balloon," the other with an empty balloon to be filled by the respondent.

6. Case history: Using fictitious names, respondents kept a diary of their activities and reactions during their visit.

7. Retrospection: After returning home, respondents wrote letters about how their visit seemed in retrospect.

8. Depth interview: Extended intensive interviews conducted on a flexible, nondirective basis to get a detailed picture of motivations and feelings.

The relative usefulness, practicability, advantages and limitations of the various techniques as applied to the visitor industry were established in this exploratory study. Each technique clearly has important contributions to make. The study also yielded significant substantive findings, such as the majority of unfavorable reactions to Waikiki because of commercialization and crowdedness. The need for further research is indicated.

HERBERT B. WEAVER
Psychology Department
University of Hawaii
Honolulu, Hawaii

10. A Comparison of the Rosenzweig P-F Study and the Brown Interracial Version*

Two projective tests measuring reactions in frustrating situations were compared. Both tests present drawings in which one person, frustrated by someone else, makes a remark. The subject is asked to supply an answer. The Rosenzweig test is well known, with established scoring and norms. It measures response in ordinary interpersonal situations. The Brown test employs the same technique, but introduces an interracial element into certain items; the remaining pictures are similar to those in the P-F Study, hence are intended to serve as controls.

Fifty college students served as subjects, half receiving each test first.

Both tests possess low, but statistically significant reliability, although the Brown version is less reliable than the P-F Study.

Performance on the Brown version was very similar to those items duplicating the P-F Study items, but different for the changed items. In comparison with the control items, the interracial situations evoked more "ego-defensive" and "extrapunitive" responses. Doubt, however, is cast upon the conclusion that this difference is a function of the interracial condition, since comparable items on the original test also differed in this fashion from the control items. That is, items selected for the introduction of an interracial condition are inherently different from the neutral items to begin with; they apparently evoke

*Presented by title only.

the indicated kinds of response even without an interracial factor. There are, furthermore, categories of response on items of the Brown test which reflect indignation, perhaps at the situation itself, rather than response instigated by the other person.

The presumably interracial items have, therefore, a spurious character which must be rectified before one can conclude that these items evoke responses different in kind or degree from those in ordinary interpersonal situations. A test more comparable to the Rosenzweig P-F Study is needed, since the Brown version does not achieve its intended aim.

W. EDGAR VINACKE
Psychology Department
University of Hawaii
Honolulu, Hawaii

11. The Uptake of Ca^{45} in Solution by *Tilapia mossambica**

Previous experiments by the authors on the metabolism of radiostrontium by marine fishes raised the question of the availability of calcium to these fishes directly from sea water. This paper reports that calcium can be taken up by marine fish directly from sea water, and discusses the rate of uptake and internal distribution of this element.

Tilapia mossambica were put in aerated, artificial sea water containing Ca^{45}. The total concentration of Ca, including the isotope, was that of normal sea water. At periods of 4, 12, and 24 hours; 2, 3, 5, 7, 11, 14, and 21 days three fish were removed, ashed, weighed, dissected, and counted.

The results showed a rapid uptake of calcium from the water for the duration of the experiment, although at 21 days the internal concentration of Ca^{45} had not reached that of the medium. At 21 days the concentration ratio (microcuries Ca^{45} per gram fresh weight of fish/microcuries per gram sea water) was found to be 0.6.

Most of the radioactivity appeared in the skeleton (43% at 21 days) followed by the integument (24%), viscera (21%), gills (8%), and muscle (4%). Other workers have found that fish contain approximately 70 per cent of their calcium in the bone, 15 per cent in the gills, 6 per cent in the integument, 3 per cent in the viscera, and 1 to 2 per cent in muscle.

We infer, therefore, that continued exposure to Ca^{45} would result in the continued accretion of this element in the bones and gills with a comparative loss in the integument, viscera, and muscle.

Analyses indicate that there is about 20 times more calcium in a whole fish than in an equal weight of sea water (concentration ratio of 20). This figure is variable and depends for the most part upon the age and species of the fish. Under the conditions of our experiment it is evident that at 21 days the net exchange of total body calcium is only 2–3 per cent. This is in agreement with the generally held view that the turnover time for bone calcium is very long, and that once the calcium is incorporated into some sort of matrix, only a small amount is involved in metabolism under normal conditions. Thus, most of it remains *in situ* for the duration of the animal's life.

A similar experiment on the uptake of radiostrontium in solution by *Tilapia* indicates that the concentration ratio in 21 days was only about half of that reached with radiocalcium. Similar ratios have been reported for mammals. It is not possible to ascribe this 1:2 ratio in marine fish to a transient state because an excessive amount of strontium was not added experimentally. We are aware of no Sr/Ca ratio of 1:2 in any organs of marine fish. If there were an equimolar accumulation of Sr and Ca, the percentage of strontium in the ash should be twice that of calcium, because this is approximately the ratio of their atomic weights. The Sr/Ca ratio in sea water is about 1:40, while in the fish it is 1:400 or less. This means that fish discriminate against strontium in comparison with calcium, either by excreting it faster or absorbing it less.

We conclude, therefore, that the rapid and continuous uptake of calcium from solution over a 21 day period indicates that an artificial diet fed to captive fish would not result in a calcium deficiency.

HOWARD BOROUGHS
SIDNEY J. TOWNSLEY
ROBERT W. HIATT
Hawaii Marine Laboratory
University of Hawaii
Honolulu, Hawaii

*Presented by title only.

HAWAII DIVISION SECOND MEETING

Snow Crystal Project on Mauna Loa

An expedition to Mauna Loa on Hawaii Island was carried out in the winter of 1956–57 in order to study the snow crystals at the summit, at 13,450 ft. altitude, and also to investigate the condensation nuclei in this district. The nuclei number above the overcast, about 6,000 ft. high, was very small on fine days, being 100–200 per cc. Seven profiles of nuclei number were made and it was found that the number was fairly large in the cloud or fog, and very small in rain or snowfall. The height of the maximum nuclei number coincided with the boundary of air masses. In the edge of a fog bank the number was very large.

About 150 microphotographs of snow crystals were taken at the summit, and it was noticed that almost all types of snow crystals were observed at this spot. The frequency of occurrence was different from that observed in Hokkaido, and the needle crystals of various kinds were frequently observed. The transition of the prevailing type of snow crystals to the other type in the course of one snowfall was sharply defined, and the transition was rapid. Several photographs were taken, which show the stage just after the attachment of an ice crystal to a supercooled raindrop. These photographs show the mechanism of formation of ice pellets. Many photographs of frost crystals were also obtained. They showed that the thermal property of the object on which the frost crystals grow influences the shape of the crystal.

UKICHIRO NAKAYA
Hokkaido University
Sapporo, Japan

SECOND SESSION

1. PGA AND PHOTOSYNTHESIS IN SUGAR CANE

Photosynthesis is the process whereby plants use carbon dioxide and water as raw materials, and light as a source of energy, to manufacture organic compounds. With the availability of radioactive carbon, the chemistry of photosynthesis has become an object of experiment rather than speculation.

When radioactive carbon dioxide is fed to a plant, any compound found to be radioactive must have been synthesized from this carbon dioxide. If the time of exposure is made very short and the plant killed instantaneously, one can discover in which compound or compounds the carbon is first fixed by the plant.

The relatively new tool of paper chromatography has allowed the separation of the frequently very small amounts of radioactive material, and has aided in their identification.

Using these methods, mostly on algae, Calvin and his co-workers at Berkeley found that as the time of exposure to radioactive carbon dioxide was decreased, larger percentages of the total activity fixed were found in phosphoglyceric acid, usually abbreviated PGA. They have recently stated that all plants fix carbon first in PGA.

In our study of the sugarcane plant, we did similar experiments with cane leaves, but were unable to find PGA. To test our methods, we also used algae, and identified PGA without difficulty. A somewhat similar compound was found in sugarcane, though only as one of three major early products of photosynthesis. This was identified as phospho-malic acid.

Another project of our group has been the identification of the phosphorus-containing compounds of the sugarcane plant. Using radioactive phosphorus, several of these compounds were identified, among them PGA. This is not surprising, as PGA is also involved in respiration.

One further test was needed to complete the picture. Instead of exposing a cane leaf to radioactive carbon dioxide for a few seconds, we allowed it to photosynthesize for five minutes. This time we were able to find a very small amount of radioactivity in PGA.

It would seem that only one conclusion is possible. Although the sugarcane plant does contain PGA, its main photosynthetic mechanism is different from that of the algae, in that it does not use the synthesis of PGA as the first step in the production of sugar.

HUGO P. KORTSCHAK
CONSTANCE E. HARTT
GEORGE O. BURR
Experiment Station, HSPA
Honolulu, Hawaii

2. THE SEARCH FOR TOMATOES RESISTANT TO TOBACCO MOSAIC VIRUS

Much is known about the virus which causes mosaic disease of tobacco, "TMV." The information concerning it as a chemical, as an organism, and as a plant pathogen is so voluminous as to be overwhelming. Much is known, too, about its host-pathogen interactions, particularly under laboratory conditions, where the host is a species of Nicotiana. But TMV has a wide host range, which includes tomato and other commercially important species. Basic knowledge about the virus on these other hosts is limited.

Breeding for resistance to the disease is thus a matter of evolving techniques which retain any resistance present, in the face of wide variations in host-pathogen interaction, and of many strains of the virus.

The most pathogenic strain available is used as inoculum, on the theory that a plant which resists this should be able to resist any other. In susceptible plants severe symptoms may appear soon after inoculation of the seedlings, but often these symptoms reduce in size and number and eventually disappear. Then later, as the plant reaches physiological maturity, symptoms of a less severe strain gradually appear.

In "resistant" lines, usually seedling symptoms do not occur, but the later symptoms are common. Our selection for resistance is made as late as possible, saving seed from plants which show little or no symptoms on the post-harvest flush of new axillary branches.

Resistance is not uniform in our most resistant lines, in spite of repeated inoculations with a single specimen of plant sap on plants inbred for several generations. Nevertheless, resistance is real, and in reducing the effect of "natural" epiphytotics under field conditions, has been shown to be highly valuable commercially.

The work of producing a commercial tomato resistant to TMV is not complete, but our present progress makes us sure of eventual success.

DONALD C. MCGUIRE
Agricultural Experiment Station
University of Hawaii
Honolulu, Hawaii

3. The Dawn Redwood, *Metasequoia*, and Its Native Environment

The "dawn redwood," *Metasequoia glyptostroboides,* was discovered in west-central China after World War II. It grows in a very isolated mountain area south of Chungking, along the Szechuan-Hupeh border. The species was described in 1948 by Hu and Cheng, who made the genus the type of a new family of conifers. The genus had been named just before the war, and is known from fossils from northern Europe, northern Asia and North America. The oldest fossils are said to date from 100,000,000 years ago, and the latest from 30,000,000 years ago (John Day Miocene of Oregon). Earlier, the fossils were thought to be those of *Sequoia,* but the living tree proves to be more closely related in several respects to the bald cypress and the southern Chinese "water-pine," *Glyptostrobus pensilis*. The local name of *Metasequoia* is the equivalent of "water-*Cunninghamia*." All three grow near water, although in the case of *Metasequoia* it is mountain streams rather than swamps or tidal reaches of deltas. The tree is straight and moderately tall, the wood is light and soft, the foliage is very soft and pale green and is deciduous, the bark is reddish and thin, and the cones are rounded-oval and resemble those of the coast redwood.

My visit to the *Metasequoia* area was as leader of the California Academy of Sciences—Lingnan University Dawn-Redwood Expedition, during the summer and autumn of 1948 (see *Calif. Acad. Sci., Proc.* IV, 28 (2): 25–58, figs. 1–13, 1953). The purpose of our trip was mainly to collect the insect fauna of the area with a view to study its relationship to that of North America. Dr. R. W. Chaney of the University of California had briefly visited the area four months earlier, and seeds had been collected for Dr. E. D. Merrill the year before. Additional seeds were shipped to California by us, and a few seedlings taken to Canton and Hong Kong, or shipped to California. At Canton with the mild winter the foliage was partly persistent, only dropping during the short periods of cold wind from the north.

The *Metasequoia* environment was found to be quite isolated, being nearly 200 km. walk from the nearest port on the Yangtze, and rather thinly populated. But for this and the apparent uselessness of the wood, and the planting of seedlings for geomantic purposes, the tree might have become extinct. The Suisapa Valley, Lichuan District, western Hupeh, where most of the trees grow (between 600 and 1200 meters alt.), still has extensive forests of mixed broad-leaved trees and conifers on its sides and on neighboring ridges. The flora includes beeches, birches, poplars, willows, oaks, chestnut, maples, sweet gum, hornbeam, hop hornbeam, linden, sassafras, pine, yew and other trees familiar in North America. The insect fauna does not seem to show such close affinity with that of North America. Over 1,200 *Metasequoia* trees were counted, but the total number may not be very much greater, as considerable searching was done in neighboring valleys.

J. LINSLEY GRESSITT
Bernice P. Bishop Museum
Honolulu, Hawaii

4. A Pedagogical Device for Clarifying the Concept of Genetic Drift

The use of mechanical models based on gaming devices in order to illustrate genetic principles is briefly reviewed, and the controversial status and educational significance of the concept of genetic drift are discussed. The pedagogical difficulty of current mathematical models in evolution theory is noted, and the limitations of the present device are pointed out. The device is described as a model of multiple factor inheritance in bisexual organisms using poker chips to represent genes.

In this model alleles are represented by the two sides of a poker chip, one side being distinguished by an X-mark. The operations representing reduction division and fusion are described as they would be performed by a class of students, each one manipulating a set of chips representing genes of an individual organism. The system for recording the distribution of genotypes in each generation is illustrated.

Three applications of the model are described in detail with the results of actual classroom use presented graphically. (1) Four duplicate pairs of alleles are used to represent the multiple factor hypothesis for quantitative inheritance and illustrate the variation in the F_2 generation following a homozygous cross. (2) Experiments are described with one and two duplicate pairs of alleles illustrating the fixation of genotypes in small populations. (3) An experiment employing two sets of three duplicate factors is described which demonstrates the combined effects of genetic drift due to random separation of a single population into two parts and selection applied to genotypes. Possibilities for other applications and developments of the device are mentioned.

JOHN A. EASLEY, JR.
University of Hawaii
Hilo, Hawaii

5. A Review of the Use of Sex Hormones in Livestock Feeding, the Physiology of Response and Results Obtained in Trials in Hawaii

In 1923, Allen and Doisy identified the follicular hormone. In 1927, McGee was successful in preparing what was probably the first effective testicular hormone. The effects of these hormones were studied primarily in relation to their effect upon the sexual activity of the individual for several years. Quantities available for research were limited to what the individual researcher could extract by himself from tissues available. The shortage of hormones of reliable purity restricted work to small animals until the late 1940's.

In 1947, Andrews and associates at Purdue began to study the effects of diethylstilbestrol on feedlot performance of ruminants because of its estrogenic properties. They were first able to demonstrate highly significant increases in rate of gain and efficiency of feed conversion with growing and fattening lambs treated with injections or implants. Their work was extended to include beef steers and heifers with comparable results. These studies showed a general reduction in carcass quality in apparent contradiction of the increased lipemia and fat deposition in chickens. Testosterone showed no apparent effect in the early work. Bogart and associates at Oregon State College were successful in producing significant increases in response with testosterone similar to the work done with stilbestrol.

Local studies have involved both methods of application. Implants have resulted in greater increases in rate of gain and efficiency of feed utilization. However, it is necessary to feed longer and to a higher weight to obtain the same degree of finish compared with untreated animals. Oral application has produced intermediate results. Treatment of animals on unsupplemented pasture has resulted in little or no improvement.

Oklahoma workers have shown that the use of the hormone or hormone-like substance results in significant increases in retention of nitrogen, calcium, and phosphorus. California workers substantiated the work on nitrogen retention and demonstrated significant increase in weight of pituitary body and adrenals. The increase in pituitary weight was probably mainly in the anterior lobe. The physiological response is probably due to greater muscle growth and less fat deposition to produce greater tissue growth of a lower caloric value than in untreated controls.

OLIVER WAYMAN
Department of Animal Science
University of Hawaii
Honolulu, Hawaii

6. The Possible Eruption in the Kauai Channel in May 1956

A disturbance in the Kauai channel was seen from the air from May 22 to 24, 1956. The evidence consisted of roily water and floating debris centered south of the end of a submarine ridge extending northwest from Kaena Point, Oahu, nearly halfway to Kauai. Though two boats passed through the debris, no samples were taken. The determination whether this disturbance was the result of a submarine volcanic eruption is uncertain. The associated turbulence and a piece of basalt pumice recovered from the northeast coast of Oahu are easiest to explain by a volcanic origin. The lack of any seismic disturbance is, however, difficult to explain on this basis, and the near coincidence of many algal blooms of very similar appearance in various Hawaiian waters suggests that the disturbance might have been algal in origin. Sonic observation from a submarine two weeks after the disturbance disclosed some low intensity, low frequency sounds in the vicinity, but nothing identifiable. Fathometer recording indicated a very irregular bottom in the area.

DOAK C. COX
Experiment Station, HSPA
Honolulu, Hawaii

7. Statistical Analysis of Oahu's 1954 General Election: II. Patterns Emerging From Sample Ballots

A stratified sample of the 1954 City and County ballots of the Fourth and Fifth Districts was examined prior to the destruction of the ballots. On the basis of voter covariance, pairs of candidates were intercorrelated, using the tetrachoric coefficient as a measure of relationship. Of the 20 City-County candidates, three, involved in races with a single opponent, were eliminated from the study for technical reasons. The resulting 17 variable matrix was factored by means of the multiple group method of factor analysis.

In general, the results of the analysis were somewhat similar to the results of a previous study by Digman and Tuttle, who used a method based upon precinct returns. In both districts, the chief factor in the present study was a Party factor, which accounted for about one half of voter variance in preference for candidates. In the Fourth District, two related Ethnic factors were isolated. These factors suggested that the electorate perceived the candidates as Japanese, Chinese-Hawaiian, and Caucasian. The latter two appeared to be related and in opposition to the first. In addition, a residual factor, tentatively identified as an Experience factor, was discovered. Arguing from a premise that the candidate-variables had about .95 reliability, a Candidate Uniqueness factor was computed. Overall, this factor was of considerably greater strength than the Experience factor, and of slightly less strength than the combined Ethnic factors.

In the Fifth District, four additional common factors were extracted beyond the basic Party factor. Factors II and III seemed best described as Ethnic factors. Their mode of operation was apparently similar to that of Factors II and III of the Fourth District. The meaning of Factor IV, a residual factor of slight importance, was difficult to determine, and has been left unidentified. Factor V accounted for so little overall covariance that it may be an imaginary factor. Assuming again a reliability coefficient of .95 for the variables, a Candidate Uniqueness factor was computed. As was the case in the Fourth District, this Uniqueness factor proved to be slightly less important than the combined Ethnic factors.

Strength ratios were computed to compare the various factors in respect to the extent that they were responsible for voter variance in preference for candidates. These ratios suggest that in the Fourth District the Party factor was about 1.4 times as effective as the combined Ethnic factors, and about 1.6 times as effective as the Uniqueness factor. In the Fifth District, the Party factor appeared to be about 1.7 times as effective as the combined Ethnic factors, and about 1.8 times as effective as the Uniqueness factor.

It may be concluded that Oahu voters, on the whole, used party labels as their chief guides to voting in the 1954 election. However, ethnic extractions of the candidates and their individual attractiveness to the electorate were of considerable importance. In a close election, these latter factors could be decisive.

JOHN M. DIGMAN
Psychology Department
University of Hawaii
Honolulu, Hawaii

8. Coalitions in the Three-Man Group

Increasing attention has been given recently to the study of small groups like the triad. This model of interaction is rather easily adapted to experimentation, and the findings of these experiments promise to be useful in understanding more complex situations. Recent theory by Caplow has concerned triads whose members are of unequal power. It is Caplow's argument that coalitions in the triad can, to some extent, be predicted once the initial distribution of power is known. His argument is also directed to the demonstration that an initially weak member of a triad may actually prove to have a position of strength in relation to the other participants. The present study submitted these arguments to experimental investigation.

A simple game situation was devised in which various triadic patterns of power could be established. Subjects, run in groups of three, drew game markers with inscribed weights requisite to the establishment of specified power patterns, and then proceeded to compete for a prize on a modified pachisi board. The game permitted the formation of coalitions and the sharing of the prize in a manner agreed upon by the allies. The experimental procedure provided information as to the member of the triad initiating alliance offers, alliances which actually formed, and the conditions under which these alliances were consummated.

In general, the results of the investigation were consistent with Caplow's contentions that coalitions in triads with unequal powers may, to some extent, be predicted from the initial distribution of this power and that the triad, by its very nature, may favor weaker members over those who were initially stronger. The weaker the initial strength of a player, the more often he became a member of a coalition; where one player was stronger than the other two combined, coalitions occurred less often than in situations where alliances improved the chances for winning; where all three players were equal in power, alliances were equally probable between any two players.

The initiation of alliance offers and the sharing of prizes also conformed to the power patterns of the game. Weaker players were more likely to initiate offers. The share of the prize received by each ally was roughly proportional to the strength he contributed to the coalition. However, it is noteworthy that bargaining sometimes resulted in alliances which deviated from these principles. In this regard, motivational and personality factors seemed particularly relevant.

ABE ARKOFF
W. EDGAR VINACKE
Psychology Department
University of Hawaii
Honolulu, Hawaii

9. Observations on the Different Causes of Sudden Death in Japan vs. Hawaii

A tabulation of sudden deaths in Japan and the U.S.A. indicates a marked variation as to causes. In the U.S.A. 638 men, per 100,000 population in ages 55–59, died of heart disease to only 60 Japanese in Japan; whereas from cerebrovascular disease (apoplexy) 123 U.S.A. males died to 375 Japanese males. Tables will be shown for both men and women, and at various ages, from these two countries. The findings suggest that these two conditions, usually regarded as due to the same causes, might be quite unrelated.

In Hawaii, a study on the plantations indicates that they have both conditions in a rising curve. Dietary studies, confirmed by animal experiments, suggest that the increasing number of cerebral deaths in Japanese might be due to the excess salt consumption. The increasing heart deaths in the U.S.A. are possibly due to the increasing fat consumption. The danger in Hawaii is that the Japanese here continue the high salt intake while increasing the consumption of fat. The rising deaths from these two conditions suggest a need for caution by the Oriental populations in taking on the Caucasian diet.

At present, studies are being conducted in many parts of the world to try to solve the arterial problems since besides the dramatic sudden deaths are the many who recover but remain cripples.

In Hawaii, we also have the "Filipino deaths" (Bangungut). This has recently been reported in 130 cases from Japan under the name "pokkuri." This is still a mystery, but certain suggestive factors that might be important in its solution have come from letters from many countries.

NILS P. LARSEN
Medical Group
Honolulu, Hawaii

10. Observations on Osmoregulation in *Aplysia juliana* (Aplysiidae, Mollusca)

On a former occasion (Weel, v. 1956. *Hawaii. Acad. Sci., Proc.* 31: 8–9) some data were reported on the oxygen consumption of *Aplysia (Tethys) grandis* when the animal was subjected to diluted sea water, which pointed to the possibility of an active osmoregulation, instead of an osmoadjustment, as Bethe (*Jour. Gen. Physiol.* 1930(13): 437–444) had proposed. Because of a sudden disappearance of *A. grandis*, the experiments were repeated and extended, using *A. juliana* as an experimental animal. It proved that this animal was even better to use, because the differences in respiration were much bigger. Using 80 per cent sea water as diluted medium (Bethe used 75 per cent, which seemed too strong a dilution), the results with respect to weight and salinity of the blood were more or less of the same order as Bethe had found. The oxygen consumption, however, showed a very peculiar curve: In the first 30 minutes the consumption rose to 420 per cent (initial value = 100 per cent), then dropped equally steeply to 100 per cent in 2 hours, continued dropping to reach a value of about 40 per cent in 6 hours. When transferred to 100 per cent sea water, the oxygen consumption continued to drop and the animals invariably died 9–12 hours after being transferred to 100 per cent sea water. It was therefore apparent that a stay of 6 hours in 80 per cent sea water caused irreparable damage to the animal, that the conditions were such, that they could not be considered as being within the normal physiological range. Where Bethe used even higher dilutions, it seems quite probable, that his conclusions were also based on data obtained from animals which were definitely abnormal, and do therefore not bear on normal behavior.

The experiments were now repeated, using 95 per cent sea water as a diluted medium. The weight curve reached a maximum of 103 per cent in 1 hour (initial weight = 100 per cent), and *remained at this level for the entire period* (usually 5–6 hours) *in 95 per cent sea water.* When transferred to 100 per cent sea water, the curve dropped quickly to 77 per cent, remained stationary for one hour and then rose, quickly at first, more slowly later, *to reach the 100 per cent level again after some 7 hours.* The Cl-concentration-curve of the blood showed a loss of salts to 96 per cent in the first hour, remained stationary for the entire duration of the stay in 95 per cent sea water, and rose to 100 per cent after transferring into 100 per cent sea water in about 2 hours.

When the various data are compared, it is obvious that a definite increase in physiological activity occurred as soon as the animal was brought into diluted sea water. This became obvious when the oxygen consumption curve was considered: In 1 hour a maximum was reached (after being put in 95 per cent sea water) of 144 per cent, after which the curve dropped to reach a steady level of 110 per cent after 2 more hours. When transferred to 100 per cent sea water, it dropped first in 1 hour to 97 per cent, remained at that level for another hour, then quickly rose to reach a maximum of 170 per cent in 4 hours, after which it dropped down in 2 more hours to 100 per cent. The definite "peak" of the oxygen consumption curve in the first hours is probably due to increased motility of the animal when brought into 95 per cent sea water, which quieted down in about 3 hours. But even then the oxygen consumption was 10 per cent higher than normal. Considering the fact that the salinity of the blood remained slightly higher than that of the surrounding medium, we must assume that this excess in oxygen consumption is caused by (a) *increased water excretion* and (b) *possibly active salt uptake.* This mechanism is not adequate to cope completely with the loss of salts by diffusion through the surface of the animal but there is definitely some regulation by which the animal tries to maintain the salt concentration of its body fluids.

When transferred to 100 per cent sea water, the body fluids lose excess water rapidly by means of osmotic forces. Now no extra excretion and salt uptake are necessary and the oxygen consumption drops consequently, even a little below normal. However, the animal must regain its normal size (weight) and since there is no osmotic gradient, it has to do so by active uptake of sea water. This is clearly indicated by the sudden increase of the oxygen consumption, which lasts until the original weight has been reached, whereupon it decreases to normal. There is no need to ascertain, that the animals stayed alive during the entire period of experiments. These data therefore definitely show that *Aplysia* is not an osmoadjustor, but an osmoregulator.

P. B. VAN WEEL
Department of Zoology
University of Hawaii
Honolulu, Hawaii

11. Cosmic Components in Deep Sea Sediments

Sir John Murray's discovery published in 1876, that there are magnetic spherules present in small numbers in deep-sea deposits, gave rise to further investigations on deep-sea deposits sampled from the Swedish Deep-Sea Expedition with the "Albatross," 1947–48. By means of a greatly improved method of extraction the author and his collaborators in Göteborg found that the number of magnetic spherules per kg. of red clay is 10 to 50 times higher than Murray found and can vary from a few hundred to several thousands per kg. of the sediment. These variations are due partly to variations in the rate of sedimentation; partly, no doubt, also to real variations in the frequency of meteors from which these so-called "cosmic spherules" are derived. The present results prove that such spherules are present also in ancient layers of sediment, dating from Tertiary time and that there is a tendency to an increase in their numbers in more recent time. It is expected that continued studies of the same type will afford means for a new kind of deep-sea chronology. By microchemical analysis and also through an activation in the pile at Harwell the presence of nickel in the spherules has been proved, supporting the assumption that they are of cosmic origin. Attempts are now being started to collect similar spherules from the atmosphere on different ocean islands in the Pacific. The results gained from the search for cosmic spherules in deep-sea deposits indicate that the accruement of such cosmic matter to the planet's surface is of the order of 2,000 to 5,000 metric tons per annum. At present the author is engaged in measuring the amount of disperse meteoric dust settling on the earth by means of air samplers with fine-pored filters running on Mauna Loa observatory and on the summit of Haleakala. A more detailed report will be printed in a coming issue of *Pacific Science.* The research has been facilitated by a grant from the Atomic Energy Commission.

HANS PETTERSSON
Göteborg, Sweden
Visiting Professor
University of Hawaii
Honolulu, Hawaii

HAWAII DIVISION THIRD MEETING

The Earth Satellite

No abstract available

JOHN A. EASLEY, JR.
MAURICE TATSUOKA
PHILIPS CARROLL
University of Hawaii
Hilo, Hawaii

FINAL SESSION

1. A New Method for Determination of Ionization Potentials

In order to determine ionization potentials of molecules with high resolution attempts were made to utilize counting techniques to measure pulses triggered by photoionization in an absorption tube. This tube was essentially a Geiger-Muller type photon counter provided with an end-on LiF window and an outlet leading to a gas handling system. Partial pressures of about 1 mm Hg of sample vapor were required for total absorption. For stable operation of the counter, the anode voltage ranged from 600 to 1100 volts and an admixture of helium gas proved helpful. Pulses from the counter were amplified with a pulse amplifier and fed into a count rate meter.

By using a vacuum monochromotor with a grating ruled with 1200 lines per mm and slits of 0.01 mm width, it was possible to obtain a resolution of 0.001 ev in the spectral region 1100–1600 A. Preliminary data were obtained for NO, CS_2, acetone, 1,3-butadiene, benzene, ethynylbenzene, and trimethylamine. In the case of CS_2 several fine structures were resolved and ascribed to transitions from vibrationally excited ground state levels. The sensitivity of the present method was found to be about 2 or 3 orders of magnitude higher than that of the photoionization method.

HAJIME SAKAI
JOHN W. LITTLE
K. WATANABE
Department of Physics
University of Hawaii
Honolulu, Hawaii

2. New Concepts of Molluscan Systematics Illustrated By a Study of *Cypraea caputserpentis* Linn.

Anatomical studies of *Cypraea caputserpentis* Linn. have demonstrated several archaic features when this mollusk is compared with other mesogastropod prosobranchs. The digestive system is characterized by a dilated mid-esophagus and by the occurrence of a posterior caecum and short protostyle in the stomach. The nervous system possesses long pedal nerve cords which traverse the length of the foot. Both of these systems are reminiscent of the archaeogastropods rather than the mesogastropods. In the reproductive system of the male there is an open seminal groove, a condition reported in only one other group of mesogastropods.

Recent work on the functional morphology of the digestive and reproductive systems of the prosobranchs, combined with previous anatomical studies has resulted in a picture of a hypothetical ancestral prosobranch, typified by several present-day archaeogastropods. In this animal, which is a microphagous feeder, the mid-esophagus has glandular esophageal pouches and the stomach has a posterior caecum and a mucous rod or protostyle which serves to wind the esophageal food string through the stomach, permitting sorting of the food particles and eventual compacting of the faecal material. The nervous system is diffuse, with long pedal cords traversing the length of the foot. The reproductive ducts presumably originated as open grooves.

In the traditional picture of the molluscan genealogical tree, based primarily on shell characters and certain aspects of the nervous system, *Cypraea* was placed high among the branches. The peculiar archaic features of *Cypraea* become understandable if, rather than picturing a phylogenetic tree, we interpret the phylogeny of the mesogastropods in terms of a basal pool of prosobranch characters, from which numerous specialized lines have radiated. Several forms in each of these lines retain some of the basal characters, while others are highly specialized. In this interpretation, *Cypraea* forms the base of one of these radiating lines, while other genera within the cypraeid line, such as *Trivia* and *Pedicularia,* are at the top of the line as suctorial carnivores with a simplified stomach pattern, concentrated pedal ganglia, and closed reproductive ducts.

This concept of the phylogeny of the mesogastropods at the ordinal and familial level of the taxonomic hierarchy employs the results of studies of anatomical characters rather than relying on conchological characters. Utilization of anatomical characters in the systematics of the Mollusca is at present being extended to the generic level of the taxonomic hierarchy.

ALISON KAY
Department of Zoology and Entomology
University of Hawaii
Honolulu, Hawaii

3. The Role of the Blood in the Transportation of Strontium^{90}-Yttrium^{90} in Fish

An equilibrium mixture of Sr^{90}–Y^{90} was injected directly into the heart of *Tilapia mossambica* fish. At intervals from 5 minutes to 8 days, blood was removed from the kidney sinus using one fish for each time interval. The total radioactivity was determined for whole blood, plasma, erythrocytes which were either washed or unwashed, and for erythrocyte ghosts. The radioactive decay of the blood from the 1-day fish was followed for 3 weeks until secular equilibrium reappeared. Owing to the biological fractionation of the two elements, to the difference in their radioactive decay rates and to their different energies, it was discovered that biological experiments using Sr^{90}–Y^{90} are more complex than previous investigators have apparently realized.

It was possible to establish the fact that almost all the Sr–Y disappears from the blood in 1 day, and that the plasma carries almost all of the radioactivity. The bulk of the yttrium originally present apparently is removed by the surface of the vascular system. A small amount is also removed from the equilibrium mixture by the red blood cells, and it is suggested that the yttrium is carried on the cell surface, because the radioactive decay of the red cell "ghosts" corresponds to the radioactive decay of the yttrium^{90}. The fact that almost no radioactivity was detectable in the erythrocyte contents suggests that very little strontium or yttrium is bound to an interior matrix.

HOWARD BOROUGHS
DELLA REID
Hawaii Marine Laboratory
University of Hawaii
Honolulu, Hawaii

4. The Uptake of Radioactive Calcium by Sea Urchin Eggs

In studying the physiology of the accumulation and utilization of calcium in the formation of the calcareous skeleton by sea urchin eggs the use of radioactive isotope of calcium as tracer would be very helpful. However, no systematic study of the uptake of radiocalcium by sea urchin eggs has been reported except an indirect one by Rudenberg who estimated the uptake of Ca^{45} by *Arbacia* eggs by measuring the change in radioactivity in the surface layer of the radiocalcium containing sea water in which the eggs were raised. The present paper is a report on a direct study of the uptake of Ca^{45} by *Tripneustes gratilla* as a function of time and as a function of the concentration of calcium ions in the medium.

Intact eggs, eggs with jelly removed, and eggs fixed in formalin with or without jelly were separately exposed to sea water having 1 μc Ca^{45} per ml. for specific lengths of time and their radiocalcium uptake measured with a Geiger-Muller counter after separation and drying. The Ca^{45} activity curves based on counts per minute per mg. of dry material plotted against time show an initial high uptake followed by a dip and then a rapid rise—showing an essentially sigmoid curve. The curves level off after the 10th hr. When plotted on semilog. paper the data fall along straight lines. They suggest that dead eggs show steeper slopes than live eggs, with and without jelly. When the Ca^{45} containing eggs were washed with natural sea water about half of the radiocalcium was removed in the first 30 min., the rate of removal became much reduced after the first hr.

In studying the effect of external Ca ion concentration on Ca^{45} uptake eggs were placed in media varying from having 0 to 80 mg. atom Ca per liter (i.e., 8 times normal concentration in natural sea water). Eggs in calcium-free artificial sea water containing 5.46 gamma of Ca^{45} per ml. show a high uptake of the radiocalcium. Increased concentration of stable calcium in the medium beyond the normal concentration in natural sea water has no special effect on the rate of Ca^{45} uptake. Dead eggs and live eggs, with or without jelly, all show a similar rate of Ca^{45} uptake as a function of stable calcium ion concentration of the medium.

SIDNEY C. HSIAO
Department of Zoology
HOWARD BOROUGHS
Hawaii Marine Laboratory
University of Hawaii
Honolulu, Hawaii

5. Organic Productivity in Marine and Terrestrial Environments

Primary organic productivity was measured during the summer and winter on a fringing coral reef at Kapaa, Kauai, by determining differences in oxygen concentration of water flowing across the reef. From these determinations the authors were able to make estimates of (1) the annual primary production of the reef, (2) the rate of respiration of the entire reef community, and (3) the efficiency of gross productivity. A comparison was also made on an areal basis between the annual primary productivity of this marine community and a nearby sugar cane field which was subject to the same insolation.

It was found that the coral reef studied is autotrophic, that is, the rate of organic production is sufficient to meet the requirements of the consumer organisms present with an excess of 7.9 g.C/m.²/day produced. The ratio of gross productivity to community respiration was calculated to be 1.1.

Gross primary productivity was calculated to be 2,900 g.C/m.²/year. This is in impressive agreement with determinations made for two atoll reefs in the Marshall Islands by Sargent and Austin (1954) and Odum (1955). The efficiency of gross productivity on the reef at Kapaa was calculated to be 1.1 per cent. With one exception, that of a rather specialized turtle grass community, the productivity of coral reefs is far greater, on an areal basis, than all other marine environments which have been studied. The authors attribute this high rate of production to benthic algae on the reef platform.

Gross primary productivity of sugar cane on fields near Kapaa reef was determined from records of the Lihue Plantation Company for a period of time comparable to that of the coral reef study. This terrestrial productivity was 1,775 g.C/m.²/year, which is in relatively close agreement with the authors' estimate of 2,900 g.C/m.²/year in the adjacent marine environment. It is noteworthy that this estimate of productivity of sugar cane in Hawaii is of the same order of magnitude but significantly higher than any other terrestrial productivity reported.

PHILIP HELFRICH
Department of Zoology and Entomology
University of Hawaii
ALAN J. KOHN
Osborn Zoological Laboratory
Yale University, and
Hawaii Marine Laboratory
University of Hawaii
Honolulu, Hawaii

6. Some Aspects of the Biology of the Central Pacific Great Blue Shark

The Pacific Oceanic Fishery Investigations (U. S. Fish and Wildlife Service, Honolulu) has made extensive longline surveys of the Pacific Ocean between the Aleutian and Society islands, and from the west coast of North America to the International Date Line. Although these surveys were designed to sample the tuna resources of the area, they also resulted in the capture of more than 6,000 pelagic sharks, of which about 40 per cent were great blues *(Prionace glauca)*. Because of the predatory and competitive relationships between sharks and tuna, and because little is known of the biology of oceanic sharks in general, a study of the distribution and habits of the great blue is of both practical and academic interest.

The great blue shark is world-wide in its distribution, and in common with most sharks, has the reputation of being both dangerous to man and deleterious to commercial fishes and to whales during capture. In appearance it is a slender species with the commonly caught size measuring about 8 feet in length but weighing only about 125 pounds. It takes its name from its bright blue upper surfaces, the color of which fades rapidly after death.

The great blue shark was found throughout the area sampled but was most abundant north of 20°N. latitude within about 1,000 miles of the American west coast. In this portion of its range the great blue made pronounced northern migrations during the summer months, during which the sexes became segregated so that some catches consisted only of males and others only of females. Factors influencing sexual segregation were season, geographical position, and undefined behavioral reactions related to size. Pupping is probably related to both migration and sexual separation, but no precise breeding season or grounds could be demonstrated.

Although essentially a surface dweller in the north the great blue becomes increasingly abyssal to the south, with temperatures of 45°–69° F. probably being limiting. In the equatorial region it was more abundant during warm years than cold, and was also more numerous in oceanic than insular situations. Its diet consisted principally of small fish and squid, and unlike other pelagic species, it did very little damage to hooked tuna.

DONALD W. STRASBURG
Zoology Department
University of Hawaii
Honolulu, Hawaii

7. Digestibility Studies on Some Hawaiian Feedstuffs

A considerable number of feeding trials have been conducted at the Hawaii Station both on ruminant and monogastric animals to demonstrate the usefulness of final cane molasses as a major constituent in the ration of these animals. Similarly, passion fruit rind and rendered fats and oils were shown to be useful as a partial nutrient source for livestock production.

However, only a limited number of digestibility tests have been reported on these feedstuffs. This paper is a partial report on the studies conducted on the nutritive value of some of our Hawaiian feedstuffs with sheep.

The composition and digestibility data of the high molasses rations are shown in table on page 29.

The results of the study showed that wethers could utilize high molasses rations with little or no scouring and that the calculated nutritive values of these rations were essentially the same as that obtained from digestibility trials.

KENNETH OTAGAKI
K. MORITA
with student assistance of
S. OSHITA and C. TAMURA
Agricultural Experiment Station
University of Hawaii
Honolulu, Hawaii

COMPOSITION AND COEFFICIENTS OF DIGESTIBILITY OF HIGH MOLASSES RATIONS

Rations	32–FA	32–F	32	32–I
	per cent	per cent	per cent	per cent
Molasses	64.0	64.0	65.0	65.0
Bagasse pith	10.0	10.0	10.0	10.0
Pineapple bran	4.5	6.5	8.0	6.0
Meat and bone meal	3.0	3.0	3.0	3.0
Urea	1.5	1.5	1.0	1.0
Salt	1.0	1.0	1.0	1.0
Tallow, stabilized	5.0	5.0	....	....
Alfalfa pellets	3.0	....	....	3.0
Cottonseed oil meal	8.0	9.0	12.0	11.0
Total	100.0	100.0	100.0	100.0
Calculated, (original moisture basis)				
Digestible crude protein	7.22	7.57	7.23	7.26
Total digestible nutrients	59.84	60.23	52.62	52.23
Coefficients of digestibility (original moisture basis)				
Crude protein	56.48	63.87	52.11	56.07
Ether extract	78.37	85.26	66.44	61.84
Crude fiber	34.40	39.11	31.35	38.30
Ash	52.95	60.25	48.88	50.99
N.F.E.	65.55	71.54	61.88	65.65
Actual, (original moisture basis)				
Digestible crude protein	7.80	8.40	7.18	7.40
Total digestible nutrients	60.74	67.06	51.64	54.88

8. Resolving Conflicts

In the present investigation Lewin's deduction that approach-approach conflicts are more easily resolved than avoidance-avoidance ones was submitted to experimentation. Conflicts were created by pairing seven personal characteristics, namely, adjustment, attractiveness, health, intelligence, popularity, talent, and wealth. Each of the characteristics was paired with every other one in both of two types of pairings, one in which the subject was required to designate the alternative which he would rather have in greater degree than he had at present (approach-approach conflict), and a second in which he was required to designate the alternative which he would rather have in lesser degree than he had at present (avoidance-avoidance conflict). In this fashion 42 conflicts were presented, 21 describing approach-approach situations and 21 describing avoidance-avoidance ones.

The method of the experiment provided two measures of conflict behavior. First, there was the amount of time taken to resolve the two types of conflict. Second, there was the number of each type of conflict judged to be easier to resolve. In addition, the method allowed for consideration of sex differences in the resolution of conflicts.

The results of the experiment were in agreement with Lewin's deduction. Approach-approach conflicts required significantly less time to resolve than did avoidance-avoidance conflicts, and significantly more approach-approach situations were judged easier to resolve than were avoidance-avoidance ones. Sex did not appear to be a factor in conflict behavior except that in judging the difficulty of conflicts males proved to be significantly more variable than females.

A second experimental procedure allowed subjects to avoid making a decision when they felt that they were "unable" to do so. This behavior, called "leaving the field" or leaving the conflict situation, has been held to be a characteristic of avoidance-avoidance conflicts. Again, in agreement with Lewin's deduction avoidance-avoidance conflicts were left unresolved significantly more often than approach-approach ones.

ABE ARKOFF
Psychology Department
University of Hawaii
Honolulu, Hawaii

9. A Scientific Investigation for the Authorized City of Refuge National Monument, Honaunau

In the ethnology of a race or racial group, significant traits, customs, and institutions may evolve that give it distinction above the commonplace that is mere product of environment or satisfaction of basic drives such as hunger and vanity. The institution of sanctuary that existed in Hawaii 200 years ago is in this category. In a framework of tyranny and fear, havens developed to which helpless and oppressed could flee for assured relief and safety. A similitude existed among the Hebrews of the Old Testament.

The concept of a place of refuge is so singularly impressive that the National Park Service has determined to reconstruct and preserve the picture of the culture of ancient Hawaii about it. Of the several typical sites, that at Honaunau has been selected as best suited for the purpose. This location held the depository of the bones of Hawaii's kings and was an important center of Hawaiian life and recent history. Consequently the Congress of United States authorized in 1955 the establishment of a City of Refuge National Historical Park at that place. Only the acquisition and transfer of title of 180 acres of land by the territory must be consummated before material operations can be started.

While the territory is carrying out its task, the National Park Service has drawn up a contract with the Bishop Museum for a detailed surface and subsurface ethnological and historical survey of the area. No other institution or group of scientists is better qualified to undertake the study, now well underway. Its findings will constitute the basis for future planning, development, operation, maintenance, and interpretation.

It is anticipated that the picture will be restored as it existed at some date, say 1750. To this end, all exotics must be eradicated and subsequent changes obliterated as are feasible. Landscaping will be tailored appropriately. In operational development only picnic grounds are contemplated. Interpretation should include an expository museum, study collections, naturalist guides, talks, explanatory markers, self-guiding trails, and literature. Native living may be demonstrated in the fashion used elsewhere in portraying colonial, antebellum, and Indian life. Study of adjacent, related areas is being included so that the territory may be encouraged to preserve such sites as Keei Battlefield and Kealakekua Bay. Their integration with the story of the City of Refuge will be mutually beneficial. Contemporary Hawaiian usage of the park such as swimming, canoeing, and fishing will be encouraged to the extent that augments and is not incompatible with the primitive picture.

GEORGE C. RUHLE
Hawaii National Park, Hawaii

10. Tornado-Like Storms in the Hawaiian Islands

Occurrence of waterspouts, funnel clouds and tornado-like storms in the Islands is discussed briefly.

A particularly violent storm which occurred on January 21, 1957, is described and evidence is adduced which indicates the rotary nature of this storm.

This storm is compared to mainland tornadoes, both from the standpoint of damage done and of antecedent and accompanying meteorological conditions over the area in which the storm developed and moved.

H. DEAN PARRY
U.S. Weather Bureau
Honolulu, Hawaii

11. Dermabrasion for Acne Scars and Other Skin Defects

Surgical planing (dermabrasion) is a procedure used in the treatment of such cutaneous defects as acne and chicken pox scars, scars of facial injuries, senile and seborrhoeic keratoses, rhinophyma, fine senile wrinkling of the face, and certain types of birthmarks.

In 1954, I selected a group of prisoners from the Oahu Prison for skin planing, chiefly for acne scars. These men were volunteers and were carefully screened for systemic disease, infections and keloid diathesis. All races were included; deeply pigmented or swarthy patients, as well as Caucasians, were selected. The satisfactory results achieved on most of these patients have stimulated interest to continue this work.

A series of 250 cases have been treated by dermabrasion, and enough cases have been observed for a sufficient time to make possible an honest evaluation of the method and results obtained.

The basic equipment for dermabrasion consists of:

1. Steel wire brushes of various width and gauges.
2. High speed electric motor, capable of 12,000 revolutions per minute.
3. Freezable plastic facial packs containing propylene glycol (5%) in water.
4. Ethyl chloride (coarse spray bottles) or Freon 114 (Frigiderm) (dichlorotetrafluorethane).
5. Air blower.

Planing is an office procedure. Preoperatively, an analgesic, is given hyperdermically. This produces satisfactory relaxation. The refrigerated prechilled packs are applied to the area for 15 to 20 minutes. A segment of skin is sprayed with a liquid freezing agent until the area is rigid and bloodless. The air blower aids the evaporation and freezing of the area.

The rapidly rotating steel wire brush is placed against the surfaces of the skin at right angles to the plane of rotation and moved slowly in a shaving stroke. The entire face can be done in 30 minutes.

Bandages are applied to the abraded surface and removed in 24 hours. The area is covered with blood and serum which dries into a varnish-like crust. This crust can be removed in seven days by soaking the face in warm soap suds.

In summary, surgical planing is a safe, effective office procedure for the treatment of various cutaneous defects and acne scars. A series of 250 cases have been carefully evaluated and followed for two and a half years. During this time, there have been no unfavorable sequelae resulting from either the refrigeration or the actual surgical dermabrasion. All patients were improved, some more than others. In cases where scars were deep and pitted, further planing was necessary.

The complications and contraindications are few. Pigmentation following dermabrasion is inevitable among the pigmented races, but it invariably disappears within a period of three to eighteen months.

Emotionally disturbed patients are difficult to treat. They are unpredictable during the operation and, in my experience, have continued to pick the defects.

While the treatment does not produce "the skin you love to touch," the results, in general, are pleasing to the patient. If each case is carefully evaluated and selected, many patients who may have been emotionally disturbed or introspective because of disfiguring scars and blemishes can be considerably benefitted.

HAROLD M. JOHNSON
Alexander Young Building
Honolulu, Hawaii

NECROLOGY

RUY HERBERT FINCH

Ruy Herbert Finch, retired director of the Hawaiian Volcano Observatory, died in California on March 25, 1957. He was born at Sunbury, Ohio, August 31, 1890. Mr. Finch was educated at George Washington University and the University of Chicago, receiving training in physics. He was meteorologist with the Weather Bureau and came to Kilauea when the Hawaiian Volcano Observatory was transferred to the Weather Bureau in 1919, where he became assistant to the late Dr. T. A. Jaggar. In 1926 he took charge of and installed the Lassen Peak Observatory in California. In 1940 he succeeded Dr. Jaggar as director of the Hawaiian Volcano Observatory where he continued until his retirement in 1951. All his later life was devoted to the study of volcanoes except for a brief period in the late thirties as an orchardist. During his sojourn in Hawaii he contributed extensively to the published record of Kilauea. He was a delegate to at least two of the Pan-Pacific Scientific Congresses and made studies in Alaska as well as California and Hawaii. During his life at Kilauea he became widely known as a guide to the regional features and a genial teller of stories. He had been a member of this Academy since the early forties.

ZERA C. FOSTER

Zera C. Foster was born in Pigeon, Michigan, on October 2, 1898. After his graduation from Michigan State College in East Lansing in 1924, he joined the Michigan Land Survey Office to do land survey work. He held this position until 1926 when he became forester and land appraiser for the Great Southern Lumber Company in Bogalusa, Louisiana. In 1927 he joined the Field Service Soil Surveys in the United States, Puerto Rico and Hawaii. In 1939 he accepted the position of associate soil scientist for the Soil Conservation Service in Hawaii. He carried on soil surveys and farm planning work until 1942 when he became a soil scientist for the Oahu Engineering Service of the United States Engineers. He was specialist in soil management for the Agricultural Extension Service, University of Hawaii College of Agriculture, from November 1, 1946 until his death on September 20, 1956.

Mr. Foster was a member of the Honolulu Lions Club and previous to World War II, belonged to the Society of Agronomy and the International Society of Soil Science. He was a member of the Hawaiian Academy of Science until his death.

Mr. Foster was a sincere, capable and conscientious worker for the Agricultural Extension Service.

JAMES WILSON GLOVER

James W. Glover was born in Franklin, Tennessee, on July 16, 1904. He received the B.S. degree from the University of Hawaii in 1929. He was associated with E. E. Black, Ltd. from 1929 to 1935, as superintendent of construction. Since 1935 he was president of James W. Glover, Ltd. and handled many important military and civil contracts during and subsequent to World War II.

He was elected to the Territorial House of Representatives in 1943, 1945, and 1947 and was president of the Territorial Cattlemen's Council from 1947 to 1954.

Mr. Glover was a member of the Hawaiian Academy of Science, the Outrigger Canoe Club, Oahu Polo and Racing Association, Kailua Racquet Club, and Alpha Tau Omega, and was an officer in the U. S. Naval Reserve.

With his death on March 1, Hawaii lost one of its outstanding citizens in the fields of Engineering and Agriculture.

FREDERICK OHRT

Frederick Ohrt, who passed away on March 13, 1957, will long be remembered for his record of engineering accomplishments and his leadership in community affairs.

Mr. Ohrt was born on May 28, 1889 at Spreckelsville, Maui. After graduating from St. Louis College he studied at the University of Oregon, and Cornell University, where he received his Civil Engineering degree in 1911. Later he did graduate work at Harvard-Massachusetts Institute of Technology School for Health Officers. He received a doctor of science degree at the University of Hawaii in 1952.

After a year in Brazil with the Madeira-Mamore Railway, he returned to Hawaii in 1913 as resident engineer of Waiahole Tunnel, Honolulu; highway inspector and assistant city engineer, 1915 to 1917; sanitary engineer, Board of Health, 1917 to 1918; Honolulu city engineer, 1919 to 1923; chief engineer, Libby McNeill & Libby, 1924 to 1925; chief engineer of the Honolulu Sewer and Water Commission, 1925 to 1929; manager and chief engineer, Honolulu Board of Water Supply, 1929 until his retirement in 1952; trustee of the estate of James Campbell, 1952 until his death in 1957.

He will long be remembered for his untiring and continuing effort in developing and building Honolulu's outstanding water plant and system in his capacity of manager and chief engineer of the Board of Water Supply.

He was a member of Phi Gamma Delta fraternity, American Water Works Association, New England Waterworks Association, and Hawaiian Academy of Science, past president of the Engineering Association of Hawaii, and honorary member of the American Society of Civil Engineers. He also unstintingly gave his time to many civic affairs and for many years served on numerous commissions and boards and was named American of the Week.

Mr. Ohrt was known for his integrity and genuine friendliness which endeared him to all who knew him.

CONSTITUTIONAL AMENDMENTS

Revise ARTICLE III (MEMBERSHIP) to read as follows:

"Section 1. Any resident of Hawaii interested in science, or any person not a resident of Hawaii who is interested in scientific problems related to Hawaii, shall be eligible for election as a Member.

"Section 2. Election of Members shall be by majority vote of the Council. Each candidate for membership shall be nominated in writing by at least two Members of the Academy. Nominations, accompanied by deposits covering a year's dues, shall be submitted to the Membership Committee, which shall examine into the fitness of the nominees and shall recommend to the Council such nominees as it approves.

"Section 3. Members shall pay dues annually, before the second month following the Final Session of the previous Annual Meeting, except that any Member in good standing who has attained the age of 65 and who has paid dues for 10 years may be exempt from the further payment of dues. A member in arrears for eighteen months in the payment of annual dues shall thereby forfeit his membership in the Academy, provided the Treasurer shall have sent the delinquent Member two written notices of the existence of this rule and of his delinquency.

"Section 4. Any person or organization interested in supporting the objects of the Academy by annual contributions shall be eligible for election by the Council as a Contributor.

"Section 5. The annual dues of Members and the minimum annual contributions of Contributors shall be amounts recommended by the Council and voted by a majority of the members present and voting at a scheduled session. Notice of a proposed change in dues or minimum contributions shall be sent with the final announcement of the session."

Amend ARTICLE V (OFFICERS), Section 4, sentence 3, to read as follows:

"At least two nominees each shall be listed for the offices of President-Elect and Councilor."

In ARTICLE VII (COMMITTEES), Section 1, at the end of the first sentence, delete the phrase:

"as provided in Section 3 of Article III of the Constitution."

In ARTICLE VIII (MEETINGS), Section 4, delete the sentence:

"New members may not be elected at such sessions," and amend Section 6 of the same Article to eliminate subsection "g. Nomination and election of new members," and to re-letter the following subsections "g" through "k."

DUES AND CONTRIBUTION RATES

In accordance with the Constitution the following rates were established by the Academy on April 27, 1957.

Dues for Members:	$2.00 per year
Dues for new Members entering during second half of year:	$1.00
Minimum contributions for Contributors:	
For individuals	$10.00 per year
For organizations	$50.00 per year

MEMBERSHIP

APRIL, 1957

Abbott, Agatin T.
Adachi, Marian S.
*Adamson, Lucile F.
Aea, Raymond
*Akamine, Ernest K.
Akamine, Ralph Norio
Akau, Thelma I.
Akers, Ernestine
Albee, William
Aldrich, W. W.
Alexander, Henry Arthur
Alexander, W. P.
**Alicata, J. E.
*Allison, Samuel D.
*Amioka, Shiro
Anderson, Donald
**Anderson, Earl J.
Anderson, Eleanor
Anderson, John W.
Aona, Francis K., Jr.
Apple, Russell A.
Appleton, Vivia B.
Aragaki, Minoru
Arakaki, Harry T.
Arkoff, Abe
**Arnold, H. L., Jr.
*Arnold, H. L., Sr.
Asato, Hideo
Ashton, Floyd M.
**Atherton, J. Ballard
Aust, Ruth Ann
Austin, Thomas
Ayres, Arthur S.

Babbitt, Howard C.
*Baker, R. J.
†Baldwin, Helen Shiras
†Baldwin, Robert I.
**Ballard, Stanley
Ballie, David W., Jr.
*Balock, J. W.
*Banner, Albert H.
Barclay, John Edward, Jr.
Barker, Ned
Bartling, Wray B.
Bartz, Ellwood L.
Batten, Grover H.
**Baver, L. D.
Beardsley, John Wyman, Jr.
**Beaumont, J. H.
Beck, L. Clagett
Bell, Martha
Bennett, Thomas
Benson, Homer R.
Benz, Rudolph W.
Berk, Morton
Bernatowicz, A. J.
**Bess, Henry A.
*Bianchi, Fred A.
Bilger, Earl M.
Bilger, Leonora N.
Bishop, Brenda
Blaisdell, Malcolm
Bohlin, Elroy W.
Bolles, E. R.
†Bonk, William J.
Boone, Edward W.
*Boroughs, Howard
Bottenfield, Vernon C.
*Bowers, F. A. I.
Bowers, Neal M.
Bowers, Rohma L.
Bowles, Herbert E.
†Bowman, Hannah K.
Boyle, Frank P.
Breese, Paul L.
*Britten, Edward J.
*Britten, John R.
Broadbent, Frank W.
*Brock, Vernon E.
Brown, Charles S.
Bruce, Frank J.
Bruce, Robert P.
Bryan, Edward C.
**Bryan, E. H., Jr.
Bryan, L. W.
Bryson, L. T.
Burgess, C. M.
Burgess, H. C.
†Burnett, Gilbert, Jr.
**Burr, George O.
Burr, Mildred
Bush, William M.
Bushnell, O. A.
†**Buttles, W. William

Campbell, R. B.
Canty, Daniel J., Jr.
†Carlson, Norman K.
Carson, Max H.
†Carter, A. Hartwell
Carter, Harold J.
**Carter, Walter
†Castle, Northrup H.
Caver, C. V.
Chang, Richard K. C.
Chapson, Harold B.
Chiang, Richard Y.
Ching, Gilbert A.
Ching, Kim Ak
Chong, Mabel T.
Christ, J. H.
**Christensen, Leroy D.
Christian, Eloise
*Chu, George W.
Chun, Edwin Y.
Chun, Paul
Chun, Raymond K.
Chun, Richard K.
Chun, Sing K.
†Chun, William H.
Civin, Harold W.
Clark, H. B., Jr.
Clark, Richard H.
Clay, Horace F.
Clements, Harry F.
Clopton, Barbara
Clopton, Robert W.
Cloward, Ralph B.
Coff, Phyllis
Coleman, Edward
Coleman, Robert E.
*Comba, Paolo
*Connor, Mary R.
Cooil, Bruce J.
Cooke, Richard A., Jr.
Cooper, John W.
Corboy, Philip M.
*Cornelison, A. H.
**Cox, Doak C.
*Cox, Joel B.
Cox, Majorie L.
*Cox, Richard H.
Craig, Robert S.
Crosby, William
*Crowell, David
Culpepper, C. S.
Cummings, John E.
Curtis, Walter
**Cushing, Robert L.
†Custer, Charles C.

Darroch, J. G.
†Davis, Clifton J.
*Davis, Dan A.
Davis, Walter E.
Deacon, Edward H.
Decker, Bryce
Defibaugh, Betty Lou
**Degener, Otto
*Deibert, Austin V.
Denison, F. C.
Denison, Harry L.
Digman, John
Doi, Mitsugi
*Dole, Arthur A.
Doolittle, S. E.
**Doty, Maxwell S.
Doty, R. E.
Douty, Helen I.
Dow, Alfred J., Jr.
Downer, J. M.
Dull, Gerald G.
Duncan, Richard A.
Durant, Richard C.
Duvall, Allan R.

†**Easley, John A., Jr.
†**Eaton, Jerry P.
Eber, Laurence
**Edmondson, C. H.
Ego, Winifred T.
Eguchi, George
Ehret, William F.
*Ekern, Paul C.
*Eller, Willard H.
Elliott, Rex R.
Emery, Byron E.
Emory, Kenneth P.
*Emory, Tiare
*Enright, James R.

Fairchild, Mary
Fairchild, William
Fankhouser, Adolph
Faye, Alexander
Feiteira, Thomas M.
Feldwisch, W. F.
Felton, George
Fernandez, Leabert R.
*Fine, Jules
Florine, Charlotte M.
Fong, Albert C.
Fong, Francis
†Forbes, Fritz W.
**Forbes, Theodore W.
Fortin, Henry O.
**Fosberg, F. R.
Fox, Roy L.
Frodyma, Michael M.
Fujii, Takeo
Fujimoto, Giichi
Fujiwara, Thomas F.
*Fukuda, Mitsuno
Fukui, Iris
†**Fukunaga, Edward T.
Fullaway, D. T.
Furumoto, Augustine

Gaston, John Zell
Gay, Frank E.
Gebauer, Paul
Geiger, Magdalene
Gibson, Warren O.
*Gilbert, Fred I.
Gilbert, James C.
Girolami, Guido
Glasgow, James H.
Glover, Mary A.
Godfrey, Mary Lynne
**Gortner, Willis A.
Gosline, W. A.
Goto, George
*Goto, Shozuke
Goto, Y. Baron
*Gowing, Donald P.
Graham, Joseph James
Gray, P. S.
Gray, Ross H.
Greenland, Thomas C.
†Greenwell, Amy
Gregory, Christopher
**Gressitt, J. Linsley
Griswold, B. E.
Guild, Douglas S.
Guillard, Robert

Hacker, Louise
Hagens, Peter A.
Hagihara, Harold H.
Halperin, Sidney L.
*Halpern, Gilbert M.
Halsted, Ann L.
Hamada, Dorothy K. I.
Hamilton, Richard A.
Hamilton, Roland K.
**Hamre, Christopher J.
Hance, John
Handy, E. S. C.
†Hansen, John Harold
†Hansen, Violet
Hanson, Noel S.
Harada, Glenn K.
†Harada, M. B.
*Haramoto, Frank H.
Harbinson, John A.
**Hardy, D. Elmo
Hargrave, Vernon E.
Harris, Anna E.
Harry, J. V.
Hart, William E.
**Hartt, Constance E.
Hartwell, Alfred S.
Hashimoto, Shoichi
Hata, Tadao
Hawkes, M. F.
Hayashi, Toshiichi
Hebert, A. J.
Hedgcock, Grace
*Heinicke, Ralph M.
*Helfrich, Philip
Henke, Louis A.
Henry, G. W.
Herrick, Colin J.
Herschler, Louis H.
Herter, Walter B.
†Hewitt, Loren
**Hiatt, Robert W.
Higa, Hosi
Higgins, Nancy H.
Hilton, H. Wayne
†Hind, Robert L., Jr.
Hirokawa, Sueko Higa
Hitch, Thomas K.
Holladay, Natalie
Holmes, Wilfred
Holmes, William John
Holtwick, Chester B.
Honl, L. A.
Honnert, Henry
Hood, Ernest L.
**Hosaka, Edward
Hoskins, Charlotta M.
**Hosoi, Kiyoshi
Howard, Francis J.
Howe, Guy L., Jr.
*Hoyt, Simes T.
*Hsiao, Sidney C.
Hubbard, Howard
*Hudson, Loring G.
*Humbert, Roger P.
Hunter, Robert C.
†Hutchison, Frieda May

Ihrig, Judson L.
†Ikeda, Warren
Ikehara, Isaac I.
Inouye, Frank
†Inouye, Morris Hiroshi
Ishii, Mamoru
*Ito, Kiyoshi
Iversen, Robert T. B.
Iverson, Edwin S.
Iwanaga, Barney

*Member, American Association for the Advancement of Science.
**Fellow, American Association for the Advancement of Science.
†Member, Hawaii Division, Hawaiian Academy of Science.

Iwanaga, Isaac I.
†Iwane, John Y.
Iwata, Harry S.
Izumi, Homer M.

Jackson, Dean C.
Jacobson, J. Robert
Jermann, Fred
*Johnson, David
Johnson, Evelyne
Johnson, Harold M.
Johnson, Ralph B.
Johnston, Elizabeth E.
Jones, Everet C.
Jones, Thomas A.
Jones, Thomas S.
Joyce, Charles R.
Judd, Charles S., Jr.
Judd, Mary Stacey

†Kadota, Shizuto
Kagehiro, George
Kainuma, Richard T.
Kalish, Richard
*Kamasaki, Hitoshi
**Kamemoto, Haruyuki
Ng-Kamsat, Abraham
Kaulukukui, Felice W.
Kaneshiro, Yoshinori
*Kask, John Laurence
Katsuki, I.
*Kau, Geraldine
Kawahara, Lloyd T.
Kawamura, Setsuji
*Kawano, Henry
Kay, Alison
Keawe, Arthur
Keiser, Irving
*Keller, Arthur R.
Kent, Martha J.
Kerns, Kenneth R.
*Kerns, Lambert C.
Kim, Youtaik
Kimmich, Robert
*Kinch, D. M.
King, Joseph E.
King, Mary Eleanor
King, Maurice V.
King, Will Norman
Kingsbury, Joe W.
†Kishimoto, Richard H.
Kiuchi, Marian
*Klemmer, Howard W.
Klinkman, Helena
Knaus, John M.
*Kobayashi, Clifford K.
Koenig, Mary Ann
*Koike, Hideo
Kohn, Alan
Kondo, K. C.
*Kondo, Yoshio
Korshover, Julius
*Kopf, Kenneth
Kortschak, Hugo P.
*Koshi, James H.
Krauss, Beatrice H.
Krauss, F. C.
*Krauss, Noel H.
Kruse, Arthur C.
Kuebitz, Elinor
*Kuninobu, James T.
Kuramoto, Kikuo

La Fon, Fred
Lam, Margaret M.
Lam, Robert L.
Lambert, George E., Jr.
*Lamberton, A. R. H.
Lamoureaux, Charles
Lane, Irwin E.
Lange, Arthur H.
Larm, Edwin
Larrabee, L. M.
Larsen, Nils P.
Larson, Harry W.
Lau, Howard K. S.
Lau, Lawrence L.
Leak, Howard S.
Lee, Bernard C.
Lee, Hyun Moo
Lee, Richard K. C.
Lee, Violet Wongwai
*Leeper, Robert W.

Leffingwell, Roy J.
*Lennox, Colin G.
Leong, Kam Choy
**Levine, Max
Levine, Melvin L.
*Li, M. H.
Liljestrand, Howard
Lind, Andrew W.
†Lindgren, Bertha
†Lindgren, Henry
Linsley, Earle E.
Little, John
Livingston, William H.
Lloyd, Mary Lou Rothwell
Lo, Pershing S.
Lodge, R. H.
Lohman, Marion L.
†Loo, Mabel N. K.
Loo, Stanley Y. T.
Look, William C.
†Loucks, Burton J.
†Loucks, Ruth Baker
Louis, James L.
Louis, Lucille
Lowrey, John J.
Luke, Leslie
Luke, Margaret
Lum, C. K.
Lum, Theresa W. T.
†Lyman, Clarence
**Lyon, Harold L.
*Lytle, Hugh

McAlister, William C.
MacArthur, Lloyd W.
MacBride, Helen N.
McCleery, Walter L.
**Macdonald, Gordon A.
McGary, James W.
**McGuire, Donald C.
McGuire, Thomas R. L.
McKernan, Donald L.
McMorrow, Bernard J.
†McMullen, Betty J.
McNaughton, Boyd
McNaughton, Malcolm
**McQuarrie, Irvine
Mack, Merton H.
*Manchester, Curtis A.
**Mangelsdorf, A. J.
Mapes, Marion
Marks, Robert H.
Marlowe, Ralph H.
Marnie, James G.
Marshall, Donald C.
Martin, D. J.
Martin, Joseph P.
Martin, Robert T.
*Masatsugu, Teruo
Mason, George
Mason, Leonard
Massey, Ronnie
Masuda, Matsuko
Matsumoto, Walter M.
Matsuoka, Edward T.
Matsuoka, Shigeo
Matthews, Donald C.
Mau, Kong Tong
Maze, W. J.
Meeker, Harvey H., Jr.
**Mees, C. E. K.
Middleton, Charles R.
*Midkiff, Frank E.
Midkiff, John H., Jr.
Millard, R. D.
**Miller, Carey D.
Miller, Harvey A.
*Miller, Robert C.
Mills, George H.
Milnes, Marjorie B. R.
Milnor, John C.
†Minette, Henri P.
Mink, John F.
Mitchell, Donald
Mitchell, Wallace C.
Miura, Arthur S.
Miyake, Iwao
Miyasaki, Yuzo
Moe, Clayton R.
Moir, W. W. G.
Molyneux, A. V.
Momeyer, Kenneth W.
Moo, Eva
Moomaw, James C.
Mordy, Wendell A.

Morgan, Andrew L.
Morgan, Edward J.
Morgan, William A.
Morita, Kiyoichi
*Moritsugu, Toshio
Morris, Thomas G.
Mottl, Joseph R.
*Mullahey, W. J.
Mumaw, Charles
Murphy, Garth I.
Myers, William A.

†Nagao, Wallace T.
Nagasawa, Larry K.
Nakae, Haruko N.
†Nakagawa, Susumu
Nakagawa, Yukio
*Nakamoto, Goichi
*Nakamura, Eugene L.
Nakamura, Robert M.
†Nakao, Harry
Nakasone, Henry Y.
Nakata, Setsuko
Nakata, Shigeru
Namba, Ryoji
Naquin, Walter P., Jr.
*Narikawa, Stanley
Natsui, Dorothy
Naughton, John J.
**Neal, Marie C.
Nelson, Tell
Newhouse, Jan
Nicholson, James R.
Nickerson, Lydia C.
Nickerson, Thomas
Nishibun, Joe
**Nishida, Toshiyuku
Nishihara, Mitsuo
Nishijima, Satoru
Nishimoto, Katsumi
†**Nitta, Asako N.
†Noda, James
Nordfeldt, Sam
Norum, Edward M.
Nutter, Ben E.

O'Dea, Katherine
*Oguri, Mikihiko
*Ohta, Ella Miyeko
Okazaki, Kyuro
Okubo, Laura
Orr, Kathryn J.
*Otagaki, Kenneth K.
Otsu, Tamio

*Palafox, A. L.
Palma, Joseph
Palmer, Clarence E.
*Palmer, Harold S.
Pang, Herbert G.
Pang, L. Q.
Pang, Morris S. Y.
Parry, H. Dean
**Payne, John H.
Pedley, Blanche A.
Pell, Charles G.
Pelle, Salvatore A.
**Pemberton, C. E.
Pen, Florence
Penhallow, H. Chadsey
†Penhallow, Richard
Peperzak, Paul
Peters, Charles W.
Phillips, Lyle
†Pierce, J. Howard
Pinkerton, F. J.
Pinkerton, O. D.
**Poole, Charles F.
Porter, Paul H.
**Powers, Howard A.
Price, Samuel
Price, Saul
Price, Sumner

†Quaintance, D. C.
†Quaintance, Evelyn

Rainwater, H. Ivan
Ramage, Colin S.
Randall, John E., Jr.
Rea, Jessica L.

**Reber, Grote
Reid, Della F.
Reppun, C. Eric
*Reppun, J. I. Frederick
Rhodes, Leon J.
Richert, T. H.
Rigler, Robert G.
Rinkel, Murice O.
Ripperton, J. C.
*Roberts, Joyce O.
*Robinson, William A.
Rockwood, Paul C.
Rose, Bernard
Rose, Stanley J.
Rosenberg, Morton M.
Ross, Serge
Rossier, Charles
†*Ruhle, George
Rusch, Kenneth H.
Russell, Robert D.

St. John, Harold
Sakata, Seiji
Sakimoto, Richard Y.
*Sakimura, K.
Samson, Walter H.
*Sandberg, Floyd A.
Sanford, Norma
*Sanford, Wallace G.
Santoki, Saburo
Sayer, John T.
Schaefer, F. A., III
Scheuer, Paul J.
Schmidt, Carl T.
Schmidt, Helen D.
†Schoen, Eleanor C.
†Schoen, Frederick
Schwartz, Herbert
Scott, Arlen M.
Scott, Frank S., Jr.
Seckel, Gunter R.
Sedgwick, John R., Jr.
Seeley, DeLos A.
Sexton, Harold M.
Shaw, Thomas N.
Shepard, R. Frederick
*Sher, S. A.
Sherk, Kenneth W.
**Sherman, G. Donald
Shigekawa, George
Shigemura, Richard H.
†*Shigeura, Gordon T.
Shimabukuro, Seichi
Shippen, Herbert H.
Shiramizu, William T.
Shiras, Edwin Paul
Shklov, Nathan
Shoemaker, James H.
Shomura, Richard S.
**Sia, Richard H. P.
Sideris, C. P.
Silva, James A.
Simpich, Frederick, Jr.
Sinclair, Gregg M.
*Singleton, V. L.
Slattery, Mabel
*Sloan, Norman R.
Sloane, George E.
**Smith, Donald H.
*Smith, Elbert C.
Smith, Jimmie B.
**Smith, Madorah E. S.
Smith, R. Q.
Spalding, P. E.
Spalding, Philip E., Jr.
Sparaga, Albert
Spencer, Frank C.
Spencer, Robert S.
*Spiegelberg, Carl H.
Spoehr, Alexander
Spooner, William M.
Spring, Thomas
Steiger, Walter R.
Steiner, Loren F.
†Stephens, Ella
Stevens, William H.
Stokes, J. F. G.
Strasburg, Donald Wishart
Strode, Walter S.
Stuhler, Louis G.
Suehiro, Amy
Sullivan, Neil J.
Sumner, George W., Jr.
†Sutherland, Mark M.
Suzuki, F. T.

Takagi, Yoshie
Takahashi, David
Takahashi, Makoto
Takasaki, Kiyoshi
Takazawa, Futoshi
Tanaka, Tokushi
*Tanimoto, Ralph H.
Tanimoto, Tyrus T.
Tanoue, Roy T.
†Tatsuoka, Maurice
Terayama, Hajime
**Tester, Albert L.
Theaker, M. L.
Thomas, Ernest H.
Thompson, Douglas B.
†Thompson, William Y.
Threlkeld, Garland M.
Tilden, I. L.
Tinker, Spencer
Titcomb, Margaret
Tom, Lorna
Tomita, Theodore
Townes, Edith
Townsley, Sidney J.
Trefz, Shirley M.
Trexler, Clarence W.
Trouse, Albert C., Jr.
Tu, Chen-Chuan
**Tuthill, Leonard
Tuttle, Daniel W.
Tyau, Steven
Tyler, Arthur R.

Uchida, Richard N.
Uehara, Mitsuko Sandra
Urata, Rokuro
Uyehara, George K.

Valenciano, Santos
Van Campen, Wilvan
Van Landingham, John William
**van Weel, Pieter
Van't Woudt, Bessel D.
*Van Zwaluwenburg, R. H.
Vasconcellos, A. L.
Vernon, Mabel D.
**Vinacke, W. Edgar
Vinacke, Winifred R.
Visher, Frank N.
Vollrath, Harvey M.
Voorhees, George

**Wadsworth, Harold A.
Wagoner, Howard Eugene
Wainwright, Stephen
Wakatsuki, Helen
Waldron, Kenneth D.
Walek, F. M.
*Walker, H. A., Jr.
*Walker, Hastings H.
Wallace, Arthur F.
Wallace, Keith K.
Wallrobenstein, Paul R.
Walsh, William
*Waring, Gerald A.
Warner, Bernice
Warner, H. H.
**Warner, John N.
Warner, Richard E.
*Wassman, Rudolph Carl, III
Watanabe, K.
Watson, Donald E.
Watson, Leslie J.
*Wayman, Oliver
Weaver, Herbert
†Weeks, John D.
Weller, D. M.
†Welsh, Pearl Hageman
Wenkam, Nao
**Wentworth, C. K.
†Wentworth, Juliette
Whitcher, S. L.
White, J. Warren
Whiton, Nat
Wigmore, Mary E.
Wiig, Laurence M.
Wiley, Frank
Wilson, Robert C.
**Wismer, Chester A.
Withington, Paul
†Wold, Myron L.
Wong, Arthur G. H.
Wong, Erwin L. S.
†Wong, Kenneth A.
Wong, Ruth E. M.
†Wong, Ruth O. T.
†Woodside, David H.
Wortman, Sterling
Wylie, W. Gordon

Yamamoto, Earl S.
Yamamoto, Tatsuji
†Yamanaka, Leslie
Yamane, Richard N.
Yamasaki, Yoshio
Yamashita, Daniel T.
Yamauchi, Shoyei
Yamaura, Teruko S.
Yanagihara, Iichi
Yee, Samuel L.
Yoshida, Howard O.
Yoshina, Teruo
Yoshioka, Tad T.
*Young, Hong Yip
Young, Robert S.
Yuen, Heeny
Yuen, Quan Hong

Zane, Lawrence F. H.
Ziesel, Edward Loeling
Zoebisch, Oscar C.

NEW MEMBERS ELECTED FOR 1957-1958

Bartos, Otomar J.
Beamer, Martha F.
Blackburn, Maurice

Clagg, Charles F.
Chun-Ming, Archie
Crawford, Carolyn

Dalton, Patrick D., Jr.

Frissell, Thomas P.
Fujita, George
Fujitani, Miharu
Furumoto, Howard H.
Furumoto, Viola C.

Glick, Clarence E.

Hormann, Bernhard L.

Ing, Lucille L.

Low, Frank Y. F.

Maeshiro, Melvin M.
Morgan, Eugene P.

Ross, Ernest

Saito, Herbert T.
Shigeta, James Y.

Takata, Harry H.

Waugh, John L. T.

Yee, Warren Y. J.

PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

THIRTY-THIRD ANNUAL MEETING 1957-1958

Published by the University of Hawaii Honolulu, Hawaii, 1958

CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

PRESIDENTIAL ADDRESS 1958

HAWAII: FRONTIER OF SOCIAL SCIENCE RESEARCH[1]

ANDREW W. LIND[2]

Down through the 180 years which have elapsed since the British explorers, with Captain James Cook, first revealed to the Western world the existence of these mid-Pacific islands, Hawaii has performed a variety of different roles and has acquired a variety of different reputations. The great explorer recognized his last discovery as being "in many respects . . . the most important that had hitherto been made by Europeans throughout the extent of the Pacific Ocean," and Cook's journal clearly reflects his conception of these tiny islands as an invaluable stopping point on the lonely sea lanes of the Pacific, a conception incidentally which still accurately describes one of Hawaii's most valued functions in the modern world.

The comment, recorded perhaps as an afterthought at the close of Cook's first visit to the Islands, stands as a prophecy of Hawaii's most persistent function during the decades which followed: "How happy would Lord Anson (his noted British predecessor in the Pacific) have been and what hardships would he have avoided if he had known that there was a group of islands, half way between America and Tinian, where all his wants could have been effectually supplied."

Later characterizations of Hawaii's major function in the modern world tend to focus attention upon the internal nature and use of the islands rather than their external position and role. How frequently and with what apparent cogency has Hawaii's destiny been stated wholly in terms of land utilization—of the most efficient cultivation of certain specialized agricultural crops, for which the peculiar Hawaiian soils and climatic conditions are especially suited. Hawaii's one obvious resource, and in a certain sense its only native and immutable possession, is the land, thrown up from the sea as rugged lava heads or coral reefs and transformed into arable soil through slow weathering and the action of plant and animal invaders. Yet recognizing that for many generations Hawaii's most evident wealth has consisted of its severely limited land, there are now equally palpable evidences that its use for the cultivation of agricultural crops is rapidly being displaced by other quite different uses. The assured predictions that Hawaii's future lay in its crop of sandalwood—to go back a century and a half—or in vegetables and fruits for the whaling trade, or in plantation crops such as coffee or rice, or even sugar or pineapples, have all appeared reasonable enough at successive periods in Hawaii's history but have subsequently been thrown into question by changed conditions.

Other observers, using much the same premises, have conceived of Hawaii as a microscopic speck, lost in the vast Pacific, whose limitations in land compel the Islanders to guard their meager resources with utmost care. It is insisted that land and a favorable climate are the only resources which nature has provided and that man must conserve these precious gifts by the extra use of intelligence and skill. To compensate for nature's niggardliness in land, as well as the serious disadvantage of geographic isolation in the wide wastes of the Pacific, it is necessary to make heavy investments in science and technology. Actually Hawaii's expenditure on technology and research in its basic industries is probably without parallel in any other agricultural region on the face of the earth. Hawaii's phenomenal outlay for research on pineapples and sugar alone, estimated at \$3.5 million per year, is unquestionably a function of the exceptionally high yields in both industries, as well as of the severe limitations in arable land to which they are subjected. If, to the research budget for these two basic plantation crops is added another million dollars expended annually by the Hawaii Agricultural Experiment Station, one arrives at the somewhat breath-taking figure of \$4.5 million devoted each year to agricultural research in the Territory, representing a capital investment of at least 110 million dollars. For many years, science, particularly as it relates to the cultivation of agricultural crops, has been of central and vital interest to the economy of Hawaii, and it has received generous support from both island industry and the federal government for the tangible results which it has achieved. It is no accident that Hawaii can claim to have surpassed all the states of the Union, for which data are available, as to the per capita membership in its Academy of Science and that the great majority of the persons enrolled are engaged in the natural and physical sciences.

Still other factors, such as climate, or race, or particular personalities, have been seized upon as providing a major clue to Hawaii's peculiar history and destiny. More than one competent observer has seriously suggested that our location on the edge of the tropics, with the happy conjunction of mountains and fresh sea breezes, does effectively explain Hawaii's unusually favorable race relations or that, as one Islander expressed it, "the humidity took the starch out of the clerical collar and loosened the stitches of the trader's money bags so that strife, bigotry, and greed were displaced by good humor, tolerance, and generous living." The easygoing disposition of the native Hawaiian, to whose friendly temperament and aloha spirit the amicable associa-

[1] Delivered at Final Session, May 10, 1958.
[2] University of Hawaii.

tion between all the various ethnic groups in Hawaii is so commonly attributed, appears especially susceptible of explanation on grounds of the physical environment. Social psychologists have proposed that hanging on to grudges "may be too laborious for these latitudes" and that the greater malleability of the Hawaiians as compared with their first cousins, the Maoris, the feebler resistance of the Hawaiians to cultural change and their lack of belligerence are a consequence of the climate. By the same token, of course, it has been argued that Hawaii can never hope to make any substantial contribution to the culture or civilization of the world, by virtue of its location outside the range of the supposedly stimulating climatic regions of the world. Similarly, the virility and vigor of the peoples from the temperate zones are allegedly deteriorated, if not destroyed, once they settle in Hawaii; the iron in the blood, so goes the ancient canard, turns to lead in their pants.

One might continue to list, but there would scarcely be time to examine in any detail, the numerous ideas and theories evolved to rationalize Hawaii's peculiar experience. Except as a diversion, however, as an entertaining, but obviously futile academic exercise, such efforts might be regarded as having little value, particularly within the confines of science. Indeed, it may be argued that problems of anything like the complexity and diversified nature of those suggested thus far must first be wholly redefined in simpler, more direct, and positive terms before they merit attention within scientific circles.

One might go further and insist, as some critics have, that any configuration in which man and his mutable passions are involved is by definition unsuited for scientific analysis, or, at any rate, that the efforts thus far to subject human society, either in Hawaii or anywhere else, to the discipline of science have been relatively ineffectual. To judge by the financial support assigned to studies of man and his social relationships, one would be forced to conclude that the general public, or at least its political representatives, shared in this evaluation of the social sciences. For example, during the post-war flurry of interest in science and the phenomenal growth of the National Science Foundation, the social sciences have been virtually excluded from consideration. In 1954, federal research support was overwhelmingly to the physical and biological sciences, with only 2 per cent allotted to the social sciences. Industrial research, according to the AAAS Committee on the Social Aspects of Science, is at least as heavily slanted toward the physical and biological sciences.

This is scarcely the place to examine the question as to the susceptibility of human behavior and relations to scientific analysis but perhaps a few passing comments by an admitted convert to one of the social sciences may not be wholly out of place, particularly since, to my knowledge, this issue has never heretofore figured in the discussions of the Hawaiian Academy. Certain concessions to the critics are immediately in order. The application of the scientific method to human society is, of course, a relatively recent development and the achievements are correspondingly meager. Systematic analysis, with a view to abstracting basic principles and laws, is obviously more difficult with problems suffused with human loyalties and prejudices. The impatience to translate research into action and to identify science with causes and movements is especially acute in matters affecting human welfare and survival. To those who are constantly beset by the popular admonition, "For God's sake, let's do something about it, instead of just looking at it," scientific objectivity does not always "come naturally," while the pressure to offer blithe assurances that social "science can save us" is frequently difficult to resist.

Granting that many of the tasks with which the social scientist is faced require more objective and specific formulation than they have thus far received, that in many areas only the outer frontiers have as yet been penetrated, and that the methods employed are sometimes of a pioneering character, while the pretensions of success are occasionally exaggerated, I would insist that progress has been made and that the prospects for the future are bright.

What I shall have to say from this point onward is largely derived from the investigations, observations, and discussions conducted during the past two years by a small group of social science colleagues at the University of Hawaii—anthropologists, economists, political scientists, geographers, and sociologists—and from the results of a questionnaire submitted by them to some 65 members of the University faculty interested or engaged in social science research, including educators, historians, linguists, and students of speech. At certain points, I shall merely paraphrase portions of a brochure soon to be published by this committee. Briefly and all to simply stated, the point of view presented here is that these Islands, small in size and therefore more amenable to close observation and study, compress within the past 180 years of their history many of the same basic processes through which underdeveloped regions elsewhere in the world are destined to pass during the years which lie ahead. Let me now suggest several areas in which this thesis appears to merit closer scrutiny.

Frontiers of Social Science

Roughly half of the world's population, more especially that of Asia and Africa, but including much of Eastern Europe and Central and South America, are peasant peoples who are likely to experience within the next generation the disrupting influences of an expanding industrialized civilization. The industrial and technological revolution, which is now sweeping over these underdeveloped areas, brings in its wake a host of unsuspected consequences even more devastating than those in Western Europe a century and a half ago.

Hawaii has only recently undergone a series of economic, political, and cultural transformations, quite as revolutionary in character as those in Europe and America at an earlier date or in Asia or Africa today, but with generally far less devastating social consequences. Within less than two centuries, one of the most isolated stone-age folk cultures of the world has been supplanted in turn by trading, plantation, and highly industrialized economies and cultures. Probably nowhere else in the world has there occurred within such a short space of time, the cultural, political, and economic mutations inherent in the industrialization of a region. Without losing sight of the unique and unparallelled character of much in Hawaii's experience, the social scientists is even more impressed by what the Islands share with vast areas of the world as they are being absorbed within the expanding world community of industry and commerce.

Particularly impressive to many observers of the world scene has been the widespread and ominous social unrest generated in part by the accelerated population growth with which this transformation is commonly associated. The explosive potentialities of a world whose population has increased by approximately 700 million persons or one quarter of its size within 25 years—most of it in the underdeveloped countries—is quite clearly a by-product of industrialization and the introduction of Western medicine and public health. Shades of Thomas Malthus!

The special insights into the nature and mechanisms of this so-called "world population bomb," which a detailed analysis of Hawaii's highly documented census record can provide, emanate from the presence here and the interaction of peasant peoples with rising expectations, quite comparable to those of the masses in Asia and Africa today. The census data for Hawaii, extending over a period of a century and unparallelled for detail and reliability elsewhere on the frontiers of modern industrialism, permits a close examination of what may happen to the peasant peoples of Asia in an industrial and commercial outpost. The scientific significance of Hawaii's experience with respect to population, however, depends less upon its value as an index of what will happen in Indonesia, or Malaya, or Kenya during the next quarter century than as the matrix from which to extract fundamental hypotheses and principles. One might mention here as a portent of others yet to be discovered, Bernhard Hormann's theory of the differential experience of isolated folk peoples, such as the native Hawaiians, and of peasant peoples, like the Chinese, Japanese, or Portuguese, in an area of expanding industrialism. The folk peoples diminish in numbers, sometimes to the point of extinction, whereas peasant peoples increase. Suggestive at least as a clue to what may be expected to happen elsewhere has been the decided drop in fertility rates among the immigrant peoples once they are weaned away from their peasant morality of fruitfulness and family virtue by the individualized goals of material comfort and personal success.

The closely associated problem of what Chester Bowles has called the "revolution of rising expectations" is likewise one in which Hawaii's experience should shed considerable light. Our age, according to Arnold Toynbee, is the first since the dawn of history in which mankind dared to believe it practical to make the benefits of civilization available to the whole of the human race, but the spread of this idea at a time when it is still so far from realization obviously spells danger. In Asia, Africa, and Latin America, continues Bowles, ten times the population of the U.S. lives on a little over one-third as much income, and the economic gap between the favored areas of Western Europe and America, on the one hand, and the underdeveloped regions of Asia and Africa, on the other, have been steadily widening instead of shrinking since World War II. This situation is clearly grist for the communist mill, and the problem is further aggravated by the long history of many of the less fortunate areas as the colonial wards of the economically favored Western nations.

Hawaii has virtually completed the revolution of rising expectations. The peasant peoples of Asia and Europe, who came to these islands with virtually nothing but the clothes on their backs, were assured a livelihood and have in many instances found a fortune. They have encountered, particularly during the early period of plantation or urban residence, many of the frustrations and discriminations which always face the uninitiated in a new venture, but as they have learned the rules of the game of industrialized society they have also advanced. Unquestionably some of the peculiar circumstances of the Hawaiian situation, including the American legal guarantees and the conceptions of fair play, as well as historical accidents of the Island setting, have played an important part in the speed with which the various peasant groups have been able to advance on the economic ladder. But here again Hawaii's experience is valuable, not as a guide to what other regions either can or should do, but rather as a test case of what is inherent in the process of industrialization. The broad outlines of the occupational adjustments of both immigrant and native peoples and their movement up and down the social and economic scale have been traced in preliminary form by Island social scientists, but these processes, and particularly their implications with respect to personality development and mental health, deserve further amplification.

That peculiar abberation of the 19th and 20th centuries, commonly referred to as race, is obviously one for which Hawaii is popularly supposed to have a magic formula. Every visitor of note, from premier to movie star, no matter how uninformed he may actually be about the Islands, has somehow acquired the sense that Hawaii's harmonious race relations is always a safe theme on which to ingratiate himself with the local public, particularly if he goes on to urge that the rest of the world should follow Hawaii's example. The familiar stereotypes for Hawaii as "the melting pot of the races," or "the racial paradise of the Pacific" have long since lost their appeal for Island social scientists as being neither accurate nor apt. And yet race is an *idée fixe* which affects the modern world as few others do—a threat to its peace and order no less ominous than the hydrogen bomb or the cold war. Whether we wish it or not, I suppose that Hawaii is destined to be cited as the striking example of race relations—magnificent to those who approve and horrible to those who disapprove of what is happening here. Social scientists in Hawaii will be forced to continue their attention upon matters of race, for their own protection and self respect in the face of enquiry from the rest of the world if for no other reason.

Hawaii's contribution to social science research in this field, both in terms of studies already completed or others which might be made, is, I suspect, somewhat different from what is commonly assumed. The proposition, so frequently stated in the popular press and repeated by almost every visiting VIP, that Hawaii's pattern of race relations is an exportable product along with sugar and pineapples may be flattering to our pride but it is scarcely an issue for scientific determination. One of the most elementary discoveries of social scientists working in this field, is the complexity of the problem and the impossibility of divorcing Hawaii's race relations from the total economic, political, and cultural complex of which it is a part.

On the other hand, the favorable circumstances for the study of race and of race relations in Hawaii offer the prospect of being able to abstract at least some of the underlying principles which operate wherever peoples of diverse biological or cultural heritages live together. Perhaps a major contribution here may be a further clarification of what is meant by the term race. Certainly this is an area in which further light is greatly needed, particularly when the scientific authorities themselves are so badly divided. Witness the attempt by a group of social scientists who were commissioned by UNESCO a few years ago to resolve this issue once and for all. They labored for days and finally evolved a compromise statement of which the major conclusions were that the biological groupings, called by them races, had been mixing from the earliest times, that people commonly confuse race with culture, and that consequently "it would be better when speaking of human races to drop the term 'race' altogether and speak of ethnic groups." The ink was scarcely dry on the paper, however, before other scientists began to protest the statement and UNESCO was compelled to convene another conference to further clarify or confuse the issue.

From the perspective of these Islands and the work of social scientists here, it seems doubtful whether this issue will ever be resolved by a priori reasoning or academic fiat. Insofar as race functions today as a critical factor in human conduct, as the nuclear stuff of foreign affairs to use Carleton Coon's expressive phrase, it is clearly a matter of social consciousness, of what large masses of people think and feel and do about other masses of people. These are the realities of which the social scientist must obviously take account, and which figure so prominently in every area where peoples of diverse cultures and physical casts are thrown together to work out a common destiny. The major social groupings of Hawaii, our so-called races, would definitely not qualify according to the UNESCO definition of race, but they are factors of especial significance in the island social scene which the social scientist dare not disregard. Indeed, the analysis of what they are, how they come into being, how they function, and how they disappear, this is doubtless the one unique contribution to social science, theoretical as well as applied, which local students are called upon to make.

One is tempted but for the limitations of time and your patience to elaborate upon a variety of other researches for which the island setting is peculiarly fitted. The fascinating story of what happens in the meeting between peoples of sharply contrasted cultures, such as Chinese and Japanese, Hawaiians, Puerto Ricans, and Portuguese, and what changes occur in their families and religions, their moral values, their hopes and aspirations, this is a story which needs to be told by historians and social scientists working together, if only to preserve the rich human drama of every such cultural crossroads. Such a detailed social history, reflected ultimately in the colorful experience of individual persons, would provide the raw material out of which to abstract the basic principles which operate in every such region. The decline and revival of native cultures, the struggle of minority groups for status, including nativistic and nationalistic movements, the individual and collective efforts to maintain or to cut across racial and class lines by means of the immigrant or creole languages, by language schools or public schools, and the press, these and many others are universal characteristics of a plural society, for the analysis of which Hawaii's resources are probably unexcelled.

In this somewhat spotty survey of Hawaii's special opportunities for social science research, attention has been focused almost wholly upon the problems which these Islands share with those other portions of the world which are now in process of being absorbed within the ever widening world community. This is not to minimize the importance of the extensive applied research on industrial personnel and institutional relations and public polling which has been conducted in this community in much the same way that it would in any modern industrialized community in America. Hawaii does, however, possess peculiar facilities for social science research not enjoyed by any other community, either in America, or for that matter, in the world. By the appropriate utilization of these facilities, social scientists in Hawaii may contribute significantly to the understanding and perhaps the control of the world in which we live.

ANNUAL REPORT 1957-58

The Hawaiian Academy of Science started its thirty-third year with a membership of 800 and ended with 920. A total of 164 applications for membership were accepted. Membership losses were 23 for non-payment of dues, 16 by resignation, and 5 by death.

We record with regret the names of those lost by death:

Ernestine Akers	E. A. Fennel	Harold L. Lyon
J. H. Beaumont		Laurence Wiig

The recent rapid increase in membership has elevated the Academy to twelfth in size among state academies of the nation and first on a per capita basis.

The Academy was ruled exempt from Federal income tax on February 4, 1958, as an organization organized and operated exclusively for scientific and educational purposes. Contributions to the Academy therefore may be considered tax deductible by donors.

Sterling Wortman, Secretary

FINANCES

General Funds

Balance on hand April 27, 1957		
Bank of Hawaii deposits	$ 425.80	
First Federal Savings & Loan	535.99	$ 961.79
Less checks outstanding		95.79
		$ 866.00
Receipts		
Dues	$1,549.00	
AAAS grant (for Radford High School Biological Society)	35.00	
Annual Dinner, 67 reservations	167.00	
Reprints sold	139.52	
Donation	.50	
Dividends, First Federal Savings & Loan	18.88	$1,909.90
		$2,775.90
Disbursements		
AAAS Research grant (Radford High School Biological Society)	$ 50.00	
AAAS donation to operational fund	8.00	
Annual Dinner, 67 reservations	167.00	
Hawaii Science Fair	200.00	
St. Anthony's School Science Fair	17.00	
Honoraria (2 at $25 each)	50.00	
Office supplies and stationery	387.27	
Postage	187.98	
Printing of Proceedings (1956-57)	529.22	
Printing of programs (3 times)	104.42	
Projector operator	2.25	
Reprints of abstracts from Proceedings	157.63	$1,860.77
Balance April 30, 1958		$ 915.13

Balance on hand April 30, 1958		
Bank of Hawaii statement	$ 379.59	
Cash deposited April 30, 1958	31.00	
First Federal Savings & Loan	554.87	
	$ 965.46	
Less checks outstanding	50.33	$ 915.13

Audited and found correct, May 3, 1958.

(s) W. M. Bush

(s) Chester A. Wismer

Science Fair Fund (Preliminary)

Receipts		$5,719.00
Disbursements		
Insurance	$ 154.19	
Janitor Service	180.00	
Meals	1,019.00	
Miscellaneous	10.00	
Plane Fares	378.56	
Postage	8.00	
Printing and stationery	522.10	
Signs	86.47	
Slides	90.00	
Telephone and telegraph	3.76	
Travel (Mainland)	2,442.43	
Wages	96.13	
Total disbursements		$4,990.64
Net Excess of Receipts over Disbursements		$ 728.36

MEMBERSHIP

As of May 6, 1958 (March 1957–May 1958) the Membership Committee has proposed 164 candidates for membership. These were elected by the Council of the Academy.

The Chairman wishes to make official note of his appreciation to Mrs. Shizuno Ebisuzaki for her unfailing and abundant assistance to the Committee.

Membership Committee

Donald P. Gowing, Chairman

Abe Arkoff	Beatrice Krauss
Elizabeth Carr	A. H. Lange
George W. Chu	C. T. Schmidt
J. G. Darroch	D. H. Smith
G. G. Dull	Andrew W. Lind, ex officio
P. C. Ekern	Sterling Wortman, ex officio

AFFILIATION

The major intersociety endeavor of the year has been the organization and conduct of the First Hawaiian Science Fair under the guidance of the Science Fair Executive Committee consisting of representatives of the Academy and its several Associated Societies, and headed by Leon Rhodes.

The success of the Fair may most readily be indicated by a few statistics. About 2,000 students, in public and private intermediate and high schools of Hawaii, Maui, Lanai, Oahu, and Kauai, participated through the preparation of some 750 exhibits. Of these, 157 were selected by judges appointed by the Exhibits Committee, headed by Ralph Heinicke, for exhibit at the central Science Fair held April 11-13 in Honolulu. The Site and Props Committee, headed by Wayne Hilton, arranged for the setting of these exhibits at Fort DeRussy. So successful was publicity, arranged by a Public Relations Committee under Peggy Hickok, that an estimated 12,000 persons were attracted as visitors. Contributions of materials and services greatly assisted in staging the Fair, and the Community Participation Committee, headed by Clarence Fronk, successfully solicited contributions covering a cash budget of approximately $5,500. These contributions are, by the way, to the Academy since the Academy established in its name, for tax reasons, the Science Fair Fund under Dwight Lowrey of Cooke Trust Company, the Science Fair Treasurer.

Judges appointed by the Exhibits Committee selected a considerable number of exhibits for awards, and the top boy and girl winners, Steven P. Gouveia and Naomi Kuniyuki, have been sent with their exhibits, and accompanied by Mr. Rhodes and Dorothy Rainwater, Secretary of the Executive Committee, to the National Science Fair in Flint, Michigan.

The Academy has nominated these top winners to honorary junior membership in the AAAS and has awarded complimentary Academy memberships to the fourteen teachers who served as advisors to the several award winners.

The Affiliation Committee has approved, and is forwarding to the several societies concerned, a resolution adopted by the Science Fair Executive Committee that such fairs be held annually under the auspices of a special Science Education Committee, to be organized in the Academy but to include representatives of the Associated Societies, which would be concerned generally with problems in science education and which would appoint a Science Fair Director.

Affiliation Committee
Doak C. Cox, Chairman
John H. Payne, Society of Sigma Xi
Amer. Chem. Soc., Hawaii Sec.
Donald H. Smith, Amer. Soc. Agron., Hawaii Chap.
Richard Takasaki, Amer. Stat. Soc., Hawaii Chap.
Leonard E. Mason, Anthrop. Soc., Hawaii
Saul Price, Geophs. Soc., Hawaii
Beatrice Krauss, Hawaii. Bot. Soc.
W. Wayne Boyle, Hawaii Ent. Soc.
W. Harold Civin, Hawaii Med. Assoc.
George F. Harding, Hawaii Psychol. Assoc.
Doak C. Cox, ex officio
Andrew W. Lind, ex officio } Hawaii. Acad. Sci.
Sterling Wortman, ex officio

AAAS REPRESENTATION

The Academy was represented at the Indianapolis AAAS meeting last December. Once again the Council meetings and Academy conferences proved to be of much interest, with discussions continuing to be concerned with means of stimulating and maintaining the interest of young people in science. Apparently, effective and dedicated leadership is an important factor in the success of junior scientist programs. Where this has been available the results usually have been more than gratifying despite numerous problems that have to be solved. There has been much improvement in public interest and growing support of certain facets of science stemming from recent satellite launchings. Indications are that effective preparation of young people for scientific careers and maintenance of proper balance and perspective among the various scientific disciplines will present a continuing challenge.

It is hoped that the Hawaiian Academy will continue to be represented at the annual meetings, preferably by members active in Academy affairs. Aside from the direct bearing of conference proceedings on Academy operations, representation also affords some opportunities for stimulating increased awareness of the quality of Hawaiian research and the favorableness of our island location for many kinds of fundamental studies. Further development of the research investment in Hawaii should remain a constant objective.

AAAS Delegate
L. D. Christenson

PROGRAM

The Thirty-Third Annual Meeting was held in two regular sessions, with the addition of five special meetings. The first session, held on November 7 and 8, at the HSPA Experiment Station Auditorium, included nine volunteer papers by various members and one invitational paper, "Hawaii's Role in the International Geophysical Year," by Dr. Walter Steiger.

The winter special session, held on February 20 and 27, was made up entirely of invitational papers. On the first evening four speakers gave papers grouped under the theme, "The Place of Social Science Research in the Modern World." On the second evening five speakers gave papers under the general title "Contributions to Science from the Ninth Pacific Science Congress in Bangkok, Thailand." Introductory comments were given by President Andrew W. Lind.

The final session, held on May 8, 9, and 10, included two evenings of contributed papers, read at the Chemistry Building auditorium, University of Hawaii campus. On May 9, six papers were presented. The session ended with a banquet at the Hawaiian Village Hotel on May 10, with the program including an address by Dr. Herbert Feigl, Carnegie Visiting Professor of Philosophy, entitled "Current Trends in the Philosophy of Science," and the presidential address by Andrew Lind, "Hawaii: Frontier of Social Science Research." The final session, as well as the fall regular session, included a business meeting.

A special session was co-sponsored with the Society of Sigma Xi on October 10 to hear Dr. Karl Meyer, Professor of Biochemistry, College of Physician and Surgeons, Columbia University, whose paper was entitled "Studies on Connective Tissue." A special session on December 12, also sponsored with Sigma Xi, presented Dr. Walter E. Thirring of Berne, Switzerland, whose paper was "Fundamental Particles." On February 6, the Academy and Sigma Xi again cooperated in presenting Dr. Gottfried S. Fraenkel in a public lecture, "Biochemistry of Host Specificity of Phytophagous Insects." The last special session was held on April 17, when the Academy in co-operation with Phi Beta Kappa presented Dr. Joshua Whatmough of Harvard University who spoke on "Man Makes Language and Language Makes Man."

Program Committee
Elizabeth Carr, Chairman

Robert Brown	John J. Naughton
Doak C. Cox	Vernon Singleton
Kenneth P. Emory	Andrew W. Lind, ex officio

Sterling Wortman, ex officio

NOMINATIONS

The Nominating Committee prepared a slate of candidates for the following offices for 1958-59: President-Elect, Vernon E. Brock and Morton M. Rosenberg; Councilor, Harold W. Civin and Fred I. Gilbert; Secretary, Sterling Wortman; and Treasurer, Eleanor S. Anderson.

Nominating Committee
A. J. Mangelsdorf, Chairman

Harry Arnold, Jr.	Alexander Spoehr
R. L. Cushing	Leonard Tuthill

Andrew W. Lind, ex officio

AUDIT

The Auditing Committee examined the Treasurer's report, summarized above under FINANCES, and found it correct and in order.

Auditing Committee
William M. Bush, Chairman   Chester A. Wismer

SCIENCE TEACHERS

The Science Teachers Committee made recommendations for the disbursement of funds available to the Academy for high school science projects, particularly with regard to funds that would revert if not spent by January 1, 1958.

It was recommended that fifty dollars go to the Radford High School Biological Society to further their botanical garden project.

Arrangements were made to supply speakers on request to local high schools for career counseling sessions. Speakers were supplied to three schools.

With the very active help of Mrs. Hieronymous of the DPI, arrangements were made to conduct a series of six Teachers Informational Meetings in Science, for primary and secondary school teachers of the vicinity. The program is outlined below. Publicity was arranged by the DPI and the Academy Secretary, and credit was arranged for the teachers in the public schools who attended five of the six lectures.

February 20—"The Place of Social Science Research in the Atomic Age"

February 27—"Contributions to Science from the Ninth Pacific Science Conference in Bangkok"

March 6—Walter R. Steiger, Department of Physics, University of Hawaii, "Satellites"

March 13—Ryoji Namba, Zoology and Entomology Department, University of Hawaii, "Insect Life"

March 20—Gordon A. Macdonald, Department of Geology and Geophysics, University of Hawaii, "Geology of Hawaii"

March 27—Albert J. Bernatowicz, Department of Botany, University of Hawaii, "Plants and the Sea"

Science Teachers Committee
John J. Naughton, Chairman

Shiro Amioka	Teruo Masatsugu
A. J. Culbertson	Esther Nolan
Ralph Heinicke	Leon J. Rhodes
Marjory Hieronymous	Bernard Rose
George Kagehiro	Andrew W. Lind, ex officio

Sterling Wortman, ex officio

AAAS FELLOWS

The AAAS Fellows Committee nominated ten members of the Academy and of the AAAS for elevation to Fellowship in the AAAS. Members and Fellows are designated by special symbols on the membership list in the Proceedings of the Academy.

AAAS Fellows Committee
Walter Carter, Chairman

E. J. Anderson	J. L. Gressitt
G. O. Burr	Herbert Weaver

PUBLICITY

The Publicity Committee has provided notices of both regular and special meetings to Honolulu's two leading newspapers. These notices have been printed, although not always in the same detail as prepared.

Edwin H. Bryan, Jr.

TRAVELING LIBRARIES

Arrangements were completed in the spring of 1957, with Dr. Hilary Deason, head of the AAAS Traveling High School Science Libraries project, for one Traveling Library (200 volumes) to be used in four small high schools on the Island of Hawaii. During 1957-58, this set has been used in Pahala High School, Pahoa High School, Honokaa High School, and Laupahoehoe High School.

Recently, Dr. Deason wrote suggesting that this set remain in the Islands another year, and be used on another island. Mr. Masatsugu is currently checking with the Office of the District Superintendent on Maui, and with the principals of Molokai High School, Lahainaluna High School, Lanai High School, and Maui High School, to see if agreements can be reached for the servicing of the collection during the summer, and for bearing the expense of transferring the sections of the THSSL from school to school during the year on the schedule prescribed by AAAS. If these arrangements are successful, the Library contributed by AAAS will be used in these schools in 1958-59. Should this not be possible, arrangements will be undertaken to get them in another group of four high schools.

Interest in the project was indicated by University faculty who teach Science 120-121. A search of the University Library showed half the list already in possession. On the joint recommendation of the chairman of this committee, Dr. Doty, and Dr. Bernatowicz most of the remaining titles were purchased.

At the behest of this committee, the President of the Academy recommended to the Superintendent of Public Instruction and the Diocesan Superintendent of Catholic Schools that certain groups of smaller high schools pool their library resources, purchase sets similar to the THSSL, and share them on the same basis that the AAAS set is being shared by the four small high schools on the Island of Hawaii.

A similar recommendation was made that eight large public high schools and seven large private high schools be encouraged by their respective superintendents to secure with their own funds, and for their own school libraries, the books contained in the THSSL.

Annotated lists (pamphlets) were secured in sufficient quantity so that one could be sent to each of the 27 public high schools and 18 private high schools in the Territory. With each pamphlet went a lettter indicating the Academy's interest, urging that the list be used as a buying guide for the school library, and asking for a report on (a) the number of titles currently shelved in the school library, (b) the number that would be bought in this school year, and (c) the number of these titles that would probably be bought in 1958-59. The letter suggested that if funds should become available, the Academy might be interested in providing assistance in quarters where there was the keenest interest and the greatest need.

AAAS Library Committee
Robert W. Clopton, Chairman
Shiro Amioka Daniel Dever
Carolyn Crawford Teruo Masatsugu
Dan Noda

MISCELLANEOUS REPRESENTATION

The Academy has been represented on other local organizations by the following persons:

Doak C. Cox, Representative on the Science Fair Executive Committee, and Representative on the Conservation Council for Hawaii.

Vernon L. Singleton, Representative on the Inter-Agency Committee on Fluoridation.

HAWAII DIVISION

The Hawaii Division held meetings in Hilo during the year, including two symposia. The officers for the coming year are John A. Easley, Jr., Chairman, and Chester Wentworth, Council Representative.

Hawaii Committee
John A. Easley, Jr., Chairman
Chester Wentworth, Council Representative

OFFICERS

1957–58

Andrew W. Lind	President
Doak C. Cox	President-Elect
Sterling Wortman	Secretary
Eleanor S. Anderson	Treasurer
George O. Burr	Councilor (1 year)
Alexander Spoehr	Councilor (2 years)
A. J. Mangelsdorf	Councilor (ex officio)

1958–59

Doak C. Cox	President
Vernon E. Brock	President-Elect
Sterling Wortman	Secretary
Eleanor S. Anderson	Treasurer
Alexander Spoehr	Councilor (1 year)
Fred I. Gilbert	Councilor (2 years)
Andrew W. Lind	Councilor (ex officio)

THE 33rd ANNUAL MEETING 1957-58

Program

SPECIAL SESSION I

Sponsored jointly with the Geophysical Society of Hawaii

May 16, 1957, Experiment Station, HSPA, Honolulu

C. C. Kiess: Results from High-Dispersion Spectra of Mars

SPECIAL SESSION II

October 10, 1957, University of Hawaii, Honolulu

Karl Meyer: Mucopolysaccharides of Connective Tissue

SPECIAL SESSION III

Sponsored jointly with the Society of Sigma Xi

December 12, 1957, University of Hawaii, Honolulu

Walter E. Thirring: Fundamental Particles

SPECIAL SESSION IV

Sponsored jointly with the Society of Sigma Xi

February 6, 1958, University of Hawaii, Honolulu

Gottfried S. Fraenkel: Biochemistry of Host Specificity of Phytophagous Insects

SPECIAL SESSION V

February 20, 1958, University of Hawaii, Honolulu

THE PLACE OF SOCIAL SCIENCE RESEARCH IN THE MODERN WORLD

A Symposium

Andrew W. Lind, Moderator

1. Clarence E. Glick: Intergroup Relations
2. Richard H. Kosaki: Government and Politics
3. Frederick Simpich, Jr.: Agriculture and Industry
4. Robert S. Spencer: Treatment of the Mentally Ill

CONTRIBUTIONS TO SCIENCE FROM THE NINTH PACIFIC SCIENCE CONGRESS, BANGKOK, THAILAND

February 27, 1958, University of Hawaii, Honolulu

Andrew W. Lind, Moderator

1. Colin S. Ramage: Meteorolgy
2. C. E. Pemberton: Entomology and Conservation
3. Mary M. Murai: Nutrition
4. George W. Chu: Microbiology
5. Alexander Spoehr: Anthropology and the Social Sciences

SPECIAL SESSION VI

April 17, 1958, University of Hawaii, Honolulu

Joshua Whatmough: Man Makes Language, and Language Makes Man

SPECIAL SESSION VII

May 19, 1958, Experiment Station, HSPA, Honolulu

Lester Machta: World-wide Radioactive Fallout

FIRST SESSION

November 7, 1957, Experiment Station, HSPA, Honolulu

1. P. B. van Weel and C. Ladd Prosser: The Effect of Protein-rich and Carbohydrate-rich Diets on the Enzyme Production by the Gland of the Midgut of the Giant African Snail
2. Maurice Tatsuoka: Mathematical Models for Learning Based on Probability Theory
3. Thomas S. Austin: Seasonal Variations in the Oceanographic and Marine Biological Features in the Waters of French Oceania (Marquesas)
4. Frank S. Scott, Jr.: Criteria for Estimating Market Potentials of New Hawaiian Horticultural Products
5. Leonard Mason: Habitat and Social Change on Kili Island

November 8, 1957, Experiment Station, HSPA, Honolulu

6. John W. Van Landingham: Stabilizing Heteropoly Color in the Estimation of Phosphate-Phosphorus in Sea Water
7. Bernhard Hormann: The Problem of the Religion of Hawaii's Japanese
8. A. Leonard Diamond: Experiments in Simultaneous Brightness Contrast
9. Jimmie B. Smith and Tetsuo Matsui: Unusual Origin of a *Drosophila* Gynandromorph

Invitational Paper

10. Walter Steiger: Hawaii's Role in the International Geophysical Year

FINAL SESSION

May 8, 1958, University of Hawaii, Honolulu

1. Harry L. Arnold, Jr.: Keloid Scars: Observations and Management
2. Agatin T. Abbott: Formation of the Mineral Gibbsite on Kauai
3. Saul Price: Remarks on the Climate of Mauna Loa
4. Francis J. Howard: Schuster's Equations
5. Richard J. Callaway: Annual Variations of Sea Surface Temperature in the Eastern North Pacific Ocean
6. A. L. Palafox, Hiromu Matsumoto, and E. J. Britten: Comparative Toxicity of β-Nitro Propionic Acid and *Indigofera endecaphylla* to Chicks
7. Ralph N. Akamine: Carbohydrate-Protein Complexes and Glycogen in Cartilage Autografts and Homografts
8. J. Linsley Gressitt: Origin of the Oceanic Insect Fauna

May 9, 1958, University of Hawaii, Honolulu
Business Meeting

9. Paul W. van der Veur: Study of a Eurasian Relocation Center in the Netherlands
10. George K. Yamamoto: Extent of Participation of Orientals in Two Types of Government Positions in Hawaii
11. R. A. Kalish and O. J. Bartos: Psychological Factors in Campus Participation at the University of Hawaii
12. O. J. Bartos and R. A. Kalish: Sociological Factors in University of Hawaii Campus Participation
13. Daniel W. Tuttle, Jr.: A Quantitative Analysis of Political Opinion at the University of Hawaii, 1957-58
14. Kenneth P. Emory and Yoshihiko Sinoto: Tracing Hawaii's Ancient Past Through Fishhooks

May 10, 1958, Gold Room, Hawaiian Village
Banquet

15. Herbert Feigl: Current Trends in the Philosophy of Science

Introduction of New Officers
Presidential Address

16. Andrew W. Lind: Hawaii: Frontier of Social Science Research

HAWAII DIVISION

SPECIAL SESSION I

August 27, 1957, St. Joseph's High School

OPPORTUNITIES FOR AMATEUR SCIENCE I
A Symposium

1. J. A. Easley, Jr., Moderator: Introduction
2. Ralph Kiyosaki: Preparing for a Science Fair
3. William Elder: Natural History Projects Suitable for Local Amateur Naturalists

SPECIAL SESSION II

November 4, 1957, St. Joseph's High School

OPPORTUNITIES FOR AMATEUR SCIENCE II
A Symposium

1. J. A. Easley, Jr., Moderator: Introduction
2. Phillip S. Carroll: Astronomy and the Amateur
3. David Robinson: Comet Searching
4. Frank Kameny: The Significance of Variable Star Observation
5. George Ginn: The Moonwatch Program

SPECIAL SESSION III

March 18, 1958, St. Joseph's High School

Ben W. Harlin: Personal Experiences of IGY Work in the Antarctic

SPECIAL SESSION IV

April 1, 1958, St. Joseph's High School

Akira Suwa: Volcanology in Japan (lecture)
Volcano Miharayama, Asamayama (sound movies)

SPECIAL SESSION V

April 15, 1958, St. Joseph's High School

Jack Pales: Special Atmospheric Studies on Mauna Loa and the Instruments Used for Them

SPECIAL SESSION VI

April 29, 1958, St. Joseph's High School

Richard MacCrosky: Problems in Satellite Astronomy

Abstracts

SPECIAL SESSION I

Results from High-Disperson Spectra of Mars

The question of the habitability of Mars can be answered only by demonstrating the existence on that planet of oxygen and water in amounts sufficient to sustain life as we know it. The best way to establish the presence of a gas in a planet's atmosphere is by spectroscopic analysis. The sunlight that illuminates a planet passes twice through its atmosphere before it is reflected toward an observer on the earth. In this process the planet's gases and vapors will imprint on the solar spectrum an absorption pattern characteristic of these gases. If these are the same as the gases in the earth's atmosphere, it is necessary to distinguish the effect due to absorption in the planet's atmosphere from that due to absorption in the earth's. A sure way of doing this is to observe the spectrum of a planet at a time when the relative velocity between planet and observer is large enough to shift the absorption patterns of the two atmospheres by a measurable and calculable amount.

In 1956, when Mars was ideally situated in the sky for observation, the National Geographic Society and the National Bureau of Standards jointly sponsored an expedition to the new Slope Observatory on Mauna Loa to make such observations. The spectrograph was one of the most powerful ever used for this purpose. Excellent spectrograms of both Mars and the moon were obtained, showing clearly the shift of the Martian spectrum due to the planet's motion. However, no displaced absorption bands of oxygen or of water vapor were detectable on the spectrograms. This means that the amounts of these gases present in the atmosphere of Mars are far too small to be detected spectroscopically with means available at present, and therefore too small to support life in the forms with which we are acquainted.

C. C. KIESS
National Bureau of Standards
Washington, D. C.

SPECIAL SESSION II

Mucopolysaccharides of Connective Tissue

All connective tissues of vertebrates contain as one of their typical constituents acidic polysaccharides of high molecular weight which contain hexosamines and are classified as mucopolysaccharides. They are believed to be present as protein complexes in the ground substances and can be demonstrated in histological sections by a variety of methods. At present, we distinguish at least seven different mucopolysaccharides, two of which are sulfate free, hyaluronic and chondroitin, and five are sulfate esters, namely three chondroitin sulfates designated as A, B, and C, keratosulfate and heparitin sulfate. The chemical structure of hyaluronic acid has been established in our laboratory by a combination of chemical and enzymatic methods. Chondroitin is an isomer of hyaluronic acid in which the D-glucosamine is replaced by D-galactosamine.

The structures of chondroitin sulfate A and C have been shown to be identical with the exception that A is sulfated in Carbon 4 of the galactosamine and C in Carbon 6. The structure of chondroitin sulfate B is very similar to that of A. It contains, however, L-iduronic acid instead of D-glucuronic acid and is completely resistent to testicular hyaluronidase which hydrolyses both chondroitin sulfate A and C. The structures of keratosulfate and heparitin sulfate are unknown.

The distribution of the mucopolysaccharides differs remarkably in different connective tissues and appears to be typical for the tissues. The mucopolysaccharides change in various ways in disease, especially in scurvy, and also in maturation and aging. One hereditary disease, Hurler's syndrome, is characterized by the intracellular storage in various organs of two mucopolysaccharides, chondroitin sulfate B and heparitin sulfate. These two mucopolysaccharides are excreted in relatively large amounts in the urine of these patients.

KARL MEYER
Columbia University
New York, New York

SPECIAL SESSION III

Fundamental Particles

In the last ten years great progress has been made in the study of the properties and the interactions of elementary particles. One might wonder to what extent the new knowledge has changed our views about the fundamental properties of matter. In fact no revolutionary way of thinking has emerged so far but the recent results provided an excellent testing field of relativistic quantum theory. It became apparent that this theory can be applied to distances up to the order of 10^{-13} cm. Furthermore, the intrinsic properties of elementary particles showed in which direction the precent concept could be extended. To illustrate both developments I shall first mention the striking features of Quantum Dynamics when applied to the system of π-mesons and nucleons in interaction. An unusual aspect is that, according to this theory, the number of particles is not a constant in time so that they are continuously created and destroyed. One knows empirically that nucleons can create mesons if one supplies them with the necessary energy. But even when this energy is lacking, a nucleon can create a pion for a short time ΔT within the quantum-mechanical fluctuations $\Delta E \cdot \Delta T \doteq h$. During this time ΔT the meson cannot get further than $\frac{h}{mc} \doteq 10^{-13}$ cm. so that these so-called virtual mesons form a tight cap around the nucleon. Nevertheless they considerably influence the electric charge distribution and the magnetic moment of the nucleon. Both of these effects could be experimentally discovered.

The internal properties of elementary particles provide an even less familiar application of quantum mechanical principles. Those properties which do not reflect themselves in any differences in space-time behaviour like mass and spin show up in interactions with other particles. They suggest that the elementary particles have a high degree of symmetry in their internal properties and these symmetries are in fact isomorphic to a rotational symmetry in a multidimensional space. As a consequence, there are many quantities which are constant in time and are similar to an electric charge. These constants dominate the dynamics of elementary particle interactions. Correspondingly it seems that our space-time becomes unimportant in such small domains and the essential events happen in this multidimensional internal space.

WALTER E. THIRRING
Professor of Theoretical Physics
Berne, Switzerland

SPECIAL SESSION IV

Biochemistry of Host Specificty of Phytophagous Insects

No abstract available

GOTTFRIED S. FRAENKEL
University of Illinois
Urbana, Illinois

SPECIAL SESSION V

The Place of Social Science Research in the Modern World

A Symposium

Andrew W. Lind, Moderator

1. Intergroup Relations

In the relatively short period of the last fifty years the extension of the scientific method to the investigation of human relations has given the social sciences a place in the world of scientific research and, as a consequence of that research, in the field of social action. Large numbers of persons trained in social science research methods have gone into applied research positions in a wide variety of public and private institutions. Social science research data are now widely used in planning policy and procedures in the world of practical affairs.

Many examples of these trends are found in the field of intergroup relations. Research on immigrant and racial groups produced findings which are altering relations between old stocks and new immigrants, dominant groups and racial minorities. Government action, judicial decisions, legislation, a wide range of nongovernmental institutions and reform organizations reflect the scientific knowledge developed by social scientists in these fields.

Wartime research concerned with programs bolstering civilian and military morale and undermining enemy morale depended primarily upon persons trained in social science research. Much of this work was concerned with policies and programs for increasing intergroup cooperation in our own country. Wartime changes also stepped up the use of social scientists and social science research in the training of Americans for military government and occupation duties. Later, civilian control of the Trust Territory established a recognized position for the applied anthropologist. Social science personnel have also been given prominent roles in work with native peoples under the South Pacific Commission. These latter trends follow the earlier work of social scientists, particularly anthropologists, with American Indians under the Indian Affairs Commission.

Postwar developments have greatly increased the international orientation of social science research. The last ten years have seen a phenomenal growth of social science research on the structure and practice of communism in communist countries and their satellites. Much of this research has been supported by government contracts and foundation grants. National problems, such as those of race relations, assume international significance when they are brought into ideological warfare. This has been paralleled by a trend among social scientists specializing in research on race relations to study race relations in world perspective. The Conference on Race Relations held in Honolulu in 1954 was an important step in this direction. In underdeveloped countries social scientists have been engaged in furthering social science training and research and have served as consultants on the human relations problems involved in such programs as inducing peasants and villagers to adopt new productive techniques. Orientation programs for foreign students and mature scholars coming to this country and for American foreign service officers, technicians, and other Americans going into overseas service have drawn not only upon factual knowledge but also upon some of the insights into intergroup relations produced through social science research. Several parts of the United Nations and its related bodies, particularly UNESCO, have also made extensive use of social scientists and their research.

It is evident that social science now enjoys recognition and acceptance in practical affairs. Social scientists in applied fields have made important improvements in the techniques of collecting and analyzing data. But in basic social science, data become significant only as they are theoretically relevant. Being young, the social sciences still have far to go in developing a body of tested theory of interpersonal and intergroup relations. Some applied research has revealed existing gaps in theory and has helped to formulate hypotheses for basic research. Funds appear to be readily available for applied social science research. The real problem now is to carry on empirical research primarily directed toward the extension of our body of basic theory. This poses another area for social science research: How to devise ways for "pure" social scientists and "applied" social scientists to be more useful to each other.

CLARENCE E. GLICK
University of Hawaii
Honolulu, Hawaii

2. Government and Politics

Present-day problems call for the vigorous pursuit of truth not only in the physical sciences but also in the social sciences. Emphasis should not only be placed on developing bigger bombs and more accurate missiles but on gaining knowledge about human behavior which will prevent or minimize the use of such weapons.

Science, though popularly restricted in application to refer to the physical sciences, involves a basic method of inquiry. As method, it can be and is being applied in the social sciences.

The attempt to apply rigorous research methods to political phenomena is a very recent development. It is viewed as the current trend in political science, and studies conducted in this vein are labeled as research in "political behavior." These studies tend to be empirical and shift the customary focus of political science from formal institutions to human inter-relations, from structure to process, and from "official" man to "political" or social man.

The most important characteristics of the political behavior approach may be listed as follows: (1) The unit or object of study is the behavior of persons and social groups rather than events, structures, institutions, or ideologies; (2) the approach is interdisciplinary, involving a frame of reference common to that of social psychology, sociology, and cultural anthropology; (3) it stresses the mutual interdependence of theory and research; (4) it tries to develop rigorous research design and to apply precise methods of analysis to political problems.

The general nature of the research conducted thus far may be assessed by focusing attention upon a few of the key concepts which have been most widely utilized. The most popular general concept initially was that of "power" or "political power." (The old approach spoke of such concepts as "state" and "sovereignty.") "Power" seemed appropriate to men who stressed "realism" but the concept seems too vague as an aid in empirical investigation.

Major emphasis has also been placed on the concept of "group," that politics is best understood as group or organizational activity. Around this concept, useful studies of interest and pressure groups have been conducted.

Behaviorists emphasize "process" rather than "structure" and have made the process of "decision-making" another focal point of study. This has led to studies in legislative and administrative behavior, focusing attention not upon formal procedures but upon pressures which influence the persons involved.

Another popular area of study can be termed that of "political participation." This involves studies of voting and nonvoting, of political party activities and public opinion. Perhaps it is because voting is such an obvious political act and an overt one, and perhaps because votes are units which are quantifiable, the young field of political behavior has seen the greatest amount of research done in the area of voting behavior.

The information thus far secured by the political behaviorists may not be significant, but the rigorous application of the scientific method to political phenomena has only begun. Political science is still attempting to achieve the first of the aims of science which are said to be description, explanation, and prediction. Any positive results, no matter how apparently insignificant, will yield rich dividends not only for mankind generally but for scientists particularly because reduction of political tensions will help create the free atmosphere that the development of all sciences requires.

RICHARD H. KOSAKI
University of Hawaii
Honolulu, Hawaii

3. Agriculture and Industry

To find the uses and place of research in the social sciences in industry and agriculture you must first penetrate the popular concepts that shroud the true workings of these activities. We usually think of industry in terms of physical things—plants, machines, products, and the research related to them, research that leads to automation, better transmissions for our cars, or startling new products like man-made diamonds. So too with agriculture, particularly here in the Islands where we think of big things such as canneries and cane hauling units, harvesting machines and turbines. And such research as agriculture does is popularly believed to center on varieties and fertilizer, insect pests, and, perhaps, by-products.

Put these concepts aside and you come to the realization that the primary problems of industry and agriculture center less on things and the physical sciences than on human affairs, such as economics, government, law, training, psychology, and sociology, and the research that concerns them. And so you find that you have recited one classical definition of the social sciences. This conclusion produces the proposition that the conduct of business is predominantly the practice of the social sciences.

Now let me back away from that a bit. In many respects we might call it blundering or groping in the social sciences, for no one can claim mastery of the conduct of human affairs, least of all business men. And those of us in business in Hawaii are perhaps less advanced in employing research in the social sciences in getting our job done than are our mainland counterparts.

But in preparing this paper I was struck by two points. First, that we in business are relying much more on research in the social sciences than one would casually expect, and second, the improbability of ever exhausting the opportunities for research in these areas. It is these two points that I hope to develop.

First, how are we using social science research? We employ it in every quarter involving people; more specifically, employment and marketing, government and public relations.

Take initially the whole question of employment. Here, business policy is guided generally by studies of the labor market. Statistics determine its size and movement, knowledge of community wage structures serves to fix compensation policy, job evaluation insures equal pay for equal work. Ultimately, in treating the individual job applicant, business employs psychological testing devices and interviewing techniques based on social science research.

Once on the job, the individual is trained by methods developed by the social sciences, his performance is rated by means that have been similarly devised. The conditions of his work are governed by principles developed through research in the social sciences. Safety programs are one illustration, and the whole industrial engineering complex is another. For industrial engineering, though designed to increase individual productivity, is based on very human aspects of the job, giving weight to necessary delay time, personal needs, reaction times, fatigue factors, and similar considerations.

Increasing importance is being given employee-attitude studies using techniques derived from social science research. These are pointed to a determination not alone of employee opinion but more basic drives and wants.

The procedures I have recited are common to all business whether unionized or not. In enterprises where a union is present, the same use of social science research goes forward but usually with the union acting as a sort of advocate trying to influence conclusions, often by criticizing methodology. In addition, the presence of a union broadens the scope of inquiries into attitudes as unions divide the allegiance of employees, raise questions of credibility and conflicting philosophies.

We turn now from employment to marketing. In most businesses, industrial or agricultural, a knowledge of the market is of major importance, and the market, too, is people.

Here again, business is concerned with both surface indications and the deeper currents of human affairs —drives and motivation. Market research is directed to the vast complex of factors that influence the desire to buy. Price, quality, use, packaging, advertising, and income status are only some of the factors studied by social science research methods in the routine course of business. More sophisticated studies are now being made in some fields such as color associations, prestige considerations, and other factors known to have some measurable influence on the urge to buy.

Business is active in social science research on the government scene. On the mainland, where new plant construction is common, much of this work has been directed to studies of what is called the "business climate" of various communities. Business wants to know before it settles in a city what manner of neighbors and government it will have. These inquiries are directed to the quality of the school system, the intricacies of the tax structure, the character of the land laws, even the extent of public support of the community chest.

Then there is the more direct participation of business in political affairs. It can be called lobbying but actually it is better phrased as presenting a point of view. This requires research in a range of the social sciences from government organization to the hazards of unemployment, equitable systems of taxation to proper regulation of labor. Business is interested as well in what people think about government and this leads to business-sponsored opinion surveys ranging from public attitudes toward candidates to views on zoning regulations.

For a final illustration of business use of social science research consider industry's conduct of public relations. What does the public think of when it hears the name of a company? Does the public know that company's products and services? How does it think of them? Is the company regarded as a good employer? Is advertising being read and believed? These are only samples of the sort of questions business is asking about itself every day. The techniques vary from opinion surveys to readership and listener ratings but they all are rooted in, and are an extension of social science research.

Now to turn to the areas in which more research in the social sciences is needed by business. We need to know more about our employees: what they want, what prompts them to work well, and, most important, how best to identify and develop their talents. We need to know more about what stimulates people to buy. Business also needs to know more about the thought processes of those who govern us as well as of the public in general. From the business point of view the need is for more work in all the areas I have enumerated. There is one common denominator to this needed work. In every case we need to determine more accurately what makes people "tick."

Why does employee A adjust to the job when employee B with the same apparent qualifications fails? Why does housewife C buy pineapple juice when housewife D with the same economic and cultural background prefers concentrated orange juice? And so on.

From this review of the application of social science research to industry and agriculture these points stand out.

First, the practice of business is largely in the field of social sciences.

Second, much social science research has been done and is being employed by business in the conduct of day-to-day affairs.

And finally, the work will never be finished because it is directed at that most complex and elusive subject, the functioning of human beings acting variously as employees, customers, governors, and exercising in mass that great force known as public opinion.

FREDERICK SIMPICH, JR.
Castle and Cooke, Ltd.
Honolulu, Hawaii

4. Treatment of the Mentally Ill

No abstract available

ROBERT S. SPENCER
Territorial Hospital
Kaneohe, Oahu, Hawaii

CONTRIBUTIONS TO SCIENCE FROM THE NINTH PACIFIC SCIENCE CONGRESS BANGKOK, THAILAND

A Symposium

1. Meteorology

Fifty-seven meteorological papers were presented, describing climate and weather of the North Pacific, southeast Asia, and the tropical Atlantic. No new or exciting theories were advanced. Unquestionably the Thai Meteorological Service benefitted greatly. It is well equipped and staffed with qualified people who however lack the self-confidence to attempt original research. The meetings and informal discussions, by showing that other meteorologists are human and liable to err, provided much encouragement. I expect Thailand soon to make significant contributions to meteorology.

The three postwar congresses were similar in many ways. Of the 118 meteorologists who attended the Seventh, Eighth, and Ninth, 70 or 3 in 5 lived in the host country. No meteorologist from any host country attended either of the other two congresses. Only meteorologists from the United States and Hawaii attended all three congresses. Of the 27 who had to travel more than 4,000 miles to a congress, 22 came from the United States, Hawaii, or Canada.

Each congress has been a local meeting attended by a few outsiders. Lack of continuity handicapped the hosts; few apart from Americans could afford to travel long distances. Able meteorologists have been reluctant to present their best work because critical discussion has generally not been possible.

Previous experience should enable us to conduct the Tenth Congress with fewer troubles than our predecessors encountered and overcame. However, if the distance restriction persists (and this is most probable), only about three non-American meteorologists can be expected to attend. The problem of travel costs must be solved if the Tenth Congress is to justify the adjective "Pacific."

COLIN S. RAMAGE
University of Hawaii
Honolulu, Hawaii

2. Entomology and Conservation

Twenty-two entomologists attended the entomology section of the Ninth Pacific Science Congress. Delegates came from the United States mainland, Hawaii, Philippines, Thailand, Formosa, Okinawa, Guam, Malaya, New Guinea, Canada, Japan, and New Caledonia. At the formal meetings some 50 papers were read and discussed. They dealt with insecticides, their merits and hazards; zoogeography of Pacific insects; faunal surveys of insects of the Pacific and Southeast Asia; medical and veterinary entomology; biological control of insects and weeds; the coconut rhinoceros beetle and other coconut pests; scrub typhus and its mite vectors; insect pests of rice and their control; termites in the Ryukyus; cacao pests in New Guinea; and finally a joint entomology-zoology session on the giant African snail, *Achatina fulica.*

The sessions were opened with the report of Dr. J. L. Gressitt, chairman of the Standing Committee on Entomology. This report covered in detail the major accomplishments in entomology in the Pacific area during the past four years.

Of exceptional interest was a discussion led by Dr. E. A. Steinhaus, head of the Department of Insect Pathology, University of California, on the culture and application of insect diseases for the control of insect pests; a method still in its infancy but of great promise for the future. The discussions were prolonged and fact-seeking by the delegates. The great development and use of insecticides in the United States also received special attention as outlined by C. H. Hoffman of the United States Department of Agriculture. Among other important papers was Dr. Gressitt's contribution on the zoogeography of Pacific and Southeast Asian insects.

Several tours were made about Bangkok and into the country, which gave the delegates opportunity to learn of Thailand's insect problems and insect fauna. An informative visit was made to the Bangkhen Experiment Station, where in five years' time an excellent insect collection has been assembled. Good laboratories and progressive work conducted in a practical insectary were also inspected.

The conservation section of the Congress was attended by 26 participants. The majority of the papers stressed the destructive effects of shifting cultivation by native peoples on the natural resources of several countries, resulting in excessive erosion, depletion or eradication of native floras and faunas, and reduced productivity of inland fisheries resources. The conservation of certain species of rare and unique animals was also thoroughly discussed.

All delegates greatly appreciated the hospitality of the Thailand people.

C. E. PEMBERTON
Experiment Station, HSPA
Honolulu, Hawaii

3. Nutrition

The Standing Committee for Nutrition of the Ninth Pacific Science Congress had been working since 1955 on nutrition programs and problems which need increased attention in the Pacific area. A summary of the various problems are cited. From these findings the program for the nutrition division was planned and papers were presented on the following topics.

1. Requirements and allowances with reference to calories, proteins, thiamine, and calcium: There has been very little experimental work done on energy metabolism in the tropical area. Work is now in progress in India to obtain data on energy values of various physical activities. Research in Japan has shown that the minimum intake of protein of 1 gm/kg/day is required with Japanese diets where the protein is supplied by rice and fish.

2. Infant nutrition and supplementary feeding: Although food supplies are more stable today, the nutrition of the infant may be affected by changing social conditions. Breakdown of customs has led to shorter breast feeding periods and failure to supplement the diet in the old way. There is a tendency to use refined cereal foods rather than traditional sources of carbohydrates. Nevertheless, the majority of Pacific area children of today have a good start in life if food supplies and health education facilities are used to the best advantage.

3. Dietary surveys: Data taken from surveys conducted in Burma, Taiwan, and Thailand, showed that

diets were usually deficient in calories, protein, thiamine, riboflavin, vitamin A, and ascorbic acid.

4. Surveys of food habits: Findings of family food habits in the Ryukyus and the aborigines in Taiwan were given.

5. Nutrition and atherosclerosis: Nutritional factors involved were reviewed. People should consider the following facts regarding the possibility for heart disease: heredity, overweight, elevated cholesterol, elevated blood pressure, and excessive smoking.

6. Nutritive values of South Pacific foods: Coconut protein is a good source of lysine. Coconut sap or toddy has a relatively high ascorbic acid value.

7. Nutrition education: Training of nutrition workers in Indonesia was cited.

8. Food and nutrition program: A program which is being carried out in Taiwan since 1953 was discussed.

9. Food production and processing in Thailand: Thai processed food products were mentioned as well as the Thailand Dairy Program sponsored by the U. S. Department of Agriculture in cooperation with the Dairy Society, International, Washington, D. C.

Recommendations of the nutrition division adopted at the Ninth Pacific Science Congress were as follows.

1. The support and encouragement of basic contributions to the science of food and nutrition in the Pacific area is of prime importance. Therefore, if possible, a research program with joint planning by the different countries for the investigation of the requirements by Pacific peoples for certain nutrients (with special reference to calories, protein, and calcium) should be undertaken. However, the application of known nutritional findings should be urged through greater emphasis on education directed toward improving the preparation and increasing the consumption of available foodstuffs of high nutritive values.

2. Fortification of foods with individual nutrients can only improve specific aspects of the diet and proposals for improving the nutrition of people living in tropical areas by means of enrichment should be fully investigated before implementation.

3. Nutritionists should cooperate more closely with other technical and scientific groups in the Pacific, particularly those concerned with food production, processing, distribution, and policies, and with anthropologists, social scientists, and others who obtain detailed information about local customs and conditions.

MARY M. MURAI
University of Hawaii
Honolulu, Hawaii

4. MICROBIOLOGY

In the field of microbiology, the Congress emphasized the arthropod-borne virus and rickettsial diseases. Investigators in California, Japan, the Philippines, Malaya, and Australia studied some of these infectious agents with respect to the problems of reservoir and natural definitive hosts, their insect transmission, and the general ecology and epidemiology for the diseases they cause. In spite of the enormous amount of data presented, it may be said that the report on PUO (Pyrexia of Unknown Origin) among children and new immigrants in Malaya was a study which could be duplicated in many areas in the tropics. In addition to the endemic Japanese B encephalitis, dengue 1 and 2, and TP-21, new viruses were isolated from patient's sera and many species of Malayan mosquitoes. These investigations together with those made on hemorrhagic fever in the Philippines, JBE in Japan, Murray Valley fever in Australia, Rio Bravo virus and Group B viruses in California reaffirm the fact that the various types of encephalitis infections might appear to be independent from one another geographically, but in reality they are frequently immunologically related because of the occurrences of cross immunity. In this respect, the possible hazard and the prevention of yellow fever in Malaya had been studied by serological and animal neutralization tests and the results were reported. In this Congress, the need for increased virological research correlating more geographical areas in the Pacific was made very evident.

Scrub typhus in Japan and Malaya, Kyasanur Forest disease in India, influenza (type A, Far East) in Malaya as well as in Thailand, and rabies in Bangkok were the subjects of other reports. Serological surveys on virus antibodies in a general population and the isolation and identification of viruses from insect intermediate hosts, animals, and man remain at this moment largely a field unexplored in the Pacific even though these problems were investigated and reported for certain areas in the Philippines and Malaya.

For the parasitological science, leptospirosis was reported to be an important disease in Malaya and Australia, since many mammals besides rats were found to act as reservoir hosts. Kanamycin, a new antibiotic from Japan, was briefly mentioned as an effective remedy. *Wuchereria malayi* as a cause of filariasis in Malaya was also reported to be in many natural and experimental animals besides man. The finding of human paragonimiasis as an endemic disease in Nong Mu district of Thailand was reported for the first time. Other reports on gnathostomiasis and schistosomiasis in Japan, filariasis and schistosome dermatitis in the Pacific, opisthorchiasis and controls of yaws and malaria in Thailand constituted the many subjects for the Congress.

There was only one report for each of the following bacteriological subjects: cholera, typhoid, type E botulism, coral reef microbiology, leprosy, and tuberculosis. The dearth of bacteriological reports was probably the result of a major shift in interests among microbiologists to the diagnosis and the epidemiology of diseases caused by viruses in man and in animals.

GEORGE W. T. C. CHU
University of Hawaii
Honolulu, Hawaii

5. Anthropology and the Social Sciences

Although "Anthropology and the Social Sciences" was only one of 18 divisions represented at the Congress, it was the largest in number of participants, reflecting the steady growth of interest in the subject among scholars in the Pacific area. At Bangkok, this growth of interest tended to crystallize around the following problem areas: (1) archaeology in relation to the culture history of Southeast Asia and the Pacific, (2) comparative linguistics, (3) the social structure of peasant and more isolated peoples of Southeast Asia, (4) demography, and (5) geography. A strong delegation of geographers attended the Congress and their active participation assured the establishment of a separate division at the Tenth Congress, more in keeping with their interest in several divisions. Likewise, it is probable that demography, including its relations to other disciplines, will receive increasing attention. Finally, the steady development of the Pacific Science Congresses through the years has emphasized the importance of a broad regional framework in the consideration of the problems of Pacific science.

ALEXANDER SPOEHR
Bishop Museum
Honolulu, Hawaii

SPECIAL SESSION VI

Man Makes Language, and Language Makes Man

Language is best described mathematically as a body of physically descrete events in which relations of similarity occur in a statistically definable pattern; *homo* is not *sapiens*, but *loquens* and *ludens*, language being a game of chance (probability) and choice that man plays. Its historical change is governed by selective variation in which man and language influence one another. Man is not the victim of language, though he may be the victim of taboo and social convention. Language is characterized by ectropy (a function of the linguistic system). It is, therefore, not static, but in a state of metastable equilibrium. It is not merely a part of the environment, it is also a form of conduct. It was Marx (*Theses on Feuerbach*) who first developed the theory that language is "the immediate reality of thought." Any rejection of the binary principle (i.e., the law of the excluded middle) says in effect that either you reject the principle or you do not; that is, the principle is accepted and followed by those who claim to reject it! Those who hold that language makes man must explain what makes language.

JOSHUA WHATMOUGH
Harvard University
Cambridge, Mass.

SPECIAL SESSION VII

World-wide Radioactive Fallout

No abstract available

LESTER MACHTA
U. S. Weather Bureau
Washington, D. C.

FIRST SESSION

1. The Effect of Protein-rich and Carbohydrate-rich Diets on the Enzyme Production by the Gland of the Midgut of the Giant African Snail

It is generally believed that (at least in vertebrates) an adaptation of the enzyme equipment to the normal diet occurs. However, the opinions on the possibility of an adaptation of the enzyme production to a change in the diet by a particular individual, differ widely. This latter problem was studied in the giant African snail, *Achatina fulica* Bowditch, because the animal, as a scavenger, shows little preference to the kind of food it eats; indeed, it devours decaying plants as well as dead animals (van Weel, 1948). It was thought that if an adaptation occurs, it would be easily recognized. Furthermore, its gland of the midgut is the main seat of digestive enzyme production and any adaptation would cause a definite change in its enzyme picture.

After a starvation period snails were fed daily with either boiled potato or frozen, lean horse meat. Each week for a period of four weeks a few snails were sacrificed and the enzyme content of the glands determined. No changes in the esterase contents were found. The cathepsin (protease) picture was strongly affected by the diets; in starch-fed snails the amount of cathepsin dropped to about 56 percent in two weeks, after which an unexpected rise to 137 percent was noted in the third week. Then the contents dropped to 115 percent in the fourth week. Whereas the picture of the first two weeks seemed to show an adaptation to a protein-poor diet, the results of the third and fourth weeks did not stand in agreement with such a hypothesis. In protein-fed animals the contents dropped to 70 percent in the first two weeks, increased to 116 percent in the third, to decrease again to 92 percent in the fourth week. In general the same picture as that of the starch-fed snails was therefore obtained. No adaptation of amylase contents to protein-rich diet could be found.

In starch-fed animals the amylase contents again showed an unexpected course; instead of a rise, there was a steady drop to 54 percent in the first three weeks, followed by a rise to 68 percent in the fourth week.

From our data the conclusion may be drawn that a special diet (either predominantly protein or carbohydrate) does affect the production of certain enzymes, but definitely not in the sense of an adaptation to a special diet, in that there is no sign of a special diet inducing an increased production of its "fitting" enzyme.

C. LADD PROSSER
University of Illinois
Urbana, Illinois

P. B. VAN WEEL
University of Hawaii
Honolulu, Hawaii

2. Mathematical Models for Learning Based on Probability Theory

The general theory of mathematical models for learning based on probability consideration, developed by Bush and Mosteller in their book *Stochastic Models for Learning,* was reviewed.

Very broadly, learning may be regarded as the modification, due to experience, of the probabilities of certain responses under specified conditions. In the mathematical theory being discussed, this modification of probabilities is represented by *operators* which operate on the several response probabilities.

Consider a simple situation where just two responses, A and B, are available to the organism. Assume that, initially, the organism has a probability p of making response A; its probability for response B is then necessarily 1-p. If, on one occasion, the organism makes response A, its probability for making this same response on the next occasion will, according to the theory, have changed from p to some function of p, denoted by Q_1p. If, on the other hand, the organism makes response B on one trial, its probability for response A on the next trial will have been modified from p to some other function, Q_2p, of p. Q_1 and Q_2 are the operators associated with the two responses. The sequence of probabilities for response A as these are modified over a series of repeated trials can then be generated successively by applying the appropriate operator to the probability as of each trial, depending on which response is made on that trial. Once the actual forms of the operators are specified, then, we have a means for a parsimonious description of the essential features of the learning process—that is, we have a model for the learning process.

For mathematical reasons, the only types of operators that have been studied so far are certain linear transformation operators. These may best be characterized by describing the types of learning situations for which the resulting models are applicable. Three types may be distinguished: (1) "approach-avoid" learning, where making either response tends to increase the probability of response A, and all organisms eventually learn to make this response with certainty; (2) "approach-approach" learning, where making each response tends to increase the probability of that response, and some organisms eventually "fixate" on A, others on B; (3) "avoid-avoid" learning, where making either response tends to increase the probability of the other response, and vacillation of responses continues indefinitely.

Some of the writer's contributions to this theory were discussed. These relate mainly to the model for "approach-avoid" learning. In particular, he has obtained the distribution of the number of times organisms with a given initial probability (p) will make response B before perfect mastery of response A. Formulas (in the form of power series expansions) for the mean and variance of the number of B-responses have also been derived. These results were presented graphically. Experimental applications of these results, as well as of those obtained earlier by Bush and Mosteller, were described.

With regard to "approach-approach" learning, a pertinent question to ask is, what proportion of organisms (among a large group with a given initial probability, p) will fixate on response A? For "avoid-avoid" learning, we might ask, after a large number of trials, what proportion of organisms will have probabilities not exceeding given values for response A? The writer, in collaboration with others, has done some work on the respective models toward answering these questions. Partial results and the work in progress on these problems were also briefly mentioned.

MAURICE M. TATSUOKA
University of Hawaii
Hilo, Hawaii

3. Seasonal Variations in the Oceanographic and the Marine Biological Features in the Waters of French Oceania (Marquesas)

The Pacific Oceanic Fishery Investigations (POFI) of the U. S. Fish and Wildlife Service is investigating the tuna resources of French Oceania, with particular emphasis in the waters near the Marquesas Islands. Two surveys have been conducted by POFI vessels, one during the Southern Hemisphere winter (August–October 1956) and one during the Southern Hemisphere summer (January–March 1957). During both surveys, the general oceanic circulation features, the productivity of the ocean waters, and the abundance of the tuna and their availability to longline and live-bait fishing methods were investigated.

Preliminary study of the oceanographic data reveals that the flow of water incident to the Marquesas–Tuamotu islands was from the southeast. In the general region of the islands, and down-current from the islands, there was evidence of large-scale, but weak, eddies. The westerly transport through a section near 145° W. longitude, between the surface and 500 meters, was $5.8 \times 10^7 m^3$ during the summer cruise, $4.5 \times 10^7 m^3$ during the winter cruise.

Although the summer-winter variations in the general circulation features were not striking, the seasonal variations in the concentration of inorganic phosphate and the indices of productivity at the lower trophic levels were very evident. During the

Marquesan summer, the supply of inorganic phosphate in the surface waters, the rate of photosynthesis as measured by the uptake of C^{14}, and the zooplankton volumes were, in general, one-half the values observed during the Southern Hemisphere winter.

The surface tunas were apparently more abundant during the Marquesan summer. On two summer cruises, 104 tuna schools and associated bird flocks were observed in January and 97 schools in February, as compared with 42 schools sighted on a similar traverse in September during the Marquesan winter. The surface tuna bit at a slow rate, however. During the Marquesan summer, 99 schools were fished; 36 responded with a catch of one or more tuna and 12 with a catch of 100 or more from each school. During the winter, only one school of tuna was successfully fished. Ten were chummed. Using longlines, the catch rate of the deep-swimming tunas was 6.0 per 100 hooks during the summer, and 0.3 during the winter.

THOMAS S. AUSTIN
Pacific Oceanic Fishery Investigations
Honolulu, Hawaii

4. Criteria for Estimating Market Potentials of New Hawaiian Horticultural Products

Successful development of new agricultural industries in Hawaii is largely dependent upon two primary factors: (1) efficient production, and (2) effective market demand. This paper is concerned primarily with the demand side and more specifically with methodology in estimating market potentials of new Hawaiian horticultural products.

Whereas historical data are relied upon in estimating opportunities for increasing sales of products for which the market is developed, no such data are available for new products. In the case of a product which has never before been merchandised, the researcher is limited, in light of present knowledge, to a test-city approach. Use of the test-city data for purposes of expansion is dependent upon the following factors.

Choice of Test City

The population of the test city should be as nearly characteristic as possible of that of the potential market area within which the test city is used as a measure of the market potential. In choosing a test city which has similar population and income characteristics and where per capita consumption of similar products follows a pattern typical of that for the entire market area, i.e., the entire nation, chances of serious error in expanding test data would not seem great. A further consideration is that where the current output of the new product is far below the indicated market potential, the seriousness of bias from test-area generalizations may well be over-estimated. As the market is further developed, a broader selection of historical data would be available for a more precise determination of the market potential.

Selling Price

Retail pricing in market testing has an important bearing on projected potential sales, especially where the demand for the product is elastic. If the product is expected to be sold for general consumption rather than as a specialty item, the test price should be competitive with the prices of similar products and also adequate to cover expected production and marketing costs.

Effects of Advertising and Promotion

The particular advertising and promotional program instituted in the test area has an important bearing on sales, especially during the introductory period. In planning an advertising program for a test city, it is essential to stimulate sales at least to the point where the product justifies the space allotted to it on the store shelf or in the frozen food cabinet. If the cost of attaining this level of movement is prohibitive, chances for successful general distribution would appear to be limited. Excessive test advertising would lead to an overly optimistic evaluation of the market potential.

Length of Test

Although many market tests have been completed in 2 or 3 months, recent findings by the Hawaii Agricultural Experiment Station and certain independent research agencies indicate the desirability of continuing tests for as long as 18 months or more in order to determine conclusively whether the product has established a place for itself in the market.

Integration of Production with Market Demand

Regardless of the accuracy of the estimate of the market potential, the market is not a reality until developed through effective merchandising and advertising programs beyond the confines of the test city. Distributors in many instances are unwilling to take on the product unless assured an adequate supply and an effective advertising program. Producers and processors, on the other hand, are unwilling to expand production unless a market can be assured. Thus coordination of quantity produced with consumer demand as the market is developed is a formidable task in itself. The effectiveness of such coordination may well be a major factor in spelling the success or doom of the new industry.

FRANK S. SCOTT, JR.
University of Hawaii
Honolulu, Hawaii

5. Habitat and Social Change on Kili Island

Kili Island in early 1948 lay abandoned, its thirty years' development as a plantation in the southern Marshall Islands ended by the misfortune of war, its contract labor population returned to their island homes, its coconut groves in need of thinning and bushing. Nine years later Kili is supporting a community of 250 Marshallese who combine copra exportation (to pay for imports of rice, flour, sugar, tobacco, and tinned meats) with direct use of abundant coconut reserves, limited marine resources, and new plantings of pandanus, banana, taro, and breadfruit.

The present population derives from Bikini expatriates who in 1946 were evacuated from that atoll to permit atomic weapons tests by United States agencies. When after two years of temporary residence on Rongerik Atoll this displaced people were resettled permanently on Kili Island, they brought with them a way of living well adapted to the dry, inhospitable habitat of the northern Marshalls. Plant food on Bikini was limited to coconut, pandanus, and arrowroot, supplemented by negligible husbandry of pigs and poultry. The inhabitants had avoided extreme want by recourse to the almost unlimited seafood from Bikini's reef and lagoon. This subsistence economy, only slightly modified by visits from traders, was tied to a system of land tenure in which matrilineal kin groups were the essential inheritance and use units. Male heads of these ranked groups provided the necessary social and political leadership for stable community organization.

Kili's 200 acres of land equal less than one-sixth the area of Bikini's many islands. Kili also lacks the finny treasure of a lagoon habitat. To some degree these inadequacies have been offset by the community's experiments with a larger variety of food plants such as thrive in the wetter climate of Kili's latitude. Eight years of trial and error have led the ex-Bikinians and their numerous Kili-born progeny to a generally successful adaptation. Remarkable changes have occurred in economic and family organization as well as in technology. The individual is emerging more prominently though he continues to function primarily as member of a kin group. Features of the traditional matrilineage mingle with and appear to be yielding to structural and functional traits more characteristic of the Euro-American family system. Land and trees on Kili are owned and managed by some twenty of these kin groups in transition. Formal allocation of this property was formulated and executed by the community's indigenous leadership on the basis of equal shares for all individuals, thereby removing inequities of the Bikini system in which some lineages held far more land than entitled by their numbers.

LEONARD MASON
University of Hawaii
Honolulu, Hawaii

6. Stabilizing Heteropoly Color in the Estimation of Phosphate-Phosphorus in Sea Water

Instability of the reduced phospho-molybdenum-complex color has long been a source of difficulty and inconvenience in the estimation of phosphate-phosphorus in sea water. Complete color development requires approximately 10 minutes for the standard method and remains relatively constant for only 20 to 30 minutes.

The chief source of difficulty with the so-called "molybdenum blue" method appears to be inherent in the nature of the reductant. The author has developed a modification of the standard method using a supplementary reductant, hydrazine sulfate, which gives a reduction product of extreme stability as compared to other methods previously described in the field of marine chemistry. Color in the conventional method is stable for approximately 20 minutes for the low phosphate concentrations, as compared with 5 days with the hydrazine sulfate modification.

In the course of investigations evaluating the new method, sources of error other than instability were examined and efforts made to overcome them. For example, standard computations for the analysis are based on the assumption that optical properties vary in accordance with Beer's Law. Such an assumption is not valid in the concentration ranges below 1.0 microgram atom per liter and above 4 microgram atoms per liter, and is only approximately true in the intermediate ranges. The use of graphical methods eliminates this source of error.

The nature of the "salt effect" error is also considered and evidence is introduced which supports a new concept of the mechanism of "salt effect." This evidence would seem to indicate that salt error may not be due to actual color differences in the presence of certain ions, but rather to a turbidity phenomenon resulting from the absence of key ions.

JOHN W. VAN LANDINGHAM
Pacific Oceanic Fishery
Investigations
Honolulu, Hawaii

7. The Problem of the Religion of Hawaii's Japanese

With the possibility of the next U. S. census having a question regarding religious identities, the problem arises as to how the Japanese of Hawaii might respond.

Official statistics by religious bodies on the religion of the Japanese are not very meaningful because of the traditional lack of concern of Buddhist sects over membership statistics. Several different samples, none statistically representative of the over-all Japanese population, suggest a wide range in the way Japanese might respond to the question as to their religious identity, so that one is left much at sea in any attempt to arrive at estimates of the religion of Hawaii's Japanese. The percentage of self-identified Christians went up immediately after Pearl Harbor. University students seem more inclined to call themselves Christians than younger Japanese children. Parents are more inclined to classify themselves and their children as Buddhist.

An analysis of personal data describing personal experiences with and feelings about religion reveals:

1. A deeper interest in the world view of Buddhism or Shintoism on the part of very few.

2. Religious "social unrest" involving a state of general uncertainty on the part of many students and, somewhat more associated with individual and group crises on the part of adults, with some "shopping about" for a satisfactory religion. Also, religious survivals as superstitious. Involvement in religious movements.

3. A fairly active minority who feel "socially" identified, rather than spiritually involved, with the organized aspects of their ancestral religion.

4. On the part of many a strongly felt sense of the unity and continuity of the family, in terms of which various accommodations occur, such as parents who remain Buddhist accepting and even encouraging the acceptance of Christianity by their children, children accepting Christianity while continuing certain family rituals, persons of diverse religious identity living harmoniously within the same family, young people becoming active in the activities of a Christian church without becoming baptized, etc.

5. Strong moral values effectively transmitted by informal family controls, supplemented to some degree by the language schools.

6. Occasional bitter conflicts over religion growing sometimes out of the fear by the parents of losing their children through Christianization or out of the reluctance of Christianized children to compromise with the "heathenish" ancestral ways.

7. A concern by a few about the changes needed in organized Buddhism to maintain itself in Hawaii.

All this suggests a state of flux which for some time will make statistics of the religious identity of Hawaii's Japanese quite meaningless. This does not, however, mean that those people are not subject to strong moral and spiritual controls.

BERNHARD L. HORMANN
University of Hawaii
Honolulu, Hawaii

8. EXPERIMENTS IN SIMULTANEOUS BRIGHTNESS CONTRAST

It has been found that the brightness (sometimes called apparent brightness) of an illuminated (test) square is depressed as an adjacent illuminated (inducing) square is raised in luminance to a value greater than that of the test luminance; also the higher the inducing luminance the greater the depression, or the lower the test brightness. The highly illuminated inducing square, therefore, seems to be inhibiting the response to the test square.

If we analyze this situation at the retinal level we can visualize two adjacent illuminated squares lying side by side in the fovea (this was a foveal study). We can then think of each cone in the inducing area, because of its greater excitation, somehow inhibiting the activity of each cone in the test area. To be consistent, however, we must in addition say that each cone in the test area is inhibiting every other cone in the test area. If we state the entire situation symbolically we would say that the test brightness, A_t, is directly proportional to its luminance, B_t, and inversely proportional to inducing inhibition, H_i, and self-inhibition, H_t. If we put these assumptions together, the following formulation results:

$$A_t = \frac{k_1 B_t}{H_i + H_t} \qquad (1)$$

where $H_t = k_2 B_t$ and $H_i = k_3 B_i$ (i.e., the inhibiting power of a cone is proportional to the luminance exciting it). This formulation closely fits the data of Diamond (1953).

A first study, concerning methodology shows that contrast is not a peculiarity of a particular methodology. A second study shows contrast to be a general phenomenon and not peculiar to any particular set of subjects.

The third study hypothesizes that the inhibiting effects of the inducing field are not only proportional to its luminance but also to its area. Or:

$$H_i = kB_i \times \text{Area} \qquad (2)$$

If, however, at the retinal level, we consider area to be determined by the total number of cones included in the inducing field then we must take account of the fact that as additional cones are added to increase the inducing area these cones are necessarily added at different distances from the test field. Since contrast has been shown to vary inversely with the distance between the test and the inducing fields, we must include distance change in our statement of area change. Or:

$$H_i = kB_iC_i \qquad (3)$$

where $C_i = f\left(\frac{\text{area}}{\text{distance}}\right)$

A prediction of test brightness, A_t, as a function of inducing area, C_i, would then be stated as follows:

$$A_t = \frac{k_1 B_t^3}{k_2 B_t + k_3 B_i C_i} \qquad (4)$$

This prediction is quantitatively supported by the data of Diamond (1955).

A fourth study makes similar prediction concerning the test area, C_t. Or:

$$A_t = \frac{k_1 B_t^3}{k_2 B_t C_t + k_3 B_i C_i} \qquad (5)$$

Again, a satisfactory fit has been obtained.

A. LEONARD DIAMOND
University of Hawaii
Honolulu, Hawaii

9. UNUSUAL ORIGIN OF A *Drosophila* GYNANDROMORPH

Gynandromorphs (sexual mosaics) occur in honey bees, silk worms, mosquitoes, and probably in other insects. Lateral gynandromorphs of different complexion have even been reported for pigeons. In the fruit flies of genus *Drosophila,* especially in the species *melanogaster,* gynandromorphs are seen frequently.

One such gynandromorph was found among the progeny of a *D. melanogaster* cross involving a balanced lethal parent of genotype Bl+/+Cy and a parent homozygous for the recessive gene, hairy. This cross was made as an experiment in a genetics course at the University of Hawaii. This particular fly had male genitalia, but was otherwise sexually mosaic. The left side of the abdomen had the male banding pattern and the left foreleg bore a male sex comb. The right side of the fly had the female banding pattern and was minus the sex comb. In addition, the right side of the abdomen was larger than the left, as might be expected, since female flies exceed males in size. This type of bilateral gynandromorphism is thought to originate by X chromosome elimination at an early embryonic cleavage.

However, this fly was also bilaterally mosaic for the traits governed by the two previously cited genes on autosome II. On the right, or female side of the fly, the bristles were shortened according to the pattern typical of the Bl gene. On the left, or male side of the fly, the wing curved upward as would be expected when Cy is present.

Mosaicism for both sex and autosomal traits is almost certain evidence that this fly originated via simultaneous fertilization of a binucleate egg by unlike sperm, and subsequent development into a sort of "Siamese twin." That silk worm sexual mosaics arise in this may has been ingeniously demonstrated, but few cases are known in *Drosophila,* and only one other of this exact type. It is interesting that such a rare event was noted in a student laboratory, thereby confirming this unusual origin of gynandromorphs in the fruit fly.

J. B. SMITH
TETSUO MATSUI
University of Hawaii
Honolulu, Hawaii

10. Hawaii's Role in the International Geophysical Year

In Hawaii today there are a dozen or so programs of study now under way or in the developing stages which will contribute to the International Geophysical Year. Some of these are programs that have been conducted on a regular basis for many years. Such is the program of ionospheric soundings being conducted by the Bureau of Standards station at Kihei, Maui.

The continuous recording of the earth's magnetic field and its variations at the U. S. Coast and Geodetic Survey's Magnetic Observatory at Barbers' Point is also a longstanding program. The Survey has expanded the program, however, with the installation of new and improved instruments. In addition, it has established a new station near Red Hill for the precise determination of longitude and latitude.

The U. S. Weather Bureau is another organization whose normal work has become an important part of the IGY. Now for the first time, however, regular meteorological observations are being made at the summit of Haleakala and at the 11,134 ft. level on Mauna Loa, at the Bureau's Mauna Loa Observatory, where atmospheric ozone measurements are also being conducted.

The Pacific Oceanic Fishery Investigations of the U. S. Fish and Wildlife Service in co-operation with the Scripps Institute of Oceanography will conduct a detailed survey of the recently discovered Equatorial Undercurrent. Studies of the changes in the sea level which are related to changes in density of the sea water are also being conducted by POFI as well as a number of surveys of the Polar Front region in the North Pacific.

Co-ordinated with a study of long-period waves and tsunamis by Scripps will be a territory-wide tsunami observation and alert program administered by the University of Hawaii Institute of Geophysics.

The IGY programs being conducted at the University of Hawaii, aside from the one just mentioned, are concerned with extraterrestrial events. At the Makapuu Point Solar Observatory the sun is kept under continuous observation in both visible radiation and radio frequency radiation. The visible-radiation telescope photographs the sun every 2 minutes by the light of the hydrogen gas on the sun, recording solar eruptions called flares. The radio-frequency telescope receives, amplifies, and records on a chart the intensity of the radio waves coming from the sun.

In co-operation with the University of California, the shower of tiny particles continuously falling on the earth from outer space, called cosmic radiation, is being monitored and its intensity recorded 24 hours a day.

Finally, the latest extraterrestrial object to come into being, the artificial earth satellite, is the subject of some concern of the satellite tracking programs at the University. The Moonwatch or visual observing program works from the Makapuu Point observatory using 16 small, fixed telescopes. The precision optical tracking camera, of which there will be only twelve in the world, is to be located on Haleakala, Maui.

WALTER R. STEIGER
University of Hawaii
Honolulu, Hawaii

FINAL SESSION

1. Keloid Scars: Observations and Management

Keloids are curious and unexplained fibrous skin lesions arising usually (though not always) after mechanical, thermal, or inflammatory injury to the skin, and lying between scars on one hand, and fibrous neoplasms on the other. A total of 147 keloids occurring in 126 patients, seen during ten years of private group practice of dermatology, are reviewed, and the results of treatment evaluated.

The supposed prevalence of keloids in Japanese is not confirmed. Japanese patients numbered 38, or 30 per cent, which is slightly less than the proportion of Japanese patients in my practice. Chinese patients made up 20 per cent of the series, and only 10 per cent of the total practice. Because of unknown factors leading to selection of material, however, the significance of this difference is doubtful. Spontaneously occurring keloids, however, were five times commoner in Japanese, and three times in Chinese, than in Caucasians.

Women outnumbered men about 3 : 1 in the age groups 20-39 and 40-59, but the sex distribution below age 20 was 1 : 1, suggesting that the frequent occurrence of keloids in abdominal midline incisions for pelvic surgery accounted in part for the discrepancy in the older age groups. Nevertheless, women outnumbered men by 3 : 1 among the spontaneously occurring keloids, and by 3 : 2 in the group due to miscellaneous causes. Only one keloid was encountered in a transverse abdominal incision, and only one in a skin graft donor site; only two occurred in the sites of skin curettement for carcinoma.

Treatment failures numbered 23, as opposed to 18 "good" (80-100 per cent flattening) and 5 "fair" (40-70 per cent flattening) results, in keloids of over a year's duration. In keloids less than a year old, good results numbered 40, fair results 5, and failures 18, with 15 patients not followed.

Twenty-seven lesions were not treated; 2 (the transverse abdominal incision and 1 curettement lesion) flattened spontaneously; 1 result was fair; 2 were failures, and 7 got worse. Fifteen were not followed. Ten lesions were simply surgically excised; 1 did well, 3 were a failure, and 6 got worse.

Excision followed by conservative x-ray therapy yielded 4 good results, 2 fair results, and 9 failures. Excision followed by vigorous radiation therapy (500 roentgens every 5 days for two to six doses) confined to the incision line and scar yielded 17 good results, 2 fair, and 3 failures; 4 were not followed. Similar vigorous irradiation alone, not preceded by excision, gave 29 good results, 4 fair ones, and 6 failures; 6 were not followed. Only four instances of mild radiation telangiectasia were produced. Conservative radiation not preceded by excision yielded 5 good results, 2 fair, and 4 failures, with 2 not followed.

Relation of results to the intensity of radiation therapy suggested only that intensive radiation gave a far higher proportion of successful results. Among those less intensively irradiated, however, a few good results were obtained with as little as one dose of 200r, or three of 250r, and no failures occurred with five or six doses of 150r each, or four doses of 375r or more.

A follow-up of 5 years or more was obtained in 26 cases, 1-5 years in 58 cases, ½-1 year in 13 cases, and under 6 months in 20; 30 cases could not be followed.

Cosmetic results were not as good as the results of attempting to prevent reformation of the keloid; many scars became unsightly due to widening, in spite of treatment. Nevertheless, the regularity of success at preventing recurrence of the raised, tumor-like scar justifies the conclusion that 500 roentgens given to the incision line every 5 days for four to six doses, starting immediately after excision, is at the present time a fairly satisfactory method of managing these unsightly scars.

HARRY L. ARNOLD, JR.
Straub Clinic
Honolulu, Hawaii

2. Formation of the Mineral Gibbsite on Kauai

Four distinct stages of weathering under subtropical climatic conditions are recognized on the Koloa flows of Pleistocene age? on Kauai. In stage 1 the unaltered rock is a dense, slightly porphyritic olivine basalt, with an intersertal texture, composed principally of labradorite ($Ab_{44}An_{56}$), olivine, augite, magnetite, and minor amounts of volcanic glass. In stage 2 the rock porosity is appreciably increased. Rims of iddingsite form around the olivine phenocrysts, and augite alters to epidote. In stage 3 the feldspar alters directly to gibbsite, which occurs as finely divided, disseminated grains and as lath-shaped pseudomorphs after the feldspar. Olivine alters further to iddingsite, iron oxide, and minor serpentine; epidote breaks down to iron oxide; some black opaque grains persist. In stage 4 the alumina from some of the finely divided grains of gibbsite in the matrix becomes mobilized and migrates along fractures and interstitial spaces to be redeposited as a more coarsely grained product which occurs as a coating in cavities and as a fracture filling. Agglutinated, nodular masses of gibbsite may result from filling of the larger openings.

Chemical analyses demonstrate the exceedingly rapid disappearance of silica, calcium, and magnesium between stages 1 and 3 and the corresponding increase in iron oxide and alumina.

AGATIN T. ABBOTT
University of Hawaii
Honolulu, Hawaii

3. Remarks on the Climate of Mauna Loa

Mountains create their own climates, modify those of neighboring regions, and affect the properties of the surrounding atmosphere.

Although mountain climate is characteristically variable within relatively short distances, due largely to the differing exposures of slopes to radiation and wind, and the ensuing differences in cloudiness, temperature, humidity and rainfall, it can be interpreted in terms of the usual climatic determinants: latitude, altitude, exposure, maritime influence and location relative to the major atmospheric eddies. However, interaction with the free air must also be taken into account.

Mauna Loa holds a particular fascination for the student of mountain weather and climate because of its great mass and its location in the midst of a tropical ocean and within the trade-wind belt. The effects of the trade inversion, a thermal barrier to the ascent of air, in suppressing vertical currents along the mountain slopes, have been little explored, but may be related to certain intriguing features of Mauna Loa's climate. Some of these appear also, but are less well defined, in Hawaii's other great mountains.

The present paper examines these questions briefly by means of the space and time distribution of the meteorological elements on Mauna Loa.

In general, the major climatic differences exist between areas exposed to and sheltered from the trades —windward and leeward, and between those above and below the average height of the trade inversion.

Although annual rainfall over the open sea near Hawaii averages about 30 inches, it ranges on Mauna Loa from less than one third to over 10 times this amount. The zone of heaviest mean rainfall occurs rather low on the mountain's slopes, at about 3,000 feet. While typical of the broader high mountains of Hawaii, this is uncommon elsewhere and may reflect the influence of the inversion in impeding the vertical growth of clouds. Diurnal and seasonal regimes of rainfall also vary strikingly from place to place.

The increase with height of the mean annual range of temperature on Mauna Loa is quite unlike what is suggested by theory and observed on other mountains, and may be attributed to the contrast between the maritime environment below and the continental environment above the inversion.

A pronounced daily "respiration" in which Mauna Loa draws air inward and upward during the day and downward and outward at night, often strongly enough to overcome locally the general circulation of the surrounding atmosphere, is suggested by marked diurnal cycles in wind, temperature, humidity, and cloud, and by their variations with altitude. The trade inversion appears only partially able to suppress these currents.

On the whole, the data imply that Mauna Loa to some degree creates and maintains a local atmospheric envelope whose properties may be at considerable variance with those of the free air.

SAUL PRICE
U. S. Weather Bureau
Honolulu, Hawaii

4. SCHUSTER'S EQUATIONS

In the eighteenth century, Bouguer and Lambert proposed that light is exponentially attenuated by matter. (The Bouguerian exponential underlies Beer's concentration exponential.) Bouguer's reasoning ignored scattering; but, in general, where streams of momentum encounter matter, back scattering generates return streams of momentum. Moreover, the incident momentum feels the influence of boundaries because back scattering maintains an interchange between the streams. Consequently, when Bouguer ignored scattering, he thereby ignored the return streams and inherently restricted his exponential to problems where the influence of boundaries is negligible.

Shortly after the turn of the twentieth century, Schuster wrote a pair of ordinary, differential equations which describe the interchange between the incident streams and the return streams. In spite of this apparent theoretical advantage, Schuster's equations have remained virtually unknown to scientists in general, whereas Bouguer's exponential has enjoyed centuries of popularity and success. This incongruity suggests three steps whereby the information contained in Schuster's equations should be made available.

First, specialized variables used in photometry are avoided by expressing Schuster's equations in terms of momentum. Thus, Schuster's equations claim that the vector sum for the time rates of change for the momentum density of the incident streams is accounted for in terms of: momenta whose magnitude is changed; momenta redirected into the return streams; momenta contributed from the return streams. With appropriate changes in symbols and algebraic signs, a similar claim is made for the return streams of momenta.

Second, a simple treatment for Schuster's equations is developed. For the first time, the incident momentum is expressed in terms of the return momentum, the incident momentum is expressed in terms of depth, the return momentum is expressed in terms of depth.

Third, Schuster's equations are reduced to Bouguerian exponentials for: the incident streams in nonscattering matter; the incident streams and the return streams above a matching bottom; the incident streams and the return streams well above a mismatching bottom. These three special cases are tolerably approximated in many photometric measurements. Nevertheless, close to a mismatching bottom under scattering matter, Schuster's equations do not reduce to Bouguerian exponentials; non-Bouguerian behavior is illustrated by applying Schuster's equations to middle of the road matter.

Fourth, in a simple tank apparatus the Bouguerian exponential is verified for an inky liquid over a white keyhole bottom; Schuster's equations are fairly well verified for a milky liquid over a black keyhole bottom; no test was made in nonabsorbing matter.

FRANCIS J. HOWARD
University of Hawaii
Honolulu, Hawaii

5. ANNUAL VARIATIONS OF SEA SURFACE TEMPERATURE IN THE EASTERN NORTH PACIFIC OCEAN

Charts showing the distribution of sea surface temperature in the eastern North Pacific Ocean are determined from commercial and military vessel reports for the middle ten days of each month. It is expected that these charts will be of considerable interest to the biologist, meteorologist, and oceanographer. The biologist may be able to predict the early or late appearance of a particular species of fish or forage; the meteorologist may be able to hindcast air mass modifications. To the oceanographer isotherms give an indication of surface flow since flow tends to take place along temperature contours, at least in the regions of swiftest currents.

Of about 2,500 individual reports of temperature for each ten-day period about 15 per cent are eliminated as obviously in error. The accuracy of the method of averaging temperatures over 1-degree squares is judged to be the same as reported by Franceschini in the Gulf of Mexico, who found a correlation coefficient of 0.92 between observations made by commercial and research vessels.

The temperatures contoured are compared with 30-year mean isotherms and regions of temperature anomaly delimited. Annual temperature variations are shown as anomalies by comparing months of succeeding years, using the earlier year as a base.

Annual variations in temperature for January, February, and March, 1958-57, show January, 1958, colder in the central part of the region contoured with cold cells near the Pacific Coast. The Pacific Coast was in general 0°-4° F. warmer. A large area of warm anomaly existed in the western central region. The situation for February was essentially the same but the cold cells near the Pacific Coast had been replaced by warm water or smaller cells had appeared. Water was warmer immediately north of the Hawaiian Islands and south of the Aleutian Islands. The large warm anomaly that existed in January in the western central region had been replaced by colder water. March, 1958, was colder by 0°-4° F. over a larger area. The Pacific Coast region still showed warmer water but the extent was not as great as in the two preceding months.

It is proposed to utilize cloud cover reports by vessels in the future in order to determine, as a first estimate, the part net insolation plays as opposed to advection in the development of large areas of comparatively warm or cold water.

RICHARD J. CALLAWAY
Pacific Oceanic Fishery Investigations
Honolulu

6. Comparative Toxicity of β-Nitro Propionic Acid and *Indigofera endecaphylla* to Chicks

Indigofera endecaphylla, a tropical legume, has desirable agronomic properties for soil protection and as a feedstuff for herbivores. It has, however, been shown to be toxic. The toxic principle has been reported as β-nitro propionic acid.

In the present experiments, leaf meal of *Indigofera endecaphylla* in which the β-nitro propionic acid content had been assayed was incorporated into a standard ration and fed to day-old chicks. Similar amounts of synthetic β-nitro propionic acid were added to a similar ration containing alfalfa leaf meal instead of *Indigofera endecaphylla* meal. A third group, the control, was fed the standard ration, containing alfalfa leaf meal but no β-nitro propionic acid.

Growth rates of birds fed the synthetic chemical and also the *Indigofera endecaphylla* leaf meal were depressed. Symptoms characteristic of toxicity of *Indigofera endecaphylla,* including partial paralysis and peculiarities of gait and posture were observed in the birds ingesting the synthesized β-nitro propionic acid. Affected birds from both lots were indistinguishable in appearance. It is concluded that β-nitro propionic acid is indeed the agent responsible for toxicity in *Indigofera endecaphylla,* since at the levels normally found in plants it produces symptoms identical with those produced by *Indigofera endecaphylla* leaf meal.

Additional tests with sodium nitrite added to the alfalfa leaf meal ration failed to induce the characteristic symptoms.

A. L. PALAFOX
H. MATSUMOTO
E. J. BRITTEN
University of Hawaii
Honolulu, Hawaii

7. Carbohydrate-Protein Complexes and Glycogen in Cartilage Autografts and Homografts

Twenty-six female albino rabbits were used to determine the relative concentrations of carbohydrate-protein complexes and glycogen in fresh and boiled costal cartilage autografts and homografts. The animals were sacrificed at various ages from 14 to 120 days after transplantation. The grafts were sectioned and the periodic acid leucofuchsin method of Hotchkiss was used to localize carbohydrate-protein complexes and glycogen. Examinations were made under the microscope.

In fresh autografts and homografts, it was found that carbohydrate-protein complexes and glycogen showed a slight decrease in concentration with age.

In the boiled autografts and homografts, carbohydrate-protein complexes were greatly diminished with age and glycogen completely lost at 60 days after transplantation.

RALPH N. AKAMINE
181 S. Kukui Street
Honolulu 13, Oahu

8. Origin of the Oceanic Insect Fauna

The insect fauna of the oceanic Pacific islands is fragmentary and mixed in origin. It is disharmonic (an uneven cross-section of the insect world), with some large groups well represented and others poorly so. The disharmony is most accentuated in Hawaii and some smaller, extremely isolated islands (not to mention atolls), where some major families (even with 40,000 world species) are completely absent. For Hawaii, Zimmerman estimated that well over 5,000 species evolved from about 250 successful immigrant ancestors, even though there are no endemic insect families in Hawaii. There are many hundreds of families of insects on all major continents. This indicates continuous extreme isolation, as well as extreme age.

The islands between Hawaii and the Asian-Australian area represent differing intermediate situations, from the Marquesas (more distant from continents but less distant from other high islands), to groups which are younger than Hawaii, but much closer to the continents, and richer and more harmonic, such as Fiji, Guam, and Palau. With New Caledonia, greater age and isolation is indicated, as the fauna is more specialized, with many endemic genera, a certain disharmony, and relationships with New Zealand and New Guinea more than with the nearby New Hebrides and Fiji. The New Hebrides are poorer than their location would indicate, suggesting that they are much younger, in terms of continuous exposure above sea level, than New Caledonia and the Solomons. All these island groups mentioned, except the Solomons, I consider to be oceanic islands. Many workers consider Fiji, New Hebrides, and New Caledonia to be continental, but they lack too many important families or subfamilies which are present in the Philippines, New Guinea, or Solomons. This follows Mayr on this point for the birds, and also the limits of distribution of mammals other than certain bats and rats. However, for the division between the Oriental and Australian regions I differ from the vertebrate zoologists, as I include Wallacea and New Guinea, together with Micropolynesia (not New Zealand), in the Oriental region, on the basis of insect distribution. This assumes that the New Guinea area has been largely insular, but obtained the ancestors of most of its fauna from the west, through much of the Tertiary when the islands were concentrated a little farther north (much of highland New Guinea was recently raised from ocean bottom), and more isolated from Australia, whereas the mammals and some birds entered from the Pleistocene union of Australia and New Guinea.

It is felt that most of the dispersal of insects to the oceanic islands has been by passive transport in air currents, secondarily by sea currents (rafts), or on the feet or feathers of birds. The insects best represented on the isolated islands could mostly have been thus carried. Experiments are now being conducted to test this theory. At present, trapping is being done on ships crossing the Pacific, with the support of the Navy and Coast Guard. It is hoped that trapping from airplanes can be initiated soon.

J. LINSLEY GRESSITT
Bishop Museum
Honolulu, Hawaii

9. Study of a Eurasian Relocation Center in the Netherlands

The Eurasians of Indonesia are defined for the purpose of this presentation as those individuals of Dutch-Indonesian extraction possessing Dutch citizenship in the pre-World War II period. Caught between expanding ranks of Indonesians pressing upward and an entrenched Dutch "upper class," the group's position became increasingly precarious. The Pacific war, the revolution, and Indonesian independence were catastrophic events for the group. Following the transfer of sovereignty, official agreements of 1949 granted Eurasians a two-year period to opt for Indonesian citizenship. Only a small minority elected to do so and a large-scale exodus to the Netherlands began.

For the purpose of conducting a participant-observer study, the author and his wife stayed for six weeks with 71 evacueé families temporarily lodged in a "relocation center" in the Netherlands. Interviews were conducted with each family following a prepared schedule and it is with the answers to some of the questions raised in the interview that the present paper is concerned. Two aspects will be included here: (1) the responses given to questions dealing with pre-war relations between Eurasians and Indonesians and between Eurasians and Dutch; (2) the reasons for not opting for Indonesian citizenship and departing for the Netherlands.

Concerning relations between Eurasians and Indonesians an overwhelming majority of the interviewees gave answers which can be interpreted as characterizing the relationship as "Fair-Good." The accompanying elaborations were of great importance and seemed to indicate that most responses were made within a status hierarchy. Most frequently mentioned were, "We felt ourselves superior," and "Lower class Indonesians treated us as superiors, but intellectuals were our equals."

In contrast, the responses to the question dealing with Eurasian-Dutch relations revealed sharp differences of opinion. Only a bare majority felt that relations were "Fair-Good" and of these many added qualifying phrases. The sizable minority which felt that the relationship was "Poor-Bad" made explicit reference to the status differential felt to exist between Eurasians and Dutch.

The above data might be interpreted to indicate that the Eurasians interviewed generally considered themselves to possess a superior status to Indonesians and felt it was rightly so. They did not so often, however, accept the fact that the Dutch considered them inferior and resented the fact. The limited and unstructured nature of the survey should obviously caution against generalizations applicable to the whole community.

The reasons for maintaining Dutch citizenship and departing for the Netherlands were complex (security, financial, further study in Dutch, etc.). The fact that several of the male interviewees made specific reference to the role of the wife deserves mention.

The elaborations revealed that the housewife's direct contact with the (hostile) outside world in marketing, her concern about providing food for the family, and her worry about the impossibility of providing adequate education for the children all played an important part in often making her position on the issue decisive.

PAUL W. VAN DER VEUR
University of Hawaii
Honolulu, Hawaii

10. Extent of Participation of Orientals in Two Types of Government Positions in Hawaii

Two limited types of political participation among Orientals (Chinese, Japanese, Korean, and Filipino) in Hawaii were selected for study for the period 1910-1955: (1) serving as elected officials of the Territorial and County governments, and (2) serving as appointed officials of the Territorial Government. The following result was obtained by tabulating all the names of persons listed in the two types of government positions according to whether they were Oriental or non-Oriental.

Per Cent Oriental	1910	1920	1930	1940	1950	1955
Of Elected Officials	0	1	6	24	37	51
Of Appointed Officials	0	1	4	6	18	30

From the United States Census Reports on the population of Hawaii, 1910 to 1950, the following result was obtained, with the 1955 percentage being a projected estimate.

	1910	1920	1930	1940	1950	1955
Per cent Oriental among U. S. citizens 21 years of age and over	3	13	24	36	48	56

On the assumption that only persons with certain characteristics are eligible for the kinds of government positions under consideration, the percentage of Orientals among citizens 21 years of age and over was selected as a criterion, or yardstick, with which to assess the extent of political participation among Orientals. It was then seen that: (1) Orientals in elected positions were "under-represented," or were below the "expected," throughout the period. The extent of under-representation decreased with each succeeding decade and, for the year 1955, it was estimated that participation among Orientals was almost equal to that among the combined non-Oriental category of people. (2) Orientals in appointed positions also lagged behind the expected percentage of participation throughout the period and in greater degree than in the case of representation among elected officials. There was a decrease in under-representation, however, with each succeeding decade. For 1955, about 30 per cent of the participants were Orientals as against an estimated 56 per cent of the adult citizens of Hawaii who were of Oriental ancestry. (3) The criterion of "U. S. citizens 21 years and over" was useful for interpreting the participation percentages over the decades. It also seemed to be a good indicator, or predictor, of the amount of participation on the part of Orientals; as the percentage of Orientals in that category increased, so did the percentage of Orientals in the two types of government participation.

Two other measures, readily obtainable from tabulation of U. S. Census data, were compared with the political participation percentages, and their utility as well as limitation as either indicators or explanatory factors of political participation are discussed. The measures were: (1) the percentage that Orientals comprised in the total population of Hawaii, and (2) the percentage that Orientals comprised among workers classified as "professional, technical, and kindred."

GEORGE K. YAMAMOTO
University of Hawaii
Honolulu, Hawaii

11. Psychological Factors in Campus Participation at the University of Hawaii

Student nonacademic activities form a small but important part of the educational scheme in American colleges and universities. The success of such activities, therefore, becomes a matter of concern for university students, faculty, and administration.

The present study is directed at interrelating attitudes towards student activities, participation in activities, leadership of activities, knowledge of activities, and biographical data.

The survey form upon which this study is based was constructed by students at the University of Hawaii supervised by the authors. It includes an Information Test (a series of multiple-choice items measuring knowledge of campus activities), an Attitude Form (consisting of Likert-type items), and a Biographical Data page. The sample consisted of 150 University sophomores, juniors, and seniors, of which 147 were eventually tested.

Several hypotheses were stated and tested for this paper:

1. That Information Test scores would be positively related to favorable attitudes regarding student activities. This relationship was in the expected direction, but was not significant.
2. That Information Test scores would be positively related to reading the campus newspaper. This relationship was highly significant in the expected direction.
3. That positive attitudes are positively related to reading the campus newspaper. This was significant at the .06 level of significance in the expected direction.
4. That campus participation would be positively

related to academic grades. This relationship was in the expected direction, but was not significant.

5. That leadership is related to academic grades. The relationship was insignificant and in the opposite direction from that hypothesized.

6. That Information Test scores are unrelated (sic) to academic aptitude. This hypothesis was verified, the high information and low information groups having almost exactly the same aptitude scores.

7. That attitudes are unrelated (sic) to academic aptitude. A slight, but far from significant relationship was obtained between being critical of activities and academic aptitude.

RICHARD A. KALISH
OTOMAR BARTOS
University of Hawaii
Honolulu, Hawaii

12. Sociological Factors in University of Hawaii Campus Participation

A random sample of 150 students was drawn from the population of all sophomores, juniors, and seniors enrolled at the University of Hawaii in fall of 1957. Information concerning 147 of these 150 students was secured: their age, sex, racial background, social class background (utilizing father's occupation and education as indices), and information about campus activities and issues were ascertained. Students were then divided into two categories: "leaders" (students who were chairmen of any student activity for at least one term, or who were elected officers or senators of the student government) and "others" (all students not counted as leaders). The findings were as follows:

1. Members of the upper classes are somewhat more likely to become student leaders than are members of the lower classes.

2. Although most leaders are of Japanese background, when size of each racial group is considered, Japanese and Caucasian students are likely to be underrepresented as leaders.

3. Young students (ages 18-20) are more likely to become leaders than are older students.

4. Women are more likely to become leaders than are men.

5. Well-informed students are more likely to become leaders than are poorly informed students.

OTOMAR J. BARTOS
RICHARD A. KALISH
University of Hawaii
Honolulu, Hawaii

13. A Quantitative Analysis of Political Opinion at the University of Hawaii, 1957-58

Student and faculty opinion concerning political subjects was sought in three opinion polls conducted at the University of Hawaii during 1957-58. Reliable information was sought as a replacement for myth and stereotype which inevitably surround a delimited public such as a university population. The involvement of students served to illustrate the utility of the immediate social laboratory and of actual participation in a process.

Five questions were presented to students (May and December 1957) and faculty (April 1958). Utilizing a sampling method known as "quota control," student pollsters interviewed, at random, 5 per cent of the student body. Control factors were sex, college, and class. The size of the faculty permitted a 34 per cent random sample. Use of schedules, distributed by method of "specific assignment," insured respondent anonymity.

Results

Statehood and an elective governor for Hawaii were supported by substantial majorities of both students and faculty.

Most students and faculty indicated "independent" political status. Partisan students preferred the Democratic Party in the May survey, the Republican Party in December. Student turn-over was a factor contributing to the shift. Faculty expressed a slight preference for the Democratic label.

If required to register as partisans at primary elections, a plurality of students in May would have registered as Democrats; in December, as Republicans. Faculty was evenly divided. Seventeen per cent of the students and 12.3 per cent of the faculty would have refused to register.

A majority of students and faculty believed our two parties equally capable of running Hawaii's territorial government. Most students expressing a choice thought the Republicans more capable; faculty selected the Democrats.

Male student choice of Democratic registration in May continued, but to a lesser extent, in the December survey while female Republican preference increased substantially over May. A majority of women faculty would have registered as Republicans; a substantial plurality of the men, as Democrats.

Democratic registration preference was indicated in May by all four student classes; only seniors remained Democratic in December.

A plurality of students in Applied Science, Teachers College, and Business Administration chose the Democratic Party in May; those in Arts and Science and Agriculture chose the Republican Party. In December, only Business Administration students remained in the Democratic column; Applied Science divided evenly.

Faculty "over 44" and "under 35" years of age would have registered Republican. The middle "35-44" group expressed strong Democratic support.

Several hypotheses emerge from results of these and a similar 1955 student survey. (1) Local student party preferences fluctuate during college years. (A pattern to such change may emerge.) (2) Campus men tend to support the Democratic Party; women, the Republican Party. (3) Campus men evidence greater resistance to partisan primary registration than do women. (4) Local faculty and student partisan preferences do not necessarily coincide nor does faculty party affiliation seem to influence student allegiance shifts during college years.

DANIEL W. TUTTLE, JR.
University of Hawaii
Honolulu, Hawaii

14. Tracing Hawaii's Ancient Past through Fishhooks

Fishhooks from archaeological excavations are destined for an important role in the tracing of origins and developments of ancient Hawaiian culture. The Polynesians who settled here more than a thousand years ago sustained themselves mainly through fishing. Their hooks of bone and shell, once buried, are almost imperishable. These hooks or fragments of them are found at sites around the shores of all the islands at all levels within these sites. For the period in which they are made we have found on the island of Hawaii that they have taken on forms and characteristics which are distinguishable to some degree from hooks made at other periods. With the determination of these forms and characteristics we can use them to identify periods of other sites we come across and to follow cultural developments. Elsewhere in the world pottery fragments have been so used, but there was no pottery in Polynesia. This is the first time in the field of archaeology that fishhooks have been so used.

At the southern tip of the island of Hawaii, as a result of four years of intensive digging with University of Hawaii staff and students, and volunteers, we have been able to obtain sufficient numbers of fishhooks to yield reliable determinations, from the very beginning of occupation down to the coming of Europeans.

For our study of more than four thousand documented fishhooks from excavations we had to classify them, devise a code for the classification, and enter each hook with its various characteristics on a manual IBM card, indicating its position in the site from which it came. Then these cards were sorted to learn the forms which came in the successive levels in a site. We then found that the hooks of certain levels in one site matched those in certain levels in other sites. Through obtaining radiocarbon dates from charcoal in the bottom of two of the sites we were able by comparing their fishhooks with the third site to place it in its proper historical position. This showed it was the oldest of the three and must have gone back to at least A.D. 750, but ceased to be occupied after A.D. 1350.

The over-all picture gained from our fishhook study is that the first Hawaiians had come with a well-developed and varied lot of hooks and that for a long period there was little change, and that, in the last third of human history in the Islands, there was a rather rapid change to slightly different forms. It is a picture of remarkable stability of culture, leaving little room for belief that any people had come here other than the Polynesian Hawaiians such as we see today.

KENNETH P. EMORY
YOSHIHIKO H. SINOTO
Bishop Museum
Honolulu, Hawaii

15. Current Trends in the Philosophy of Science

Twentieth-century philosophy of science developed by way of a radical transformation out of the earlier "philosophy of nature." Speculations concerning the universe and man's place in it have been supplanted by more sober logical analyses of the basic assumptions, concepts, and methods of the sciences. The enormous complexity of present-day scientific conceptual systems makes it imperative to clarify their logical structure as well as their empirical foundations. Many a great scientist has been his own philosopher in this sense, but as in so many other cases specialization has proved fruitful. During the last few decades very significant achievements have been attained in the logic and methodology of the formal and the factual sciences. Important and often surprising conclusions have been reached in the philosophy of mathematics, and of the natural and the social sciences. A better understanding of the scope and the limitations of the deductive and the inductive (hypothetico-deductive) methods has shed a flood of light upon the nature of mathematical systems, of mathematical proof, of empirical explanation, concept-formation and confirmation. Such basic concepts as space and time, measurement, matter and energy, causality and probability, determinism and indeterminism, organic life, behavior and mind, social structures and processes, etc., have been subjected to searching and illuminating logical scrutiny.

In contradistinction to the individualistic procedures of traditional philosophy, current philosophy of science is in many places pursued co-operatively by teamwork.

One of the results, of particular interest to this Academy, is that the often alleged fundamental differences between the natural sciences and the social sciences do not exist. The social sciences have now reached the level of a responsible application of the methods of measurement, statistical design, and in many cases of straightforward experimentation. The charge that the "social studies" are not genuinely "scientific" (because they are supposed to be idiographic, empathetic, teleological and valuative) rests on precisely the sort of confusions which the logical analyses of the modern philosophy of science has been able to dispel.

HERBERT FEIGL
University of Minnesota
Minneapolis, Minnesota
Carnegie Visiting Professor
University of Hawaii

NECROLOGY

ERNESTINE AKERS

The death of Miss Ernestine Akers occurred in May, 1957. Miss Akers came to Bishop Museum in 1947, and before becoming manager of the Bishop Museum Book Shop was in charge of the office at the Museum of the Pacific Science Board of the National Research Council. In her work for the Pacific Science Board she gave invaluable assistance to Honolulu and mainland scientists and scientific expeditions working on projects in the Trust Territory.

JOHN HERBERT BEAUMONT

John H. Beaumont passed away on July 16, 1957, in Honolulu. He was born March 23, 1895, at Wheeling, West Virginia. After graduating from the University of West Virginia in 1917, he attended the University of Chicago, Cornell University, and the University of Minnesota, where he received his Ph.D. in 1925. After two years as an assistant professor at Minnesota, he spent four years at North Carolina State College as head of the Department of Horticulture. In 1932 he joined the staff of the University of Maryland in a similar capacity, and in 1936 accepted a position as horticulturist at the Hawaii Agricultural Experiment Station. From 1938 to 1950 he was director of the Station and, until his death, senior professor of agriculture at the University of Hawaii, and head of the HAES Department of Horticulture. He was a member of the American Society for Horticultural Science, the Society of Plant Physiologists, the Hawaiian Academy of Science, and Sigma Xi.

In 1951 Dr. Beaumont won the gold medal for outstanding achievement in agricultural research from the University of Minnesota. During 1952 and 1953 he was a Fulbright scholar at the University of Queensland in Australia. During 1956 and 1957 he served as general chairman of the joint planning committee of the Second World Orchid Conference, held in Honolulu.

Dr. Beaumont was widely known for his contributions in tropical crop culture, particularly coffee, macadamia, and orchids. He was responsible to a great extent for the introduction and development of the macadamia nut industry in Hawaii. As a teacher and leader of research, Dr. Beaumont contributed much to the agricultural progress of Hawaii; and his kindly nature and dynamic direction will be long remembered in the hearts of his many friends and associates.

ERIC A. FENNEL

Eric A. Fennel, charter member of the Academy and for nearly forty years pathologist of the Straub Clinic, was born in Cincinnati, Ohio, September 24, 1887. He graduated from the University of Cincinnati College of Medicine in 1912, and from the Army Medical School in 1917. He remained there until his transfer to Hawaii as department pathologist in 1919.

He was an inspiring, stimulating, and indefatigable worker and writer in his specialized field. Keenly interested in leprosy, he was an active member of the Board of (Leprosy) Hospitals and Settlement from its founding in 1932, till its demise some twenty years later. He was the first to identify the existence in Hawaii of half a dozen diseases, among them endemic (murine) typhus fever and infectious mononucleosis. He urged the formation of a civilian blood bank prior to World War II and was the principal technical adviser to it in its formative period.

He was a member of Alpha Omega Alpha and of the Society of American Bacteriologists, and a fellow of the College of American Pathologists. He was a diplomate of the American Board of Pathology in both clinical pathology and pathologic anatomy. He was the only president of the Hawaii Medical Association since 1895 to serve two consecutive terms.

He died December 24, 1957, after a prolonged illness. He is survived by his widow, Nancy Nickell Fennel, his son, William, his daughter, Mrs. Arch Harrison, and three granddaughters.

HAROLD LLOYD LYON

Harold L. Lyon, who died on May 15, 1957, was born in Hastings, Minnesota, October 14, 1879. He earned three degrees from the University of Minnesota and taught there for seven years. He was brought to Hawaii in 1907 by the Hawaiian Sugar Planters' Association as a pathologist, for the purpose of determining why the native forests of the Islands were dying, and to make new plantings to preserve the watersheds. Dr. Lyon soon realized that overgrazing had destroyed many of the native species, and that hardier species of trees and plants and vines must be imported and established in order to protect and maintain the watersheds. When, in 1918, the Department of Botany and Forestry was established at the Experiment Station, HSPA, Dr. Lyon became its head. From 1936 to 1948, he served as the Station's director, and remained director emeritus and consultant until his death.

Dr. Lyon was a charter member of the Hawaiian Academy of Science, a member of its first publications committee, and its seventh president (1931-1932).

Part of Dr. Lyon's early reforestation program necessitated trial plantings of trees, shrubs, and vines which were imported from many parts of the tropical and subtropical world. For this purpose, the HSPA purchased a 124-acre tract in upper Manoa valley, called the Land of Haukulu. This became an extraordinarily interesting and valuable botanical garden. In 1953, at Dr. Lyon's suggestion, this arboretum was given by the HSPA to the University of Hawaii on condition that the University "maintain and preserve the granted premises as an arboretum and botanical garden only." Dr. Lyon's will provides that the net income of his estate shall go in perpetuity for the maintenance and development of the arboretum, which the University has renamed the Harold L. Lyon Arboretum.

In 1946, the University of Hawaii bestowed an honorary doctorate of science upon Dr. Lyon. In 1951, the University of Minnesota awarded him a gold medal for "Outstanding Achievement." In 1956, he received from the Massachusetts Horticultural Society the George Robert White Medal of Honor which is the nation's highest horticultural award.

Dr. Lyon's greatest monument lies all around us in the fruitfulness and beauty of these Hawaiian Islands, not only in the re-established forests and the myriad beautiful and useful trees and fruits, but in the vitalizing of the sugar industry and the establishment of the pineapple industry through the research done by himself and his staff at the Experiment Station. He was a dedicated scientist, tireless in his service to the Islands and their people.

LAURENCE MAXON WIIG

Laurence M. Wiig, surgeon, was found dead in his office July 30, 1957. He was born in North Dakota, the son of a physician, and went east for his medical training at the University of Pennsylvania Medical School. After completion of internship in Philadelphia at the Philadelphia General Hospital, he came to Hawaii where he practiced on the islands of Molokai and Maui. He became increasingly interested in surgery and accepted a four-year fellowship in surgery at the Mayo Clinic.

In 1946, he returned to Honolulu and soon was recognized as one of the most proficient surgeons in the Islands. He gave much of his time and energy to the surgical training program at St. Francis Hospital. He was frequently seen at the hospital, surrounded by a group of interns and residents, towering a head taller than most of the hospital staff. When he had completed a full surgical schedule in Honolulu, he would often drive out to Wahiawa General Hospital to further exercise his surgical skills.

He was held in high regard by all of his colleagues in the medical profession. He was a member of the Hawaii Medical Association, the American Medical Association, a fellow of the American College of Surgeons, Alpha Omega Alpha and Nu Sigma Nu at the University of Pennsylvania, and Sigma Chi at the University of Florida.

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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

THIRTY-FOURTH ANNUAL MEETING 1958-1959

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CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

PRESIDENTIAL ADDRESS 1959

THE FIELD OF THE HAWAIIAN ACADEMY OF SCIENCE
A TRIENCENTENNIAL REVIEW

DOAK C. COX

With proper foresight, I might conceivably have arranged matters six and a half years ago so that the relinquishing of the figurative gavel would have meant the end of my Academy responsibilities. At that time there was under consideration, by a committee of which I was a member, a sweeping revision of the Academy Constitution. A number of constitutional provisions honored principally in the breach were about to be dropped, a number of innovations were about to be adopted, and, just possibly, the requirement for a Presidential address could quietly have been eliminated. Unfortunately, the original Constitution was most specific: The President "shall deliver an address at the annual meeting"; the practice in this respect had been consistently correct and further, frankly, it didn't occur to me to have a personal concern. That chance was lost, the Constitutional provision was retained in all its firmness, and the tradition has been made yet firmer by the regrettably conscientious observance of the six presidents since.

Unlike Presidents of the United States or Governors of Hawaii, Academy Presidents are not expected to make annual or biennial reviews of the state of the Academy. However, since the opportunities for such reviews at the end of the first decade and first quarter-century of the Academy were overlooked, the field of Academy history seems ripe. With the fortunate discovery that a third of a century of Academy existence had been completed just about the time of last fall's meetings, and with the appropriate word designating such a period successfully (I trust) juggled out of the Latin, I decided to run the risk inherent in attempting such a review. I have chosen for my title that of the first Presidential address, "The Field of the Hawaiian Academy of Science," merely appending the pertinent phrase designating the passage of time.

The risk, I might point out, stems from the fact that 17 of the original charter members are still members of the Academy, including six who were later Presidents. Indeed, 24 former Presidents are still members. With many of these persons present tonight, I cannot expect to get away with any errors, and am somewhat limited even with the truth.

ORIGIN

The first Proceedings of the Academy (5) refer to several already existent Hawaiian scientific societies of restricted field and, indeed, there had been some scientific or quasi-scientific societies born and deceased long before the advent of the oldest of these; for example, the Royal Hawaiian Agricultural Society (1850-1856) (14).

The Medical Association of Hawaii was organized in 1895 from a group that had already been meeting informally for five years, and it later slid over the charter and claimed the tradition of an older Hawaiian Medical Society dating from 1864 (4). This substantial association began the regular publication of annual Transactions in 1900.

The Hawaiian Entomological Society was organized in 1904, began the series of monthly meetings never since broken, and, in its first year, with the help of the Hawaiian Sugar Planters' Association, commenced the publication of its Proceedings (12).

The Hawaiian Chemists Association grew out of the Hawaii Sugar Chemists Association, organized in 1902, but it merged with the Hawaiian (earlier, Honolulu) Engineering Association and the Sugar Mill Engineers to form the Association of Hawaiian Sugar Technologists in 1922. The general chemists were not to be downed, however, and the next year they received a charter as the Hawaiian Section from the American Chemical Society (13).

The Hawaiian Botanical Society was organized in 1924 (3, 10).

The first action to lead in any direct way to the organization of the Academy began in 1921 when a group of local members of the Society of Sigma Xi met to discuss the organization of a local general science society of some sort, a Sigma Xi club, a Honolulu Academy of Science to be affiliated with the American Association for the Advancement of Science, or an informal science club. There was considerable correspondence with both Sigma Xi and the AAAS Pacific Division headquarters which indicated that the organization of a local branch of the Pacific Division had actually been approved the year before. A Natural Science Club of Hawaii was organized in June 1921 "as a center for informal discussion of scientific topics relating to Hawaii," since a less formal organization was preferred. Harold S. Palmer served as Secretary-Treasurer of this society for two years, during which 17 meetings were held. This informal organization became inactive thereafter, leaving the Hawaiian scientific community again without a society.

In April 1925, members of the American Association for the Advancement of Science resident in Hawaii were called to a meeting at which a committee was appointed to formulate plans for a permanent organization, again possibly a local branch of the AAAS. The AAAS Council discouraged the local branch plan, but suggested the formation of an Academy of Science to be affiliated with the AAAS. The Academy organization was adopted at a meeting in June, and a constitutional committee was appointed which acted with noteworthy speed.

On July 23, 1925, the Constitution of the Hawaiian Academy of Science was adopted (5), officers were elected, and the Academy was in existence and functioning. It was voted that members of the AAAS, of its affiliated societies, and of the local botanical and entomological societies, were eligible for charter membership, and 79 charter members were recorded before the roll closed on October 1. An additional 42 candidates were elected to membership in the first year, giving a total membership of 121.

The expected field of the Academy was discussed by Frederick C. Newcombe, the first President of the Academy, in his retiring address on May 19, 1926 (11). Professor Newcombe's views may be considered fairly representative, because before his presidency he had served as chairman of the committee that drafted the Academy's constitution. He considered that the program of the Academy would be centered around the scheduled sessions for the presentation of individual papers. "In the meetings of the Academy," he said, "all scientists in Hawaii will have an opportunity to present the results of their studies to their fellows, to state their problems, to learn of the work and problems of their fellows in other sciences, and thus to contribute to the solidarity of science in Hawaii, to the good of Hawaii; and thus also to do all that can be done to overcome the scientific isolation which our geographical isolation necessarily entails." Newcombe emphasized that the Academy's field was science as a whole, not the specialties that were covered by the botanical, chemical, entomological, and medical societies, but he also pointed out that there were several scientific fields represented by workers in Hawaii who had no local specialized societies, and noted that half of the papers presented in the first year of the Academy were in these fields.

Newcombe explicitly assumed that in the Academy's program "only the so-called natural sciences, including medicine, [were] expected to participate." This is curious since at least eight of the members at the end of the first year, including several of the charter members, were social scientists. He also discounted any interest in science teaching. "The pedagogical side of science," he said, "is already looked after by teachers' organizations; and while the Academy might, at some time, wish to inquire into the adequacy of the equipment for teaching science, the methods, and so forth, would probably be best left to the teachers themselves."

The strangest specific omission from the Academy's program was "the presentation of popular addresses, in exposition of science," which, according to Newcombe, "should be but occasionally, if at all, attempted by the Academy. This very useful function," he continued, "is now exercised by other organizations and the Academy may well leave this service to them." Newcombe was certainly referring here to the weekly lectures that had been started two years before by the Pan-Pacific Science Council (11), one of the many subsidiary movements and offshoots from the Pan-Pacific Union. The omission over a decade in the Academy records of any specific reference to the Council, the Union, or the later established Pan-Pacific Research Institute (2), is a striking indication of the schism in the intellectual community, stemming from personal antagonisms, that must certainly have seriously hampered the development of many organizations, including the Academy.

Newcombe summarized his views concerning membership as follows: "The Academy offers its facilities and solicits the adherence of the young research worker, of the large body of amateurs, of the physicians doing research, of the scientific specialists in the industries and on the plantations, of the scientific staffs of the half-dozen research institutions of Honolulu, and of the investigators in government departments."

ADMINISTRATION

The 1925 Constitution (5) provided that the Academy would be governed by a Council, composed of a President, a Vice-President, and a Secretary-Treasurer, all elected annually, two other Councilors elected for staggered two-year terms, and the retiring President. The President could not serve two consecutive terms, but this restriction did not apply to the other officers. Only an Auditing Committee was specified, but as a rule a nominating committee and a resolutions committee were additionally appointed by the Council in the early years.

In 1936, the Constitution was modified slightly to permit scheduling a regular session in the fall and to make some minor changes in membership election procedures (6). By tradition, starting about 1939, the Vice-President came to be almost automatically nominated for the Presidency. Otherwise, the administrative policies remained unchanged for more than a quarter of a century.

I should have liked at least to identify the Presidents, Secretaries, and Treasurers in the Academy's history, and cannot adequately express my regret that time will not permit this. I cannot refrain from mentioning a few: E. L. Caum, who was the first Secretary-Treasurer, and who later served in the same post for six consecutive terms, and then as Councilor for a two-year term, making a total of nine years on the Council, an all-time record; Mabel Slattery, who served as Secretary-Treasurer for eight consecutive years; Edwin H. Bryan, Jr., who was Secretary-Treasurer for four years, Vice-President, President, Councilor, member of the Organizing Committee and of many committees since; and Chester K. Wentworth, who was Vice-President, President, Councilor, Secretary for five years, leader of an expedition, and chairman of a vital publication committee.

Only two irregularities occurred in the first quarter-century: the 13th President, leaving the Territory, resigned and was replaced by an Acting President; the 17th President and the other officers were held over for a second term because the annual meeting could not be scheduled during the wartime conditions of 1942.

In 1952-1953, it seemed probable to the Council that the Academy could be more useful both to its members and to the community if some of its responsibilities were delegated to committees. There were several special committees appointed that year to try the practice out, and in the second half of the year a revised Constitution was drafted. It provided for standing committees on membership, affiliation, program, and nominations, as well as the original auditors. It split the office of Secretary-Treasurer. It called specifically for publication of the Proceedings of the Academy and affiliation of the Academy with the AAAS, permitted affiliation with local scientific societies of restricted interest, and modified the procedures of the Academy in a number of other ways.

The revised Constitution (8) was adopted by the Academy in the spring of 1953, after amendment to require at least two nominations for each elective position. There were some further amendments adopted during the next year, which changed the office of Vice-President to that of President-Elect, introduced a ballot by mail for officers, relaxed the requirement for two nominations for offices whose incumbents were willing to serve again, and provided for the establishment of Regional Divisions on the neighbor islands. This last provision was made in response to a petition from the Big Island and resulted in the organization of a Hawaii Division in 1954.

To ease the task of the Nominating Committee in 1957, when replacements had to be found for both the Secretary and the Treasurer, the Constitution was further amended to remove the requirement of dual nominations for those offices (9). Recognizing the load on the Secretary, the Council at its last meeting established the appointive position of Membership Secretary.

These administrative arrangements have been discussed primarily as a convenient historical framework on which to hang the make-up and program of the Academy.

MEETINGS

From the earliest organizational discussion, it was obvious that one of the basic needs to be supplied by the Academy was meetings at which papers could be presented by those who had done some piece of scientific work which they thought would be of interest to others, and heard by those who wanted to know what work was in progress both in their own disciplines and in others. Not only by Constitutional requirement, but to meet a continuing need, the essential part of the regular or "scheduled" sessions of the Academy has always consisted of these miscellaneous volunteered papers.

About 665 papers have been presented in the sessions, a yearly average of almost 20. Thirty-five volunteer papers were offered at the first annual meeting, a record never equalled since. Four of these were read by title only, but that still left eight to 12 for each of three evenings. Speakers at our recent sessions who may have been disappointed by the time limit set for their papers may contemplate the restrictions that must have been necessary during an evening of 12 papers.

Until the tenth year there was only one "scheduled" session, that in the spring. The custom of a two-session annual program started with a fall session in 1935 and has continued since, except in 1942, when the spring session had to be dropped due to wartime restrictions, and in 1957, when there was an extra "scheduled" session in the winter.

For 27 years the meetings were arranged by the Council, or to be more accurate, by the Secretary-Treasurer, who negotiated the reduction in number of papers in fat years, and pried up extra papers in lean years. The 1952-1953 Council appointed a Committee on Membership and Program, and since then there has been a standing Program Committee provided by the revised 1953-1954 Constitution.

Many of the Program Committees have arranged at the regular sessions for food for the eye as well as for the ear in the form of some 20 exhibits in all. It took this year's Program Committee, however, to come up with the provision of food for the palate at the regular sessions. Previously the members starved, so far as the Academy was concerned, until the Annual Dinner. The tradition of the dinner was begun at the second annual meeting, and has been followed uniformly except when evening functions could not be held for three years during World War II, and when an austerity program forced the substitution of a lunch in 1952.

For the first 15 years, and again since the 29th year of the Academy, special sessions, or "public meetings" as they were first termed, have generally been held to take advantage of visitors of scientific fame. These averaged better than two a year in the early period. Since 1954, there have been 22, an average of more than four per year, most of them sponsored jointly with one or more of the Associated Societies.

Symposia have been scheduled at both regular and special sessions, which in the course of time have involved a total of some 62 speakers. Many of these symposia have dealt with problems of local resources; three with Island natural resources in general, two with water resources, one with soils, one with food resources, and one with the rat problem. Others recently have dealt with education and will be discussed a little later.

PUBLICATIONS

The Academy was very fortunate in being able to have its Proceedings published from the very beginning. In 1926, the Bernice Pauahi Bishop Museum offered to publish them in its series of Special Publications without cost to the Academy. The first issue contained a historical sketch of the organizing effort and the first active year, the Constitution, the list of members, the program of the meeting, and abstracts of the papers presented, including an extended summary of the Presidential address. The second issue, which set the pattern for subsequent issues through the fifteenth, contained a summary of the year's activities, a list of officers, the program, abstracts, and a list of members.

In the spring of 1941, the fortunate arrangement with the Bishop Museum had to be terminated owing to the limited finances of the Museum. The Council decided for the time being to file typewritten copies of the abstracts in four libraries in Honolulu. The war undoubtedly delayed consideration of better arrangements, but in the spring of 1943 negotiations were started with the University of Hawaii as a potential publisher. Finally, in August 1944, a plan was approved whereby the 1940-1943 Proceedings would be published by the University in a format similar to, though somewhat reduced from, that of the earlier issues, with the Academy paying three-fifths of the cost.

The Proceedings of the sixteenth through the eighteenth meetings, and those of the nineteenth and twentieth meetings, were publishd in two issues in 1945 and 1946, and the Proceedings have been issued annually since. With the 26th Proceedings were presented the Proceedings of the Symposium on Scientific Research in the Pacific sponsored by the Academy in March 1951. Beginning with the 29th Proceedings, an annual report containing abbreviated committee reports was added; beginning in the 32nd, the Presidential address was printed in full.

During the time that negotiations were under way with the University, a list was drawn up of institutions around the world with which exchanges would be desirable. This list has since been so expanded that our Proceedings now go to more than 200 institutions. The exchanges from this distribution are received by the University Library.

MEMBERSHIP

The most important element of the Academy is, of course, its membership. No matter has received such serious and repeated attention as membership policy. In the organizational meetings in 1925, it was agreed that some interest in science was an essential prerequisite to membership. There were proposals for both a single-class membership, and a dual-class membership with classification based on activity or professional scientific achievement. What was adopted, however, was a provision for two classes of members with the distinction based on residence, those not living in Hawaii being called Corresponding Members. The requisite degree of scientific interest to be required was vigorously debated; a proposed qualification, "actively interested," was amended in the final version of the Constitution by omitting the adverb.

In spite of the lack of stringency in the requirements for eligibility, the procedure of election was originally tightly prescribed. Three members had to nominate each applicant to the Council, the Council recommended to the Academy what nominees is approved, and the Academy voted by ballot—at least in theory. There is no record of any nominee failing of election, and after a few years the ballots were reduced to one cast by the Secretary by unanimous consent. These provisions were modified somewhat in the 1953-1954 revisions of the Constitution, and finally relaxed in 1957, so that only two sponsors are required, and election is by the Council upon the recommendation of the Membership Committee.

There were never more than four Corresponding Members, and administratively they were an inconvenience hardly compensated by the fact that they were exempt from the payment of dues! In 1936, the Constitution was amended by simply dropping the provision for Corresponding Members, but retaining residence in Hawaii and an interest in science as qualifications for membership. In succeeding years, several members who left the Territory were allowed to retain their membership, and in the 1953-1954 revised Constitution, eligibility was extended to nonresidents without special classification and without waiving dues.

The possible advantages of recognizing a class of the elite within the general Academy membership has been raised repeatedly, most recently three years ago. After thorough study, the 1956-1957 Membership Committee recommended the exemption from the payment of dues of the Academy's elder citizens and the creation of a category of contributors. These provisions were adopted by Constitutional amendments in February 1957. At the advice of the Committee, the single class of membership was retained with the simple "interest in science" criterion for eligibility.

The dues for members in the Academy were set at $1.00 in 1925, and remained unchanged for 32 years. The inflationary increases in publishing and general operating costs after World War II were met for several years by the increasing efficiencies arising from an increasing membership. By 1956, however, it was obvious that either the program would have to be cut, or the dues would have to be raised, and the Academy voted in 1957 to double the dues rate to $2.00.

The charter membership of 79 had increased rapidly at first, so that at the end of the second year the total membership stood at 157. Thereafter, for 26 years, it increased erratically, with frequent though temporary slumps, at an average rate of 7 per year, so that in April 1953, the total was 345. The next five years showed a phenomenal increase of over 100 per year, then during the year just past, there was some loss through the loss of delinquents unwilling to meet the higher dues established two years ago, and also through the dropping of those who had been drawn in during years of proselytization and whose interest was casual.

At the end of the year just closed, our membership stood at 838. It is worth noting that our Academy is about the tenth largest in size of those in all the states, with by far the largest membership per capita of state population.

AFFILIATION

Turning now to a consideration of the Academy's relationship with other societies, you will remember that affiliation with the American Association for the Advancement of Science was one of the aims of the foundation of the Academy. In the organization of the Academy itself, the AAAS affiliation was overlooked, and indeed it was hardly considered again for 26 years. In November 1951, the Academy voted to seek affiliation, and in June 1952, was accepted by the AAAS, thus finally bringing to actuality the relationship that had been considered more than 31 years previously in connection with the forming of the Natural Science Club.

As an affiliated society, we gained a seat on the AAAS Council, and, thus, full-scale citizenship status in the national scientific community seven years before we gained the political equivalent. Generally our delegate to the AAAS, or an alternate, has been in actual attendance at the annual meetings. In addition, our Academy is automatically a member of the Academy Conference which represents all of the 44 affiliated state academies of science. Through the AAAS we are in touch with national events that are of concern to us; for example, the proposal and eventual passage of the National Science Foundation appropriation for aid to science education through the state academies. Through the Academy Conference, we see what fields other academies attempt to cover, how they are organized, and how successful they are. From the AAAS we also receive annually a small grant for the support of research or science projects, based on our mutual membership.

Through the Academy Conference we were aware, when reorganization of the Academy was considered in 1953, that many state academies were organized by sections of restricted interest. There were in Hawaii strong and active local societies and local sections of national societies, of restricted scientific interests. It would have been absurd for the Academy to attempt either to compete with or to absorb these societies, but it did appear that a tie of some sort between the Academy and the specialized societies would be of value, and so there was written into the 1953 revised Constitution a provision for "Associated Societies," those in Hawaii "whose objects are in keeping with those of the Academy."

During the 1953-1954 year, seven of the specialized societies accepted the invitation of the Council to Associate status. These were the American Society of Agronomy, Hawaii Chapter; American Chemical Society, Hawaiian Section; Anthropological Society of Hawaii; Geophysical Society of Hawaii; Hawaii Medical Association; Hawaiian Entomological Society; Society of Sigma Xi, Hawaii Chapter. Three of these, the Chemical Society, the Entomological Society, and the Medical Association, have already been referred to as antecedents of the Academy.

The Anthropological Society of Hawaii had been organized in 1929, had held regular monthly meetings since, and had published its society "News" from 1937 through 1949, and "News from the Pacific" thereafter.

The Geophysical Society of Hawaii was organized in 1953 as a joint local section of the American Meteorological Society and the American Geophysical Union. It was formally an outgrowth of the Meteorological Society of Hawaii, dating from 1931, but it took over also some of the membership of the Hawaiian Dana Club, a geologic group started in 1935.

A local club of the Society of Sigma Xi had, you will remember, been considered here in 1921, when the Natural Science Club was organized. A Sigma Xi Club of Hawaii was finally founded in 1939. Two years later, a full charter was approved, but the action was postponed because of the war, and the installation did not actually occur until 1947.

Members of the American Society of Agronomy began meeting in Honolulu in 1950, and in 1952 a Hawaii Chapter of the Society was chartered.

In 1954-1955, two more societies became the eighth and ninth Associates. One was the Botanical Society, an antecedent of the Academy, which had been invited the previous year to become an associate, but which had delayed action to see how the Association principle was going to work. The other was the Hawaiian Psychological Association which had been started in 1949. This society is an affiliate of the American Psychological Association and a member of the Conference of State Psychological Associations.

In 1957, the American Statistical Society, Hawaii Chapter, which had been chartered in 1946, became the tenth Associate, and at the last Council meeting of the past year, an eleventh society was accepted as an Associate, the Hawaii Dietetic Association, a local chapter of the American Dietetic Association, chartered in 1939.

It is probable that the combined membership of the Academy and its various associated societies, eliminating overlaps, exceeds 1,600.

An affiliation committee was established by the 1953 revised Constitution to include the representatives of the associated societies, those of the Council, and the delegate to the AAAS. The Committee undertook immediately, on behalf of the Academy, the administration of the AAAS research grants, which were then used in support of postgraduate research. Between 1953 and 1957, six awards were made, totalling $300.

Three years ago, when the AAAS requested that its grants be used for support of science projects in schools, the Affiliation Committee, relieved of its responsibilities for administering them, turned in 1956-1957 to the organization of a science fair. I wish to cover this endeavor in more detail when considering the efforts in science education. It will suffice at the moment to call attention to the early joint effort in this field, and to the success that was reported back to the Affiliation Committee by a special Science Fair Executive Committee in the spring of 1958.

This year the Affiliation Committee has undertaken a review of notable activities in the scientific field that might be undertaken during the first year of Hawaiian Statehood.

Through the connection with the Associated Societies, the Academy has thus found very useful means for studying its program and possible modifications in the light of their widest value.

SPECIAL ACTIVITIES

The number of "scheduled" sessions and of special sessions varied from year to year, as has been indicated, but they may still be considered the Academy's normal program. Three sizeable activities have, however, been distinctly non-normal.

One was the expedition made to the summit area of Mauna Kea in 1935. The Council named Chester Wentworth, who, incidentally, was President that year, as leader, and appropriated $100 to support it. To that magnificent sum was added a certain amount of cooperation by other agencies. An advance party was given transportation on the Coast Guard cutter *Itasca* to reconnoiter the area and set up camp. A detachment of 10 enlisted men from the Hawaiian Department, U. S. Army, under the command of H. A. Meyers, was responsible for logistics and communication. Parker Ranch provided truck transport on the Big Island and the CCC provided mules.

The total scientific staff numbered 16 and included botanists, entomologists, geographers, geologists, meteorologists, and zoologists. An informal report was made to the Pan-Pacific Research Institute afterward, the only evidence of cooperation recorded between the Academy and that institution, and several technical papers on the individual fields of effort were published.

The Academy appointed a new Expedition Committee in 1936, and appropriated $250 for an expedition to the Kokee area of Kauai, but this plan never materialized.

A second special activity was the Symposium on Scientific Research in the Pacific, held in March 1951, spark-plugged by Dr. Loring Hudson. L. D. Baver, Vice-President of the Academy, served as general chairman. After a general session, the more than 150 participants were separated into 11 committees which reviewed as many aspects of scientific research of interest in the Pacific. Current needs were discussed and recommendations prepared in the form of resolutions. The resolutions were then coordinated and presented at a final meeting of the whole group.

It is of interest to examine these resolutions in the light of subsequent action. Of the 10 prepared by the committee with which I am most familiar, that on geology, geophysics, and hydrology, six resolutions cover fields in which there has since been substantial action, including progress on deep-sea surveys, the establishment of a geophysical institute at the University of Hawaii (at least in nuclear form), and the initiation of quantitative hydrologic inventories in Hawaii. The other four resolutions still need implementation; for example, that concerning comprehensive work on beaches and sand supplies.

The Proceedings of the Symposium were published in the 26th Proceedings of the Academy (7), after abbreviation through the heroic efforts of the Academy Secretary, so that the printing cost would not break the Academy's treasury.

SCIENCE EDUCATION

The third special activity, science education, has grown to be larger than the whole of the rest of the program, so far as number of participants, demands in time, and probable importance of results are concerned.

The first discussion of science education as a possible interest of the Academy, or rather the first after President Newcombe disavowed interest in it, arose early in 1953, partly as a result of the offer to the Academy as a new affiliate by the American Association for the Advancement of Science of a couple of honorary junior memberships in the AAAS for high school students. The Council realized abruptly what an insignificant contact the Academy and its membership had with science education. An attempt was immediately launched to invite science teachers to membership in the Academy, and before the spring meetings, 36 responded. From this group a Science Teacher Committee was appointed the next year, and instructed not only to administer these AAAS awards, but to investigate the formation of a science teacher society that might become associated with the Academy, and the formation of science clubs.

This Committee was maintained for four successive years. The first two years' work was largely exploratory, but a break-through seemed to be scored in the third year when a Science and Mathematics Teachers Organization was launched at a meeting of 100 teachers and guests at Coconut Island in November 1955. The success was only temporary; in spite of the continuing support of the Committee, the organization foundered.

In the meantime, however, the concern of the Academy in the field of science education had born fruit in a number of other ways. Members of the Academy began to be called with increasing frequency for service as Career Day Councilors in the high schools, as participants in meetings organized by the Department of Public Instruction to acquaint elementary and intermediate teachers with the features of Hawaiian natural history, and as members of curriculum advisory groups.

In 1954-55, a program subcommittee headed by John Warner arranged two popular symposia intended especially to acquaint teachers with the activities and facilities of the research institutions in Honolulu.

Two years later, Sterling Wortman, then head of the Program Committee, arranged, in cooperation with the Department of Public Instruction, a series of six lectures by Academy members for the science teachers of Honolulu. So enthusiastic was the reception that the DPI insisted on a repeat performance the next year. Again Wortman handled the arrangements for the Academy, this time as Secretary and ex-officio member of the Science Teachers Committee.

In 1956, the American Association for the Advancement of Science suggested strongly that the annual funds formerly used for postgraduate research grants be diverted to the support of high school science projects. The administration of these funds was transferred to the Science Teachers Committee, which arranged for a grant to the students of Radford High School for the construction of a botanical garden.

Through the stimulus of the Hawaii Chapter of the American Chemical Society, the affiliation committee in 1956-57 undertook serious consideration of a Science Fair. A special Science Fair Executive Committee was set up representing 8 of the 10 societies with the aim of organizing a fair for the spring of 1957. This timing proved too ambitious, but in the spring of 1958, under the leadership of Leon Rhodes, the First Annual Hawaiian Science Fair was held in Honolulu. About 2,000 students participated in schools throughout the Islands. Of the exhibits prepared, 157 were shown at the central fair, and the top boy and girl winners were sent to the National Science Fair in Flint, Michigan. This activity required a budget far beyond the Academy's norm, but the community responded well to an appeal for financial and material support and assistance. To receive the monetary contributions, the Academy filed as a tax-exempt institution and established a special Science Fair Fund.

At the recommendation of the First Science Fair Committee, an Inter-Society Science Education Committee was established by the Academy and its Associates in May 1958. At a meeting of the executive officers of the several associated societies with the Academy Council, it was instructed to organize the next Science Fair and to promote the extension and improvement in science education in other ways. The Academy Council transferred to the new committee all of its efforts in the field, changed its Science Fair Fund to a Science Education Fund under the new committee, and named A. J. Mangelsdorf the first chairman.

The results of the first year's activity have been far beyond most expectations. The Second Annual Hawaiian Science Fair was organized under the direction of Saul Price. This time 5,000 students participated in 75 schools, and the competence of local boys and girls in the field of science was demonstrated to some 15,000 persons at the central fair, plus uncounted others at local fairs. Two sizeable scholarships were added to the mainland trips for the boy and girl winners.

The AAAS traveling science library of 2,000 key books, which had been obtained during the previous year by a committee headed by Robert Clopton and circulated in schools on Hawaii, was moved to Maui County schools, arrangements were made for obtaining two additional sets of books, and individual schools were stimulated to add a substantial number of the books to their own libraries.

The Science Teachers Seminars were again organized by Sterling Wortman, this time in two series, one for elementary and one for high school teachers.

A thorough survey of science clubs and their needs was made by a committee headed by Donald McGuire. Assistance to them was started, and definite plans were made for additional and very substantial future support.

A series of seminars for especially talented students was started by Albert Carr, a token initial contribution was made toward the preparation of a series of elementary science text supplements by Sister Mary St. Lawrence, and a number of other studies and activities were commenced.

Endeavors of these kinds take considerable money, but money has not yet proved a limitation. The annual grants from the AAAS, local contributions of $4,700, and a $5,000 grant from the Alfred P. Sloan, Jr., Foundation, have carried on the activities to date, and the Academy has requests before the National Science Foundation for grants under its new State Academies of Science Program for some $60,000 worth of projects, including publication of the series of elementary science text supplements, preparation and use of a series of miniature museum-type displays, organization of a science club service, continuation of the students science seminar series, and expansion of the Teachers Science Seminars Program to the neighbor islands. We have recently received word that some $7,000 has been allotted for the Teachers Seminars and the museums, and we are anxiously awaiting word on the rest.

THE FUTURE

It is obvious from the foregoing discussion that the Academy has had a role to play, and to a substantial degree has played it successfully. Before speculating about its future role, it would be wise to identify the factors in the Academy that have led to its successes.

I believe there is one predominant, essential element, and that is that the Academy has served and represented the whole Hawaiian scientific community. Both this specialized community and the community in general recognize that there are functions in which an agent acting for the Hawaiian scientific community as a whole can exercise a special competence.

Now the interest of this Hawaiian scientific community cannot be described in terms of definite boundaries. Let me attempt an analogy in the terms of physics. Imagine a three-dimensional field in which science grades to metaphysics in the first and grades to technology in a second of three mutually perpendicular directions, and in which the third direction is a composite geographic one. The field of interest of the community which the Academy serves and represents is a force field whose intensity decreases asymptotically toward zero in all directions in this field.

If this concept is essentially correct, it is futile to argue about the limiting criteria of Academy membership eligibility, or the exact measure of scientific content that an Academy program must have, but it remains important to keep the scientific as well as the geographic criteria in mind in weighing the intensity of membership proselytization and in budgeting the energy devoted to various elements of the program. Otherwise, the Academy might conceivably lose the very competence that makes its participation in the kind of enterprises I have named worthwhile, or might find itself spreading over programs that other agencies are better qualified to undertake.

With this background, the logical continuation and extension of the Academy program may be projected, at least in the broad outlines and at least for a limited future.

The regular sessions of papers presented by members primarily for the benefit of other members must remain the essential heart of the Academy program, no matter how much else is added. These programs are what maintain the community of interest in the Hawaiian scientific community.

There is a continuing problem with the offering of specialized papers to the Academy. It is highly important for members to discuss their specialties with others not in their fields, but only if it is in language understood by the others. Program Committees in the past have met this problem either by ignoring it, by scheduling the specialized papers for presentation by title only, or by refusing to schedule them. None of these procedures can be as satisfactory as channeling such papers to the societies of more specialized interests. Unfortunately, as in Newcombe's day, there are still gaps in the array of these societies. For specialized papers in marine biology, for example, there is no place to go except to the Academy. The number of marine biologists is great, and sometimes, though certainly not always, the things they wish to say are understood only by other marine biologists. I have not infrequently wondered whether there was anything the Academy might do to encourage the establishment of an independent but associated society in this general field; and perhaps with a marine biologist as president, the next year might seem an appropriate one for exploration of the possibilities.

The continued publication of Proceedings also seems an essential. The printing of abstracts not only suitably records the substance of the communication at the meetings, but serves as feedback to stimulate the offering of other papers. There is a possibility, investigated in the past but not conclusively, that some of our Associated Societies that do not have publications of their own might be interested in having some record of their proceedings published with ours. There has also been thought given to fuller publication. So far, other outlets seem adequate for the full papers that deserve wide circulation. It might well, however, seem desirable to file full manuscripts of papers presented, so that copies could be made available on demand—a scheme seriously proposed as a substitute for journal publication in general.

We need no longer claim, as Newcombe did, that the Academy will refrain from the sponsorship of special public meetings for topics of general interest. Many scheduled in the past have been highly successful in public education and public relations, as well as in educating and entertaining our members. Here, again, our associates are important in providing speakers and topics, and in sharing with us the responsibility and honor of sponsorship.

Our large and growing program in science education has frequently been justified explicitly on the ground of the Academy's interest in the training of future scientists and, of course, implicitly on the assumption of the competence of the Hawaiian scientific community to judge what constitutes the proper training. This is a perfectly logical justification, but I think it is at least as important to promote the production of a future citizenry which understands more fully what science is, what it can and cannot do, and what it needs. From such a citizenry, the scientific profession will arise with greater spontaneity.

It would be hazardous indeed to predict the details of the future programs in the promotion of science education. To an extent which already makes an important dent in the scientific manpower, we are committed to several lines of attack, each of which has its own advantages. A very few of these may fail; some will run a useful course and peter out; most will, I believe, continue in one form or another. Some other lines of attack are already under study—scholarship assistance, counselling, and evaluation of teaching aids. Still others are suggested by successes experienced by other state academies—Junior Academies, Collegiate Academies. Nothing but additional careful consideration can determine which lines are expedient for us.

The Academy is likely to run into some limitations in the extension of its program in the near future. One possible limitation, of course, is financial, but I am inclined to discount this likelihood. Another is the limitation of manpower, but if the cataloging of Academy membership that has been considered for several years is accomplished, I am inclined to think this may be postponed.

Still other limitations may be set by those inherent in the Academy's volunteer and amateur administration. For a time these can be by-passed by mechanization and office-splitting, but there is a limit to the amount of splitting that can efficiently be done.

If and when the limit is reached, there will have to be some soul-searching. Should the limit simply be accepted, or should the Academy turn to professional or semi-professional administration. If the latter, can the expenses be recovered by increased dues or by contributions, or should the Academy accept state aid as do several other academies?

I have at several points emphasized the importance of maintaining our scientific rather than technologic make-up and attitude. This is not because I do not regard technology as important, even as the principal activity of Academy members. But technology has its own supporters, and that most creative part of science which is not technology, that part which is most basically essential, may expect to find its most intelligent support almost exclusively from the scientific community.

I trust that from this scientific community will come the realization that though the major ills that beset mankind are not in essence, perhaps, a matter of science, they are amenable to a great deal more scientific understanding, and thereby treatment, than is generally recognized. The due support of the social sciences is likely to come only with the expression of faith by the rest of the scientific community, that scientific methods have their place in the social field, expression through organizations such as the Academy.

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ANNUAL REPORT 1958-59

The Hawaiian Academy of Science ended its thirty-fourth year with a membership of 838. Thirteen persons were elected to membership during the year, while 61 were lost through nonpayment of dues and 21 resigned.

Sterling Wortman, Secretary

FINANCES

Balance on hand April 30, 1958		
Bank of Hawaii deposits	$ 410.59	
First Federal Savings & Loan	554.87	$ 965.46
Less checks outstanding		50.33
		$ 915.13
Receipts		
Dues	$1,336.00	
Annual Dinner—131 reservations	425.75	
Reprints sold	62.11	
Donations	5.48	
Dividends, First Federal Savings & Loan	19.56	1,848.90
		$2,764.03
Disbursements		
AAAS donation to operational fund	$ 16.00	
Annual Dinner—132 reservations	429.00	
Complimentary membership (15)	30.00	
HAS-Hawaii Division, 1956/57 & 1957/58	67.50	
Mailing operations	32.84	
Postage	213.94	
Printing of Proceedings 1957/58	475.07	
Printing of Programs (2 times)	76.26	
Projector service	10.00	
Reprints of abstracts of Proceedings	117.83	
Science Education Fund	200.00	
Science Fair project assistance	6.77	
Supplies	124.50	1,799.71
Balance March 31, 1959		$ 964.32
Balance on hand March 31, 1959		
Bank of Hawaii	$ 864.96	
Cash not deposited	6.00	
First Federal Savings & Loan	574.43	
	$1,445.39	
Less checks outstanding	481.07	$ 964.32

Status of Dues Payments:

	April, 1958	March, 1959
Advance	$370.00	$233.00
Arrears	377.00	367.00

Audited and found correct April 8, 1959.

/s/ W. M. Bush
/s/ Chester A. Wismer

SCIENCE EDUCATION FUND

Balance November 14, 1958 (Science Fair Fund)			$ 500.10
Receipts			
Alfred P. Sloan Foundation		$5,000.00	
McInerny		1,000.00	
Charles M. & Anna C. Cooke Trust		500.00	
Juliette M. Atherton Trust		500.00	
Contributions		2,375.00	9,375.00
			$9,875.10
Disbursements			
Postage & supplies		$100.90	
Grant—Sister Mary St. Lawrence		100.00	
Science Fair			
Supplies	$59.25		
Awards	70.61		
Entry fee—10th National Science Fair	100.00		
Luau chairs & tables	165.60		
Insurance	87.50		
Miscellaneous	149.07	632.03	832.93
			$9,042.17

Eleanor S. Anderson, Treasurer

MEMBERSHIP

Over 20 prospective members were screened by the Membership Committee and recommendations were made to the Board. An attempt was made to acquaint delinquent members with the fact that they were in arrears in dues.

Notification of acceptance to membership was prepared by the Committee chairman for transmittal to new members.

Membership Committee

W. Harold Civin, Chairman

Amy Greenwell	Dorothy Wendt
Christopher Gregory	Edward Y. Hosaka
Richard K. C. Lee	Doak C. Cox, ex officio
Hugo Kortschak	Sterling Wortman, ex officio
H. Ivan Rainwater	

AFFILIATION

The Committee recommended that the application of the Hawaii Dietetic Association for affiliation with the Academy be approved. The Council subsequently passed favorably upon this recommendation, thereby adding one more affiliated society to the Academy.

The Committee recommended that a suitable award or awards be presented annually at the banquet of the Academy for outstanding contributions to the teaching of science in the secondary schools. It was further recommended that the mechanics of selecting the person or persons to whom the award would be made and its nature be determined by a suitable subcommittee of the Inter-Society Science Education Committee.

The Committee, recognizing the need to contribute to events scheduled for the Year of the Aloha or Island State by scientific societies, has recommended that societies encourage scientific meetings in Hawaii during this period and that they disseminate information concerning the existence of unique opportunities for scientific work in many fields in Hawaii.

The Committee suggests that the Academy sponsor a television series on Hawaiian science through the use of suitable films and other materials available through members or through affiliated societies. Such a program would have, as a theme, scientific developments which were pioneered in Hawaii or in which Hawaii was a center.

Affiliation Committee

Vernon E. Brock, Chairman

John J. Naughton, Amer. Chem. Soc., Hawaii Sec.
Yoshinori Kanehiro, Amer. Soc. Agron., Hawaii Chap.
Richard Takasaki, Amer. Stat. Assoc., Hawaii Chap.
Saul Price, Geophys. Soc. Hawaii
Harold W. Civin, Hawaii Med. Assoc.
Leonard Diamond, Hawaii Psych. Assoc.
Charles F. Poole, Hawaii. Bot. Soc.
Wayne Boyle, Hawaii. Ent. Soc.
Willis A. Gortner, Soc. Sigma Xi, Hawaii Chap.
Robert Jay, Anthro. Soc. Hawaii
Kimiko Higa, Hawaii Diet. Assoc.

AAAS FELLOWS

The AAAS Fellows Committee nominated six members of the Academy and of the AAAS for elevation to Fellowship in the AAAS. Members and Fellows are designated by special symbols on the membership list in the Proceedings of the Academy. The individuals nominated were: H. L. Arnold, Sr., Albert H. Banner, John Digman, Jerry P. Eaton, Saul Price, Norman R. Sloan.

J. Linsley Gressitt, Chairman

H. L. Arnold, Jr. — Gordon A. Macdonald
Maxwell S. Doty — Toshiyuki Nishida

AAAS REPRESENTATION

The Academy was represented at the 1958 AAAS meeting, Washington, D. C., by Dr. Laurence Snyder, President of the University of Hawaii.

George O. Burr, Chairman

CONSERVATION COUNCIL FOR HAWAII

The senior representative attended six meetings of the Executive Committee on which she sat as treasurer as well. She also served on the Flora Committee.

The junior representative has written a letter to the Honorable Stanley Hara, Chairman of the House of Representatives Finance Committee, endorsing the plan to create a system of parks throughout the Territory. This was in the capacity of HAS representative to the Conservation Council.

An expanded report will be filed with the Secretary.

Beatrice H. Krauss,
Senior Representative
Doak C. Cox

INTER-SOCIETY SCIENCE EDUCATION

At a joint meeting of the Council of the Academy with the presiding officers of its ten associated societies, held on May 29, 1958, an Inter-Society Science Education Committee was established "to assure the holding of annual science fairs in Hawaii and to co-ordinate and undertake such other activities in the field of science education as the Academy and its associated societies might deem desirable." The following is an abbreviated report of the activities of ISSEC during the past year.

Organization. The initial ISSEC membership included one representative from each of the associated societies plus the chairman appointed by the Academy. The committee thus formed subsequently augmented its membership by adding representatives from the D.P.I., the private schools, the Engineering Association, and the armed forces. Subcommittees were appointed to undertake certain functions; the subcommittee chairmen were asked to serve also as ex officio members of ISSEC.

Meetings. Each of the subcommittees organized to undertake specific projects met at the call of its chairman. Monthly meetings of ISSEC were held throughout the year to consider the initiate projects, to review the status of projects under way, and to receive the progress reports of the subcommittee chairmen.

Activities. A mere enumeration of the activities undertaken by ISSEC must inevitably fall far short of doing justice to the effective and dedicated efforts of the chairmen and members of the various subcommittees by whom the work is being carried out. It is regrettable that the present report must confine itself to a brief mention of the projects under way.

1. Science Fair.

The Second Annual Hawaiian Science Fair was held at Fort deRussy on March 13 to 15. Attendance during the three days of the Fair is estimated at more than 15,000. The 147 exhibits were selected from some 3,000 projects undertaken by 5,000 secondary and high school students at 75 public and private schools throughout the Islands. The two finalists, Christiana Robbins and Jack Semura, will take their exhibits to the National Science Fair which is being held at Hartford, Connecticut, on May 6 to 9. They will be accompanied by Saul Price, Fair Director, and Mrs. H. Ivan Rainwater, Chairman of the Exhibits Committee.

2. Science Library Resources

This subcommittee arranged for the circulation of the 200-volume AAAS travelling High School Science Library among the Lanai, Molokai, Maui, and Lahainaluna high schools. Arrangements were also completed for two additional sets, one to be circulated among the smaller Catholic high schools, and the other among three high schools on Kauai. The set now on Maui will circulate next year among the high schools in rural Oahu.

The AAAS Travelling High School Science Library project is aimed at augmenting the limited library resources of the smaller schools, and at stimulating them to develop their own science libraries.

Annotated bibliographies listing selected science reference texts were distributed to all high schools, public and private.

The Travelling High School Science Library was displayed at the Second Annual Hawaiian Science Fair together with selected paperback editions furnished through the courtesy of Hawaiian Magazine Distributors.

3. Teachers' Science Seminars

This subcommittee organized two series of six lectures each, the first for elementary school teachers, the second for high school instructors. Attendance at the meetings ranged from 125 to 175.

An application submitted to the National Science Foundation for support next year to extend the program to rural Oahu and to the neighboring Islands has received favorable action.

4. Counseling and Scholarships

This subcommittee is in process of organization.

5. Science Teaching Aids

This subcommittee has assembled and circulated brochures and other pertinent material among interested high school teachers. It also organized a field trip for science teachers during the Easter holiday period.

6. Science Clubs

A questionnaire circulated by this subcommittee revealed that as of November, 1958, only 26 of the 64 schools reporting had, or were starting science clubs.

The subcommittee has formulated plans for a program to be called "Hawaiian Science Clubs Service" which contemplates a weekly television program as a medium of communication. The television program would show science films, report science club news, and provide talks and demonstrations by professional scientists.

The Science Clubs Service would also provide assistance to science club advisers, arrange for guest speakers and field trips, and advise on projects and experiments.

Support for the program is being sought from the National Foundation. Certain aspects will be carried out even in the absence of NSF support.

7. Budget Subcommittee

This subcommittee has approved the following budget estimates:

Science Fair	$5,700.00
Science Library Resources	200.00

8. Community Participation

This subcommittee has publicized ISSEC projects and objectives through editorials, radio talks, and letters to individuals and organizations. Through the cooperation of the Honolulu Academy of Arts the subcommittee also arranged for the preparation of a poster publicizing the Second Annual Hawaiian Science Fair.

The community is responding generously to the subcommittee's appeal for contributions in support of ISSEC projects. Local contributions as of April 6 amounted to $4,712.50, which together with $72.50 from AAAS and the $5,000 donation from the Alfred P. Sloan, Jr., Foundation bring the total contributions for the year to $9,785.

9. Student Science Seminars

This subcommittee has organized a series of eleven weekly evening seminars for a group of fifteen highly selected high school students. This limited program is in the nature of an exploratory effort, to be expanded as experience develops.

10. Legislation

This subcommittee was established in February to maintain contact with proposed legislation that might affect science and mathematics education, and to acquaint legislators with the science education objectives of the Academy and its associated societies. The subcommittee suggests that the best insurance of desirable legislative action will come from widespread public appreciation of the value of science education.

AAAS Grant. A small fund becomes available each year from AAAS for the support of science projects. The 1958 grant was awarded to Sister Mary St. Lawrence in support of her elementary science texts project. The AAAS contribution of $72.50 was increased by $27.50 from ISSEC funds to bring the total amount to $100.

National Science Foundation. The National Science Foundation has invited proposals from state Academies of Science requesting support of projects planned to improve the status of science and mathematics education in their respective areas. It is anticipated that most proposals under this program will fall under one of two headings.

1. Development of collaborative efforts by professional scientists and high school science teachers to improve science instruction;

2. Development of coordinated programs for stimulating interest in science among young people, principally at the precollege level, and providing them with opportunities for science experience.

"Novel ideas designed to accomplish the objectives indicated above are encouraged so long as they reflect the general spirit of the program outlined above."

In response to this invitation the following proposals have been submitted to NSF.

1. Preparation under the guidance of Sister Mary St. Lawrence of a series of elementary science texts entitled "Exploring Nature in Hawaii." This series, which is already well under way, would involve the cooperation of the University of Hawaii Press and the Catholic School Department.

2. Preparation of a series of teaching aids in science for elementary and secondary schools under the title "Museums in Miniature." This project would involve the cooperation of Dr. Alexander Spoehr, the Bishop Museum Association, and the Academy through ISSEC.

3. Organization of a Science Clubs Service (described above) under the direction of Dr. Donald McGuire with the cooperation of the University of Hawaii.

4. Expansion of the Students' Science Seminar program (described above) under the direction of Dr. Albert Carr.

5. Expansion of the Teachers' Science Seminar program (described above) under the direction of Dr. Sterling Wortman.

Notification has been received from NSF of its approval of the Teachers' Science Seminar program. The other four proposals are still under consideration.

The Future. The magnitude of the contribution that the Fiftieth State will be able to make toward enhancing the strength and well-being of the nation will depend in large measure upon its efficacy in developing its most valuable resource, namely, the intellectual endowment of its youth. While the strengthening of science education is but one facet of the over-all problem, it is one of growing importance.

The magnitude of the contribution that ISSEC can make toward the furtherance of science education will continue to depend in large measure upon the extent of interest among the Academy membership and the membership of the Associated Societies, and upon the willingness of each of us to participate in the tasks which we, as members, have assigned to ISSEC.

A. J. Mangelsdorf, Chairman

INTER-SCIENCE EDUCATION COMMITTEE

Amer. Chem. Soc., Hawaii Sec., L. J. Rhodes, J. H. Payne (alternate)
Amer. Soc. Agron., Hawaii Sec., Edward J. Britten, Wallace E. Holmes (alternate)
Amer. Stat. Soc., Hawaii Sec., Gordon Frazier, Richard Takasaki (alternate)
Anthro. Soc. Hawaii, Dorothy Rainwater
Geophys. Soc. Hawaii, Saul Price, Thomas Austin (alternate)
Hawaii Med. Assoc., Harold Civin
Hawaii Psych. Assoc., Leonard Diamond, Edgar Vinacke (alternate)
Hawaii. Acad. Sci., A. J. Mangelsdorf
Hawaii. Bot. Soc., Gerald Dull
Hawaii. Ent. Soc., Wallace C. Mitchell
Soc. Sigma Xi, Hawaii Chap., John H. Payne

Subcommittee Chairmen and Associate Members, ISSEC

Saul Price, Science Fair Director
H. Wayne Hilton, Associate Director
Robert Clopton, Chairman, Science Library Resources Subcommittee
Sterling Wortman, Chairman, Teachers' Science Seminar Series
Shosuke Goto, Chairman, Counseling and Scholarships Subcommittee
Y. Baron Goto, Chairman, Subcommittee on Science Teaching Aids
Donald C. McGuire, Chairman, Subcommittee on Science Clubs
J. H. Payne, Chairman, Budget Subcommittee
Nils P. Larsen, Chairman, Community Participation Subcommittee
Albert B. Carr, Chairman, Student Science Seminars Subcommittee
Wilfred Greenwell, Chairman, Legislation Subcommittee
Kenneth Chapson, Engineering Association of Hawaii
Teruo Masatsugu, Department of Public Instruction
John J. Naughton, University of Hawaii
Col. Carl K. Warren, Jr., Lt. Col. Travis A. Gerrells (alternate), Armed Forces Representative
Doak C. Cox
Ralph Heinicke
E. H. Bryan
Mrs. H. Ivan Rainwater, Secretary

PROGRAM

The Thirty-fourth Annual Meeting of the Academy was programmed in two sessions, the first time being held November 25-26, 1958, and the second April 23-25, 1959. Sixteen professional papers were presented in the first session, thirteen in the latter. In addition, for the first time, two outstanding scientific papers written by high school students were presented in the spring session. Another innovation was the serving of refreshments at intermission time for both sessions. The Annual Banquet was held April 25 in the Gold Room, Hawaiian Village Hotel, with Governor William F. Quinn and Dr. Charles E. Kellogg as special guests.

Two special sessions were presented involving reports by scientists of the Russian scientific ship, "Vitjaz," and an address by Dr. H. Kihara, eminent scientist from Japan.

The Academy also cooperated with the Anthropological Society in presenting Dr. Samuel Elbert and with the Geophysics Institute in presenting Dr. Seth Nicholson.

Jimmie B. Smith, Chairman

Agatin Abbott	Garth Murphy
Leonard Mason	Thomas Austin
Alfred Hartwell	Doak Cox (ex officio)
Shosuke Goto	Sterling Wortman (ex officio)

NOMINATIONS

The Committee submitted the following recommendations for the year 1959-1960: President-elect, Dr. Fred I. Gilbert and Miss Beatrice Krauss; Councilor, Gordon Macdonald and Kenichi Watanabe; Secretary, Sterling Wortman; Treasurer, Mrs. Eleanor Anderson.

Andrew W. Lind, Chairman

Harry Arnold, Jr.	Robert W. Hiatt
Willis Gortner	Beatrice H. Krauss

HAWAII DIVISION

The Hawaii Division held one meeting in Hilo and one in Kealakekua since the last report. It has not proved feasible to hold an election of officers, so the present officers will continue to serve until further notice. The Hawaii Division is represented on the Planning Committee of the newly formed Community Program for Arts and Sciences by its Chairman, John A. Easley, Jr., and by an appointed representative, James Noda. Mr. Noda served as chairman for the Big Island Science Fair, which was jointly sponsored by the Hawaii Division and the CPAS.

John A. Easley, Jr., Chairman
Chester Wentworth, Council Representative

THE 34th ANNUAL MEETING 1958-59

Program

SPECIAL SESSION I

September 25, 1958, Experiment Station, HSPA, Honolulu

H. Kihara: On the Origin of Common Wheat

FIRST SESSION

November 25, 1958, Experiment Station, HSPA, Honolulu

1. Sea Weed Dermatitis Apparently Caused by a Marine Alga
   Harry L. Arnold, Jr.: Clinical Observations
   Franklin Grauer: Clinical Investigative Procedures
   George Chu: Laboratory Observations
2. Albert H. Banner: Preliminary Observations on Toxic Fish
3. Maxwell S. Doty: Phytoplankton Photosynthetic Periodicity as a Function of Latitude
4. Donald W. Strasburg: Underwater Observations on the Behavior of Hawaiian Tuna
5. Thomas W. Austin: Secular Warming in Sea Surface Temperatures, Equatorial Pacific, 1955-58
6. Philip Helfrich: Observations on the Reproductive Behavior of the Maomao, an Hawaiian Damsel Fish
7. P. B. van Weel: The Effect of Special Diets on the Utilization of the Food by the African Giant Snail*

November 26, 1958, Experiment Station, HSPA, Honolulu

8. Abe Arkoff: Personality Patterns in Several Generations of Japanese Americans
9. John Digman: A Reappraisal of the Ebbinghaus Curve of Retention
10. Leonard Diamond: A Theory of Visual Facilitation
11. Leonard Mason: Space, the Scarce Commodity in Atoll Living
12. Richard T. Wootton: Origins of American Scientists by States of Birth: Relevance to Scientist Production
13. A. H. Lange: Studies of Factors Affecting the Floral Development of *Carica papaya* L.
14. Walter S. Lang: Satellite Tracking at the Haleakala Observatory
15. Walter R. Steiger and Harold Krivoy: Some Ionospheric Phenomena Associated with Nuclear Explosions
16. Gladys S. King: Correlative Phenomena with Auxin and Adenine Sulfate Demonstrated by Simple Tests with Etiolated Pea Seedlings

* Presented by title only.

SPECIAL SESSION II

Sponsored jointly with the Hawaii Chapter, Society of Sigma Xi

February 5, 1959, University of Hawaii

Zinaida Filatova: Exploration of the Pacific Ocean and Its Deep-Sea Fauna by the "Vitjaz"

FINAL SESSION

April 23, 1959, Experiment Station, HSPA, Honolulu

1. Robert Hiatt: Report on Upcoming Pacific Science Congress
2. Marshall Eto: Corrosion Studies (High School Paper)
3. Haruyoshi Ikawa and G. Donald Sherman: The Gibbsite Concretions of Cape York, Australia
4. Donald H. Smith: Volatilization Losses of Soil and Fertilizer Nitrogen
5. William J. Holmes: The Battle Against Blindness in Asia
6. E. J. Britten: Genetic-Environmental Control of Flowering in *Trifolium repens*
7. Estel Cobb, K. K. Otagaki, and I. I. Iwanaga: Relationship Between Slaughter Weight and Carcass Characteristics in Swine
8. Albert B. Carr, Jr.: Air Pollution: An Educational Problem

April 24, 1959, Experiment Station, HSPA, Honolulu

9. Jack Semura: One Phase of Liesegang Ring Research (High School Paper)
10. Saul Price: Observations of Surface Ozone at the Mauna Loa Observatory
11. Della F. Reid, Sidney J. Townsley, and Winifred T. Ego: Uptake of Sr^{85} and Ca^{45} Through the Epithelia of Fresh-Water and Sea-Water Adapted *Tilapia mossambica*
12. Vernon E. Brock and Robert H. Riffenburgh: Fish Schooling: A Possible Factor in Reducing Predation
13. Robert E. Grinder: A Report on the Development of Conscience in 140 Sixth-grade Children
14. Robert Kiessling and Richard A. Kalish: Leaderless Group Discussion as a Selection Technique
15. Caroline F. Will and Arthur A. Dole: A Survey of Freshman Values and Educational Choices I.
16. David H. Crowell: Neonatal Maturity and Responsiveness
17. Bernard I. Bloom and Abe Arkoff: On the Ability of Schizophrenics to Play "Normal"*

* Presented by title only.

April 25, 1959, Gold Room, Hawaiian Village

Banquet

18. Charles E. Kellogg: Soils and the Food Problem

Introduction of New Officers

Presidential Address

Doak C. Cox: Field of the Hawaiian Academy of Science: A Triencentennial Review

HAWAII DIVISION

SPECIAL SESSION I

February 27, 1959, University of Hawaii, Hilo Campus

Seth B. Nicholson: Where Do We Live?

SPECIAL SESSION I-A

February 28, 1959, Konawaena High School

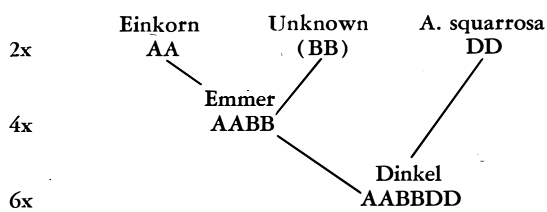
Seth B. Nicholson: Where Do We Live?

Abstracts

SPECIAL SESSION I

ON THE ORIGIN OF COMMON WHEAT

The genealogical relationship of wheats and the related genus *Aegilops* is given in the following diagram.



This relationship was established by morphological and genomeanalytical investigations. Its final evidence was obtained by the synthesis of 6x-wheat by means of hybridization between its two ancestors. The artificial 6x-wheat was crossed with natural 6x-wheat and the F_1 was proved to have normal chromosome conjugation and also to be normal in seed- and pollen-fertility.

It is beyond doubt that our common wheat was originated from a hybrid between tetraploid wheat and a wild grass, *Aegilops squarrosa.* As to the tetraploid parent, there is a wide choice among wild and cultivated varieties.

If we assume that 6x-wheat was once originated from a cross between a wild growing 4x species of wheat and *A. squarrosa,* then we must further assume that wild 6x-wheats should be found, most probably in Armenia, Syria, and western Iran. They were not yet discovered, or have become extinct. Both assumptions seem to be scarcely plausible in my opinion. Evidences so far obtained are in accord with our tentative hypothesis that 6x-wheat arose as the result of hybridization between cultivated 4x-wheat and *A. squarrosa.*

From the information obtained by many other geneticists and also from our own experiences, 6x-wheat should be included in a collective species, *T. aestivum.* Accordingly, five species of *Triticum,* namely *vulgare, compactum, spelta, macha,* and *sphaerococcum,* should be treated as five respective subspecies of *T. aestivum.*

Among these five subspecies we know that four, except *T. sphaerococcum,* are found in Transcaucasus, including Armenia, Azerbaijan, and adjacent regions of Iran. *T. macha* or a species similar to *T. macha* seems to the progenitor of all 6x-wheats.

The supposed progenitor of 6x-wheat, which arose by hybridization most probably in Armenia, Azerbaijan, and adjacent regions, might have had two dominant genes, S and C, if we only take ear forms into consideration. Then two types, *spelta* (*SScc*) and *compactum* (*ssCC*), would be each separated only by one gene difference from this progenitor. Hybridization between these two would produce *T. vulgare* (*sscc*). In this way 3 species of *Triticum* could have been obtained. The fourth, *T. sphaerococcum,* which differs from *T. vulgare* by one recessive gene, might have arisen in Pakistan.

H. KIHARA
National Institute of Genetics
Japan

FIRST SESSION

1. SEA WEED DERMATITIS APPARENTLY CAUSED BY A MARINE ALGA

Clinical Observations

Dermatitis (inflammation of skin) due to external causes is of two principal types: dermatitis venenata and dermatitis escharotica. Dermatitis venenata is caused by a wide variety of substances which have the ability to induce sensitivity in the skins of certain more or less specifically susceptible persons, and which, after having induced this susceptibility by one or more preliminary episodes of contact, produce an inflammatory reaction following each subsequent exposure. Dermatitis due to plants (aside from actual mechanical irritation due to fine hairs or spicules) is almost always of this variety.

Dermatitis escharotica, on the other hand, is caused by a wide variety of substances which have the capacity to irritate or injure the skin of all normal persons, not merely susceptible ones; and they require no prior episodes of contact in order to induce this effect. Concentration and duration of exposure are the only important limiting factors.

In the summer of 1958, cases came to the attention of many local physicians, including the author, of acute dermatitis of either the most dependent portion of the scrotum, or the perianal area, of persons who had very recently been swimming off the beaches of Laie, Kailua, or points between. The water had in each instance been turbid with finely broken up floating seaweed; burning sensations or itchiness had been noted within a few minutes to a few hours after leaving the water; and within 8 to 24 hours, redness, blisters, and open erosions (caused by breaking of blisters) appeared in the involved areas. Colonel Grauer at Tripler Hospital found fragments of a filamentous marine plant, a blue-green alga subsequently identified as *Lyngbya majuscula,* in the bathing garments of two patients so afflicted.

It seems probable that allowing *limu* to accumulate on the beaches, as has been done this year so extensively, results in its being washed back into the ocean, thus contaminating it with this alga.

It is noteworthy that although there are many well-known stinging animals in the ocean, skin irritation produced by marine plants has not, to my knowledge, been reported by any observer. Moreover, when any plant produces dermatitis by contact (without the agency of spines or spicules), it is usually dermatitis venenata rather than escharotica that is produced. The latex of *Euphorbia tirucalli* (pencil plant) is a notable exception.

Why so very widespread an alga as *Lyngbya majuscula* should suddenly produce so many cases of dermatitis in so limited an area remains unexplained.

HARRY L. ARNOLD, JR.
Straub Clinic
Honolulu, Hawaii

Clinical Investigative Procedures

Employing the patch test, one of us (F.H.G.) was the first to ever demonstrate that a marine, blue-green alga was the cause of this previously unreported contact dermatitis. This variety of alga subsequently was identified as *Lyngbya majuscula* Gomont by one of us (G.W.C.).

More than 40 volunteers were tested with over 75 patch tests. Of 29 tested with a pure culture of *Lyngbya,* all gave strongly positive vesicular reactions (4 plus) after 24 hours. Diatomes, a yellow and a brown alga from Kailua were excluded as a cause.

The reactions of 5 volunteers to *Lyngbya* were further studied with 22 serial patch tests, which were removed after 1, 2, 3, 4, 6, and 8 hours. The immediate reactions were read upon removal of the tests. It was observed that the longer the tests remained in contact with the skin, the more positive were the immediate reactions and the more intense the resultant inflammatory processes. With reference to delayed reactions, read approximately 24 hours after removal of the patches, it was observed that the reactions had increased in intensity during these 24 hours, even 1-hour applications becoming positive.

Soap and water bathing as a preventive measure was evaluated. The investigation described above was repeated in 5 additional subjects, the only difference being that each skin site upon removal of the patch was immediately cleansed. Delayed reactions in the cleansed group were compared with the uncleansed control group. These results suggested conclusively the value of bathing. Although the series were not large, they suggested that if washing is done up to 1 hour after contact, there is a good chance of avoiding the dermatitis entirely; if performed sometime after 1 hour but within 3 hours after exposure, bathing will decrease appreciably the severity of the symptoms, but if it is not done until 3 hours or longer after exposure, bathing probably will be of little value.

In 8 subjects small segments of skin from positive patch test sites were removed for histopathologic examination. The patches were allowed to remain on the skin for approximately 24 hours in 4 cases, 6 hours in 2, 2 hours in 1, and 1 hour in 1. All biopsies were removed approximately 24 hours after application of the patches. Microscopic studies uniformly corroborated the clinical reactions and revealed findings of acute, vesicular dermatitis consistent with contact dermatitis.

FRANKLIN H. GRAUER
Tripler Hospital
Oahu, Hawaii

Laboratory Observations

On July 19, 1958, a strain of the common blue-green alga, *Lyngbya majuscula* Gomont, was collected from Kailua, Oahu, and proven by patch tests on man and guinea pigs to be very toxic. (The alga was identified by Benito Vergara and Jan Newhouse, both formerly of the Department of Botany, U. H.) This finding seemed to support the premise that toxic *L. majuscula* was the etiological agent for the epidemic of swimmer's itch that occurred in Kailua at that time. Although beach boys have recognized for some time a relationship between these hair-like algae and swimmer's itch, a blooming of this species of alga during and after a storm in July led to an epidemic of dermatitis (vesicular type) which brought the relationship into sharper focus and to the attention of medical authorities. Further collections of toxic *L. majuscula* have been made at Kailua as recently as October 18th of this year.

Although Schwimmer and Schwimmer (1955, The Role of Algae and Plankton in Medicine) list several fresh-water and marine algae as causative agents of dermatitis in man, *L. majuscula* is believed to be unreported until now as a dermatonecrotic agent for man. However, Halstead *et al.* (1955, J. Wash. Acad. Sci. 45:101) have reported its toxicity for mice.

With reference to toxicity, the most striking fact is that not all strains of *L. majuscula* are toxic. Specimens collected from Waikiki, Hanauma Bay, and Waianae were not dermatitis-producing. Also, both toxic and nontoxic strains have been found at Kailua at various times. Thus far, morphological differentiation between strains has been observed, but no definite conclusion can be made. The toxic substance or substances associated with this species of alga are fairly stable in that after two months' culture of specimens in sea water the toxicity was unabated as shown by patch tests of man and guinea pigs. In addition, boiling for thirty minutes only mildly reduced the toxicity. Positive patch tests also were obtained with ground-up preparation of *L. majuscula.*

Since toxic bacteria have been found by Canadian workers as being partners of certain toxic fresh-water algae, the marine bacteria associated with *L. majuscula* are being investigated. The most predominant bacterium isolated has been a gram negative pigment-producing bacillus which forms a gel in algal extract broth after two weeks' incubation. However, preliminary studies indicated that it or its gel product was nontoxic by patch tests.

As long as the exact source of the toxic substance (or substances) and its chemical nature are unknown, the question of strain differences in *L. majuscula* remains a challenge in the field of medical microbiology.

GEORGE W. T. C. CHU
University of Hawaii
Honolulu, Hawaii

2. PRELIMINARY OBSERVATIONS ON TOXIC FISH

Toxicities from eating tropical Pacific fish may be divided into several types, the most well-defined being known as puffer or *Tetraodon* poisoning, and *Ciguatera* poisoning. The latter type of toxicity has been subject to preliminary studies at the Hawaii Marine Laboratory. *Ciguatera* is a regional or geographic type of toxicity found most notably in the snappers (*Lutjanidae*), the groupers (*Serranidae*), and the ulua (*Carangidae*); these are esteemed as food fish in most areas, while in adjacent areas, perhaps only a few miles away, they may be found to be highly toxic. A person eating the toxic fish first shows gastrointestinal disturbances, followed by sensory aberrations and neuromuscular malfunction with locomotory paralysis; in extreme cases the poisoning may lead to coma and death. Preliminary investigations confirmed that some fish are lethally toxic; that the smaller specimens of one species from a particular area are less toxic than the larger specimens; and that the native accounts were correct in stating that the fish were regionally toxic. The majority of typical laboratory animals, like the rat, mouse, and chicken, did not respond when fed on toxic fish, but cats and mongooses exhibited symptoms similar to those in humans and would die when fed sufficient amounts of toxic fish. Preliminary chemical studies showed that the toxicity of the fish did not decrease when held for two years in cold storage, nor when heated to 105° C. for a day; that the toxin is not soluble in distilled water, but soluble in 90 per cent alcohol. Attempts to purify the toxin from the alcoholic solution lead to detoxification unless the procedure was carried out under a nitrogen atmosphere. After a separation of the alcoholic extract with diethyl or petrol ether under nitrogen the toxin was found in the fat solvent. Finally, the published technique for assay of the toxin, wherein an aqueous extract of the fish was injected intraperitoneally into mice, was found to be unreliable. Work continues at the laboratory on the chemistry and on the biological origin of the toxin.

ALBERT H. BANNER
University of Hawaii
Honolulu, Hawaii

3. PHYTOPLANKTON PHOTOSYNTHETIC PERIODICITY AS A FUNCTION OF LATITUDE

It was found that the ability of oceanic phytoplankton populations to photosynthesize under uniform conditions of light varied with the time of the day when the measurement was made. Other workers, in seeking to substantiate this phenomenon, found the ratio between the maximum and minimum values to be less than those originally observed. These ratios reported by our colleagues and obtained more recently by ourselves were plotted as a function of latitude, for those obtained nearer the equator seemed progressively larger. In the plot made an inverse relationship was suggested by the distribution of the plotted points.

We explain this relationship at present on the assumption that the rhythmic variation is pulsed into the population by light variations in conjunction with the growth of the phytoplankters in the relatively fertilizer-poor oceanic medium. The regular pulsing effect of uniform day lengths near the equator could be expected to induce a more pronounced rhythm than the changes in day lengths of temperate regions or their lack during some parts of the year at more polar latitudes. This variation with latitude in pulsing by alternating periods of darkness and light we postulate to be the cause of the variation in photosynthesizing ability, the magnitude of which is observed to be correlated with latitude.

MAXWELL DOTY
University of Hawaii
Honolulu, Hawaii

4. Underwater Observations on the Behavior of Hawaiian Tuna

The oceanic skipjack or aku (*Katsuwonus pelamis*) is subject to a considerable fishery in Hawaii, Japan, and the continental United States. Because this tuna is caught by chumming with live bait, and because bait is delicate and in short supply, the yield and profit of the fishery are not as great as warranted by world demands. The Pacific Oceanic Fishery Investigations is attempting to increase the efficiency, and hence the yield and profit, of live-bait fishing by studying skipjack behavior as it is related to several fishing variables.

This study has been conducted from the research vessel "Charles H. Gilbert," which is equipped with an underwater observation chamber. Through this chamber movies were taken of skipjack behavior under normal and experimental fishing conditions. As a supplement to the movies, comments of underwater and surface observers were recorded, along with recorded bell tones denoting catch rate. The observation chamber had three months of use during 1958, a poor year for the Hawaiian fishery, during which observational techniques were developed while experiments were conducted. The experimental results, although encouraging, are only tentative.

Several experiments involved the effects of variations in chumming on skipjack behavior. When live and dead nehu (*Stolephorus purpureus*) were chummed alternately, the use of dead bait resulted in skipjack decreasing their swimming speed and number of surface dashes, and also in falling so far astern that fishing ceased. When the rate of chumming was doubled, more nehu accumulated than could be eaten by a small tuna school, again causing the tuna to fall behind. This did not apply to large schools, for these consumed the bait as rapidly as it was thrown. With the chumming rate halved, the tuna slowed their swimming and tended to scatter, no doubt as a result of an insufficient feeding stimulus. When water sprays were turned on and off at intervals, the "off" condition resulted in speed-slackening, reduction in the number of surface dashes, and deeper swimming, again reflecting inadequate feeding stimulation. Experiments in which nehu were replaced by threadfin shad (*Dorosoma petenensis*) showed that a too-conspicuous or too-active bait also resulted in a reduced catch.

Four other experiments dealt with rather extrinsic fishing variables. Noise produced by hammering on the ship's hull had no effects on behavior, nor did blood sprayed in the water or allowed to drain from the deck. Skipjack skin extracts thought to contain fright-producing purines or pterines similarly produced no visible response. When red food coloring was sprayed into the sea in dense concentrations, skipjack avoided any deeply stained masses of water, suggesting that perhaps they can be corralled by walls of sufficiently dark dye.

As more is learned about bait-skipjack interactions it becomes easier to select better bait species and lures and to modify existing fishing practices. The results of such tests as the dye experiments may lead to entirely new fishing methods.

DONALD W. STRASBURG
Pacific Oceanic Fishery
Investigations
Honolulu, Hawaii

5. Secular Warming in Sea Surface Temperatures, Equatorial Pacific, 1955-1958

During the months of November, 1955, through January, 1956, sea surface temperatures in the eastern and central equatorial Pacific were from 0.5 to 2.5° F. cooler than normal. Subsequently, mean monthly sea surface temperatures in these areas, although exhibiting comparatively normal seasonal variation, were increasingly warmer than normal. The upper limit of the trend was reached in January, 1958, when these temperatures in the eastern central equatorial Pacific were 4°–6° F. above normal. The trend, as measured at the Christmas Island station, then reversed and by August, 1958, the temperatures were approaching the normal. A comparable reversal was not as apparent in equatorial waters to the north and south of Christmas Island.

Daily temperatures from Christmas Island in the Line Islands group, and temperatures at frequent intervals measured by Matson vessels between Honolulu and Samoa and by POFI vessels in oceanic areas near the Marquesas Islands were the principal data used for the analyses. Consideration of similar data from the north central and northeastern Pacific indicates that the higher than normal temperatures observed in the eastern and central equatorial Pacific during 1957 and early 1958 were characteristic of a large segment of the Pacific Ocean.

Although available data are as yet inadequate to confirm the hypothesis, consideration of both the surface and the subsurface temperatures (to 900 feet below the surface) near the Christmas Island station and in the Marquesan waters suggests that the above-described higher than normal temperatures during 1957 and early 1958 resulted primarily from advection and not from localized heating.

THOMAS S. AUSTIN
Pacific Oceanic Fishery
Investigations
Honolulu, Hawaii

6. Observations on the Reproductive Behavior of the Maomao, a Hawaiian Damsel Fish

Observations on the reproductive behavior of a common Hawaiian Damsel fish, the "maomao" (*Abudefduf abdominalis*), were made in its natural habitat near Coconut Island, Kaneohe Bay, over a three year period. This investigation afforded an unusual opportunity to observe various aspects of the behavior of this species which appear to create a favorable environment for the early survival of the progeny.

The "maomao" spawns throughout the year, although reproductive activity is greatly increased during the spring and early summer. Mating is initiated by the male. He choses a suitable site on the substrate and establishes a territory in the surrounding area which he defends while preparing a "nest" for egg deposition. During this period of preparation, the male assumes a pale blue nuptial hue, which is in striking contrast to its normal brassy-green and black coloration. The male then attempts to attract a suitable female by executing a sequence of displays and maneuvers which include swimming in a characteristic zig-zag and looping manner. The male's courting maneuvers are coupled with territorial defensive activities and therefore often take on aggressive overtones. The male eventually orientates a suitable female, and she follows him to the "nest" where her final acceptance or rejection follows a rapid circular tail-on-tail chasing. When stimulated to spawn by the male's nudging, the female attaches her eggs to the prepared surface in a single layer by means of adhesive filaments and the male fertilizes them. After spawning, the female leaves the brood to the exclusive care of the male who fans them to insure proper aeration, picks out defective eggs, and defends the area against predators. The male guardian is able to distinguish obligate herbivors from other predators and usually allows them to swim through the territory undisturbed. Additional females may be attracted to spawn on the same site, and as many as five distinct clutches of eggs have been observed in a single "nest."

Fanning of the eggs by the male steadily increases during the five-day incubation period coinciding with the increased oxygen requirements of the embryos.

Analysis of the "maomao" reproductive behavior reveals the following sequence of events required for successful mating: (a) mutual recognition of gravid male and female, (b) submission of the female to the male's overtures, (c) orientation of the female, (d) acceptance of the female by the male in the "nest."

PHILIP HELFRICH
University of Hawaii
Honolulu, Hawaii

7. The Effect of Special Diets on the Utilization of the Food by the African Giant Snail*

Whether or not the African Giant Snail is able to change its digestive enzyme production according to the type of food on which it has to subsist has been investigated by Prosser and van Weel (Proc. Hawaii. Acad. Sci. 1957-58; Physiol. Zool., 1958. 31:171). Of more importance still is the resorption of the digested material, since digestion is only the first step. Experiments covering 7 weeks were performed to determine the utilization of the special foods, that is, the amount of food resorbed by the animals. For this purpose two groups of four snails each were fed for 7 weeks either with boiled potato or with horse meat. At the end of each week each group received a weighed amount of food. After 24 hours the faeces and not-devoured food were collected. The "starch faeces" were hydrolyzed and the amount of reducing substances determined as mg. glucose with Schoorl's sugar titration. The Kjeldahl-N content of the "protein faeces" was also determined. The same determinations of samples of boiled potato and meat made it possible to compute the "glucose"- and N-content of the food given and by subtracting the first value from the latter, the utilization was found. This was expressed in per cent of the food offered. The results were:

	1	2	3	4	5	6	7 weeks
utilization of protein in %	80	79	76	51	76	61	65
utilization of starch in %	80	86	84	52	37	37	44

From these experiments the conclusion can be drawn that particularly the snails on a starch diet show an appreciable decrease in utilization after 3-4 weeks. Although nothing is known of nutrient requirements, other than "food" (like for instance certain vitamins, etc.), the data do suggest that a certain deficiency of some specific dietary requirement seems to play a role, particularly in the starch-fed animals.

P. B. VAN WEEL
University of Hawaii
Honolulu, Hawaii

8. Personality Patterns in Several Generations of Japanese Americans

The purpose of this investigation was to measure personality patterns in several generations of Japanese Americans and compare the generations with each other and with a mainland normative population. The subjects were 320 University of Hawaii students who were of Japanese ancestry; of these

* Presented by title only.

135 were second generation and 185 were third generation Americans. The research instrument was the Edwards Personal Preference Schedule whose normative sample consists of approximately fifteen hundred mainland college students and whose results are reported in terms of fifteen personality needs: abasement, achievement, affiliation, aggression, autonomy, change, deference, dominance, endurance, exhibition, heterosexuality, intraception, nurturance, order, and succorance.

The results showed that the Japanese American group, considered as a whole, is considerably different from the mainland sample in its personality pattern. In general, the Japanese American group appears to have higher need for abasement, change, deference, order, and nurturance and lower need for achievement, dominance, exhibition, and heterosexuality. Few of the differences between the two generations of Japanese Americans achieved statistical significance, but consistency in the patterning of these differences suggests the possibility of several sorts of systematic change within this group:

(1) Some personality needs (abasement, affiliation, deference, endurance, intraception, nurturance) are more highly expressed by the Japanese American group than by the mainland sample, but within the local group less highly expressed by the third generation than by the second, perhaps indicating *movement down toward mainland norms.*

(2) Some personality needs (achievement, dominance, exhibition) are less highly expressed by the Japanese American group than by the mainland sample, but within the local group more highly expressed by the third generation than by the second, perhaps indicating *movement up toward mainland norms.*

(3) One personality need (change) is more highly expressed by the Japanese American group than by the mainland sample, and within the local group more highly expressed by the third generation than by the second, perhaps indicating *movement up away from mainland norms.*

(4) One personality need (autonomy) is less highly expressed by the Japanese American group than by the mainland sample, and within the local group less highly expressed by the third generation than by the second, perhaps indicating *movement down away from mainland norms.*

ABE ARKOFF
University of Hawaii
Honolulu, Hawaii

9. A Reappraisal of the Ebbinghaus Curve of Retention

Since the pioneer work of Ebbinghaus on retention, it has been generally assumed by psychologists that his results were essentially correct, and constituted a reasonable approximation to "the" curve of retention. This view was reinforced by the careful research of such people as Luh, Krueger, and Jenkins and Dallenbach. Recently, Underwood has questioned the validity of all the classical studies of retention. He believes that a major methodological error of these studies was the use of subjects who had previously participated in a large number of similar studies, and that a large source of forgetting observed by Ebbinghaus and by those who repeated his work can be attributed to interference tendencies associated with this prior learning. Some recent studies suggest that forgetting is much less rapid during the first 24 hours than has been believed, perhaps 25 per cent rather than the 65 per cent forgetting obtained by Ebbinghaus. Apparently, far from having a basic psychological function adequately described, present-day psychology lacks an answer to the question: What is the course of retention as a function of time? The study which is reported represents an effort to obtain part of the answer to this question.

Fifty-seven student subjects, none of whom had participated in a similar experiment before, learned a list of 10 nonsense syllables, presented serially with a three-second interval between syllables. Learning was brought to the criterion of one perfect trial. Subjects were then divided into three retention groups and tested after one, two, and seven days. Two measures of retention were obtained: recall (number of correct responses on first test trial) and relearning (percentage of trials saved in relearning list to original criterion).

The results for the three retention conditions were: one-day interval, 69 per cent recall and 74 per cent relearning; two-day interval, 72 per cent and 75 per cent; seven-day interval, 45 per cent and 62 per cent. Because of the small samples used, the slight rise at the two-day point is doubtless due to chance.

The data suggest that Underwood's criticisms are probably valid, but that the forgetting process slows down after the first 24 hours. Since this latter effect was observed by Ebbinghaus, one may conclude that the present results differ from the classical studies in only one respect: forgetting during the first 24 hours is much less rapid than has been believed. Beyond that point the rate of forgetting reported by Ebbinghaus may be correct.

JOHN DIGMAN
University of Hawaii
Honolulu, Hawaii

10. A Theory of Visual Facilitation

There are two phenomena in visual perception both of which illustrate what we mean by facilitation. The first, which we might call contrast facilitation, involves two fields: a test circle upon which we discriminate brightness and brightness changes, and an inducing surround which concentrically surrounds the test circle. We find that facilitation in this situation occurs under a specific condition of luminances. That is, when the inducing surround is of a slightly lower luminance than that of the test circle, the test circle appears "subjectively" brighter than it would if there were no inducing surround there at all, even though the test "physical" luminance has not been changed.

A second situation in which facilitation can be demonstrated involves only one field, the test circle, by itself. If we determine the threshold energy for the test circle; i.e., that light energy necessary just to see the test circle, as a function of the area of the test circle, we find that as the test circle increases from very small to some larger area, the energy necessary to see the circle decreases, or in other words, as the area of the test circle (the luminance of which is near threshold) increases, the brightness of the test circle increases. Here again, therefore, a manipulation of conditions facilitates the brightness of the test circle in the absence of a corresponding change in the luminance of the test circle.

The theory which attempts to explain these phenomena of facilitation is as follows: We know that in the retina, in the nonstimulated dark surround around the test area or around the inducing area, there are certain retinal elements that are discharging spontaneously. Further, we have evidence to support the notion that these spontaneously discharging elements are what are called "off" retinal elements; that is, these "off" elements discharge in the absence of light but are turned off when light hits them.

We know, further, that there is an antagonism between the "off" and the "on" fibers in the retina (the "on" fibers discharge when stimulated by light and do not discharge in the absence of light). This antagonism results in an inhibition of the activity of the "on" fibers while the "off" fibers are discharging. At this point, we have enough information about which to build our theory.

With respect to contrast facilitation our theory would state that when the inducing field is presented around the test field, it turns off the "off" elements immediately surrounding the test field, thereby releasing the "on" fibers within the test field from "off" fiber inhibition. (Since the inducing luminance is lower in this situation than test luminance, the "on" activity within the inducing field is not enough to disturb the activity in the test field.)

With respect to area threshold facilitation, our theory would state that as the test area increases from small to large, or as the borders of the test area extend outwards, it figuratively pushes away the effects of "off" spontaneous discharge. That is, as the test area grows in size, its light falls on more and more "off" retinal elements, thereby reducing more and more the inhibitive effectiveness of the "off" discharge field.

This theory adequately explains existing data that have to do with contrast and area-threshold facilitation. It also suggests further specific tests which are now in progress.

LEONARD DIAMOND
University of Hawaii
Honolulu, Hawaii

11. Space, the Scarce Commodity in Atoll Living

A coral atoll, while endowed with almost unlimited space in the waters of lagoon, reef, and ocean, is characterized by critical shortages of land needed for house sites, food production, and relief from overcrowded living. In the Marshall Islands, Arno Atoll exemplifies this situation. Lagoon areas amount to 130 square miles but barely five square miles of land exist in the more than 100 named islands. In 1950 when the present study was conducted the atoll's population was about 1,000. In this paper two of Arno's 22 communities are examined as to the manner in which the problem of restricted space on land has been met.

Parenthetically, the Marshallese consider resources of lagoon, reef, and ocean to be sufficiently abundant that ownership or use rights have never been defined. Intense concern about land, however, is evidenced by the fact that every bit of every island, no matter how poor, is claimed by one or another family group, or lineage. Each landholding is commonly described as a shore-to-shore cross-section of an island, which in larger, wider islands provides all of the necessities of atoll subsistence.

In the hamlet of Jabu, one of five communities in the extremely narrow, 15-mile long island of Ine, the shore-to-shore distance is nowhere more than 350 yards. The population of 53, representing five corporate lineages, occupies landholdings in the wider, more favored parts of the island where breadfruit is easily grown. The less desirable, narrow parts of Jabu are also divided into parcels although productive only of coconut, pandanus, and such hardy plants. Individual lots, 36 in all, range from half an acre to more than six acres. The holdings of one prominent lineage amounts to 24 acres distributed in seven parcels between poorer and more productive areas of Jabu.

Greater wealth in space and land resources exists at Arno Island, the largest in the atoll. Actually 500 feet shorter than Jabu, Arno's width in places approaches half a mile, which means that soil and groundwater conditions are especially favorable for production of staples like taro and breadfruit. Residential units, representing some 31 lineages, extend from one end of the island to the other. Some of Arno's 63 landholdings are nearly as small as those on Jabu but others run as high as 18 acres in extent. One of the largest corporate properties consists of four such parcels which together equal 40 acres. The island's population in 1950 was 205, and estimated density of population was about the same as on Jabu.

LEONARD MASON
University of Hawaii
Honolulu, Hawaii

12. Origins of American Scientists by States of Birth: Relevance to Scientist Production

Using the 1938 edition of *American Men of Science* as a source, the late Dr. Edward L. Thorndike conducted a study of scientists by states of birth compared to the white populations of the states.

This study revealed an immense disparity between the states in per capita scientist production. The highest state (Utah) was 14.4 times as high as the lowest (Georgia). The highest state was 30 per cent beyond the second place state (Colorado).

Using the 1949 edition of *American Men of Science* as a source, the present writer did the same kind of study again to see what changes might have occurred in that decade during which the number of scientists listed grew from approximately 28,000 entries to approximately 50,000.

Again a great disparity between the states as scientist producers was revealed. However, the highest state (which was still Utah) was now only 11.7 times as high as the lowest (which was now Arkansas). The highest state was now 32 per cent beyond the second place (which was no longer Colorado but Idaho).

Several studies have been made which shed light on the factors which stimulate scientist production. None of these analyze the differences in scientist production between the various states of the union as a source of information on factors stimulating scientist production.

The present study is a preliminary analysis of what factors seem to be present in the top scientist producer (Utah) which are not present in the less productive states. Several factors seem to be eliminated as the main causative agents in Utah's lead by the fact that several other states not only have the individual factors to an approximately similar degree but even the admixtures of the factors to a similar degree.

No student has reported being able to associate any of the following with Utah's lead:

Higher inherited abilities in its population, climate, types of industry and employment, comparative average or total income, racial stock of its people, or national origins of its people.

Utah has been almost as distinctive for an excellent public school system as for production of scientists, being recognized as first in percentages of young people going to college and highest in average number of years education in its population. Yet its standing in education is not proportionately as far beyond other states as in scientist production.

A most clear and incontestable sociological difference between Utah and other states is the presence and influence of the Mormon Church in that particular state. A study among Utah-born scientists points to the philosophy and influence of the Mormon Church as a likely causative factor in high scientist production. Another study by a non-Mormon student (De Boer, Denver U.) credited Mormon influence with being largely responsible for Utah's high standing in education in general.

RICHARD T. WOOTTON
The Church College of Hawaii
Laie, Oahu, Hawaii

13. Studies of Factors Affecting the Floral Development of *Carica papaya* L.

Many trees of the hermaphroditic form of Solo papaya are unstable, producing normal flowers most of the year but changing from season to season and occasionally changing sporadically from one flower type to another out of season. Flowers initiated during cool winter temperature are highly carpeloid (more female and less male parts) when they bloom. Flowers initiated during the high temperatures of summer often have abortive pistils or a greater ratio of male to female parts than normal when they bloom in the fall.

An early low-bearing type papaya treated at three months of age with 17 nights of 40°, 60°, and 80° F. temperatures produced flowers tending toward higher female development after cold nights and less female development after warm nights. Hermaphrodite plants growing in the field covered with a polyethylene tent (day temperature increased 10°–15° F.) produced flowers having fewer male and more female parts than normal one month after treatment.

These results support the tentative hypothesis that in the papaya plant there is produced a substance which increases during warm days and is reduced during warm nights but accumulates during cool nights (or wide diurnal fluctuation in temperature). A high level of this substance in the growing apex results in the development of more pistillate flower parts and a low level results in less pistillate and more staminate flower parts.

A. H. LANGE
University of Hawaii
Honolulu, Hawaii

14. Satellite Tracking at the Haleakala Observatory

With the anticipated launching of artificial earth satellites, it became necessary to find means of precisely obtaining positions of satellites while they are in orbit. Optical means are employed since electronic methods have not been developed sufficiently to obtain the accuracy required.

The Smithsonian Astrophysical Observatory has the responsibility of obtaining precise positions of all artificial earth satellites launched during the International Geophysical Year. A network of twelve tracking stations, using Baker-Nunn Satellite Tracking Cameras, located around the world between the north and south 30° parallels obtain photographs that make possible the positioning of a satellite in the most exacting manner known today.

As a service of the IGY Program, the data collected by the satellite tracking stations are made available to universities, institutions, and interested individuals upon request from the Smithsonian Astrophysical Observatory.

WALTER S. LANG, JR.
Smithsonian Institution
Washington, D. C.

15. Some Ionospheric Phenomena Associated with Nuclear Explosions

The United States Government exploded two nuclear devices from Johnston Island, about 700 miles to the southwest of Honolulu, on August 1, 1958, at 12:50 a.m. Hawaii time (1050 GMT), and on August 12, 1958, at 12:30 a.m. Hawaii time (1030 GMT). Both of these produced flashes clearly visible from Honolulu, the first being by far the more brilliant and spectacular. One would presume on the basis of the observed flashes, that the first explosion took place at a very high altitude, perhaps 80 miles or more, and the second at a considerably lower altitude. Both of these nuclear explosions produced disturbances in the earth's ionosphere which were observed both visually and instrumentally.

The ionosphere is a region of the earth's atmosphere, ranging from 60 to 200 miles above the surface of the earth, which plays a vital role in the production of the auroras, the magnetism of the earth, and in the transmission of radio waves over long distances. Observers from Mt. Haleakala on Maui, at an elevation of 10,000 ft., reported seeing a red cloud drift overhead from the direction of Johnston Island about a half hour after the explosion. This red cloud was undoubtedly an aurora-type phenomenon taking place in the ionosphere as a result of the energy released by the explosion. Only a very small and faint aurora was produced by the second explosion.

It is a common experience that solar disturbances often increase the ionization in the ionosphere so that radio signals are absorbed in the ionosphere instead of reflected in the normal manner. Such an effect produces what is called a radio fade-out. A very strong radio fade-out followed the first explosion immediately and lasted for several hours. After the second explosion there was no fade-out for almost 8 hours. But soon after 8 a.m. a very strong fade-out commenced and lasted until about noon, after which it gradually subsided. Attempts to relate these fade-outs to solar disturbances have not shown any known events on the sun that would normally be expected to produce a fade-out.

Geomagnetic disturbances are also known to be frequently produced by solar events such as flares. A large flare may emit great quantities of ultraviolet and even X radiation, as well as high energy particles. When the radiation is absorbed in the earth's atmosphere ionization is produced and a small fluctuation in the geomagnetic field often results. Sometime later when the particles arrive in the earth's atmosphere a fairly large and sudden disturbance may result. The magnetograms from the Honolulu Magnetic Observatory of the U.S. Coast and Geodetic Survey indicate a sudden but small disturbance at the precise time of each of the explosions. Ten to 15 minutes later a much larger disturbance occurs, reaches a maximum in another 10 to 15 minutes, and then returns to normal. We interpret the first small disturbance to be the result of the ultraviolet radiation emitted by the explosion, and the later and larger disturbance to the high energy particles produced by the explosion.

WALTER R. STEIGER
HAROLD L. KRIVOY
University of Hawaii
Honolulu, Hawaii

16. Correlative Phenomena with Auxin and Adenine Sulfate Demonstrated by Simple Tests with Etiolated Pea Seedlings

There is now considerable evidence that plant hormones operate in various regulatory phenomena as participants in correlative reactions. One plant response so regulated is the formation and growth of organs. Initially the hormones participating with auxin in organ formation were given the general physiological name, calines. The calines were distinguished as caulocaline, phyllocaline, rhizocaline, and florigen according to their action in regulating the formation and growth of stems, leaves, roots, and flowers, respectively. It now appears that one compound, adenine sulfate, reacts with auxin in all of these processes and, in addition, regulates the formation of lateral branches.

These different responses to adenine sulfate, whether in controlling the growth and formation of organs or of lateral branches, are determined by its relative concentration in comparison with that of auxin. Low auxin (indole acetic acid) and high adenine sulfate results in accelerated stem growth as found here and by others. In this reaction adenine sulfate qualifies as caulocaline. As for phyllocaline activity, adenine sulfate presumably independent of auxin controls the growth of leaf mesophyll. In the initial work on this effect of adenine sulfate, mesophyll growth was found to be promoted by a diffusate prepared from peas. The active constituent was later identified as adenine sulfate. Veins and midribs are believed to be regulated in the same way as stem growth which at this time appears to be under joint control of auxin and adenine sulfate. The conjunctive role of auxin and adenine sulfate in the formation of roots and flowers has been shown, although more work is needed. Adenine sulfate in these cases reacts as rhizocaline and florigen, respectively.

These observations made by different investigators with various plant materials seem to fit together in support of adenine sulfate as a universal caline. Some recent studies employing etiolated pea seedlings

(Alaska) further substantiate this conclusion. A summary of this work follows (1AA—indole acetic acid; AS—adenine sulfate):

1. Seedlings which were treated with 40 ppm AS showed a marked increase in stem length in 14 days. Here AS appears to function with normally occurring auxin in stem growth, fulfilling the part of caulocaline.

2. Seedlings which were prepared as above, but treated in addition with 10 ppm 1AA applied apically, formed lateral branches. In this case the reaction of AS with high auxin in the formation of lateral branches is shown.

3. Seedlings of seeds which were soaked in 40 ppm AS for 5 hours before germination, formed lateral branches directly above the cotyledons within 8 days. It seems that in this treatment AS combined immediately with natural auxin present in the cotyledons to form lateral branches before any lessening of auxin content occurred through its utilization in stem growth.

4. Seedlings which were decapitated and given no additional treatment formed typical lateral buds. On the basis of auxin-adenine sulfate phenomena, this would be explainable as a reaction between increased auxin released at the site of lateral buds through loss of concentration gradient and normally occurring AS.

5. Decapitated seedlings which were treated with 40 ppm AS showed a growth rate of lateral branches far above those not receiving AS. Here again is illustrated the caulocaline effect of AS.

6. Decapitated seedlings which were treated over the cut surface with 100 ppm indole butyric acid in lanolin formed no lateral branches. This is the typical phenomenon of bud inhibition through apical dominance by auxin as it occurs concentrated terminally in stems of intact seedlings.

7. Decapitated seedlings which were treated with indole butyric acid as above, and in addition with 40 ppm AS, formed lateral branches. Here again is an experimental demonstration of reaction between AS and high auxin in the formation of lateral buds. In addition, the effect of AS in overcoming apical dominance is shown.

Appreciation is expressed to Francis S. Shibuya and Kenneth H. S. Kwak, Chaminade College of Honolulu students, who performed some of the tests described.

GLADYS S. KING
Chaminade College of Honolulu
Honolulu, Hawaii

SPECIAL SESSION II

Exploration of the Pacific Ocean and Its Deep-Sea Fauna by the "Vitjaz"

During the last 10 years complex oceanologic investigations have been carried out in the Pacific Ocean and its adjacent seas by the Institute of Oceanology from its ship the R/V "Vitjaz." This ship, which has a displacement of 5,600 tons, contains 13 laboratories with facilities for all kinds of oceanographic work and has living accommodations for 65 scientists and assistants besides the crew.

The "Vitjaz" has been engaged in 29 expeditions, 4 of these under the IGY program. More than 4,000 stations have been occupied, more than 600 during the IGY. On the fourth and final IGY cruise, 330 stations have been occupied in eight traverses totalling 24,000 nautical miles in length.

Hydrologic work has been directed to the study of the distribution, structure, origin, interaction, and transformation of water masses, and especially to the current systems of the northern and western Pacific and their boundaries. The chemistry of the water, the atmosphere, and the bottom sediments have been studied.

The geologic work has included echo-sounding recording of ocean-bottom relief and bottom sediment mapping by means of coring. A core of 34 m. length has been recovered. Special attention has been directed to the exploration of trenches. A new one has been discovered northwest of Fiji, and the greatest known ocean depth, 10,990 m., was located last year in the Marianas trench.

The biological work has included studies of the fish, plankton, and bottom fauna. Much attention has been given to the bottom fauna of the deep sea, and particularly of the trenches, in 10 of which bottom trawls were made. The deepest trawl was made in the Marianas trench at 10,710 m. The catch included actinians, polychaetes, crustaceans, and holothurians.

The deep-sea bottom fauna in the abyssal zone and particularly the ultra-abyssal zone (below 6,000 m.) is characterized by "primary deep-sea species," primitive in their organization and systematic position and accordingly considered older, but also includes "secondary deep-sea species," more progressive and with slight taxonomic self-dependency, perhaps migrants from lesser depths of the ocean. A new phylum of invertebrates, the Pagonophora, has been described from the abyssal zone.

In general the bottom-fauna biomass varies inversely with the depth. The deep-sea bottom-fauna biomass has been found to vary from values measured in g/m^2 in regions near continents or large islands to values of a much lower order of magnitude in mid-ocean areas. Particularly low bottom-fauna biomass values have been found in the central tropical Pacific, corresponding to a scanty plankton population there and in the northeastern region between California and Hawaii where large escarpments, a narrow shelf zone, and sparse outflow from shore provide only a small quantity of organic matter at the bottom.

The Pacific Ocean is vast and complex. Only by cooperative efforts of oceanographers from all of its bordering countries can its problems be studied successfully.

ZINAIDA FILATOVA
Institute of Oceanology,
Academy of Science
Moscow, USSR

FINAL SESSION

1. Report on Upcoming Pacific Science Congress

No abstract available.

ROBERT HIATT
University of Hawaii
Honolulu, Hawaii

2. Corrosion Studies

Corrosion is a chemical change in which metal passes from the elementary to the combined state.

Metals are corroded by several different conditions. The most common, atmospheric corrosion, is affected chiefly by the amount of moisture present in the air. Here in Hawaii, however, the amount of sodium chloride present from ocean spray does the most damage.

To study the rates of corrosion of iron in different solutions, measured amounts of steel wool were moistened with water, sodium chloride, calcium chloride, cane sugar solution, glycerine, and acetic acid and thrust into separate glass tubes which had their open ends placed in water. Other tubes were filled with rusted steel wool and dry steel wool. Corrosion taking place in the tubes used up the captive oxygen present and caused water to rise up the tube. Hourly measurements of the water column showed the per cent of oxidation occurring. Although 100 per cent oxidation is theoretically possible, it was never achieved and readings up to 90 per cent were never consistent.

Galvanic corrosion was observed by dissolving agar-agar in water to form a gel and adding .1 molar solutions of potassium ferricyanide and phenolpthalein. By placing two metals of different reactivity in contact with each other in the solution, definite anodic and cathodic areas were observed. Anodic areas are blue and cathodic areas pink. This is effected by the action of the positive and negative ions on the potassium ferricyanide and phenolpthalein, respectively. Corrosion took place at the anodic areas only, and the amount of corrosion varied as to the difference of the colors of the anodic and cathodic areas.

Actual galvanic corrosion takes place only if current flows. An iron nail and a piece of magnesium foil were placed in contact in a table salt solution. After an hour, corrosion had eaten away the magnesium in many places and voltage had dwindled from 1.5 to .5 volts.

Final conclusions are: Water acts as a catalyst on corrosion. Electrolytes, acids, and alkalies also act as catalysts, but do most damage when hydrated. Nonelectrolytes retard corrosion. Different solutions cause different types and shades of rust. Rust acts on itself as a catalyst. 100 per cent oxidation does not occur. The oxidized material seldom removes more than 93 per cent of the oxygen from the air. Common methods of corrosion prevention are effective against most corrosives, but do not stop all types of corrosives. Corrosion takes place more readily at points of stress and strain.

MARSHALL ETO
Roosevelt High School
Honolulu, Hawaii

3. The Gibbsite Concretions of Cape York, Australia

A sample of gibbsite concretions from Weipa, Cape York, Australia, was obtained by G. Donald Sherman of the Department of Agronomy and Soil Science, University of Hawaii, during his trip to Australia in 1957.

The bauxite deposits occur in the low level coastal plains along the Gulf of Carpenteria of the upper portion of Cape York Peninsula. During the cyclonic storms of the monsoon season (December to February), this area is covered by the flood waters of numerous intermittent rivers and drainage systems to a distance of 10 miles inland. These cyclonic storms promote the floods through heavy precipitation and by the high waters in the Gulf of Carpenteria.

It was observed that some of these concretions were whitish on the outside, while others were more reddish-white. Upon splitting these concretions, it was further observed that they were either nonconcentric or concentric types.

No attempt was made to separate the different types of concretions. Instead, a representative sample was taken, and differential thermal and chemical analyses were made. The differential thermal analysis showed that the sample was predominantly gibbsite. The thermal curve showed a strong endothermic peak at 325° C. which is indicative of the mineral gibbsite. There were also small endothermic peaks at 105° C. and at about 525° and 550° C. The former is due to adsorbed water while the latter two may be due to the presence of boehmite and some kaolin-type mineral, respectively. The chemical analysis of the Australian sample showed 5.68 per cent SiO_2, 63.48 per cent Al_2O_3, 5.96 per cent Fe_2O_3, 2.32 per cent TiO_2, and 25.00 per cent loss on ignition. The pure mineral gibbsite contains 65.35 per cent Al_2O_3 and 34.65 per cent H_2O, while the mineral boehmite contains 84.97 per cent Al_2O_3 and 15.03 per cent H_2O. Because of the presence of only 25.00 per cent loss on ignition (the ignition of a sample at 800° C. to measure the expulsion of such constituents as CO_2 and H_2O) in the Australian sample, it is believed that this sample may contain some boehmite in addition to gibbsite.

Thin-section studies of several concretions were also made by Klaus W. Flach of the Soil Survey Laboratory of the Soil Conservation Service, U. S. Department of Agriculture at Beltsville, Maryland. Of six concretions studied, four of them showed well-organized concentric shells whereas two did not. The microstructure and the presence of rounded quartz grains in one of the latter suggest a fossiliferous sandstone in a relatively early stage of weathering. Aside from the inclusions of minute crystals in this concretion, there are also many subrounded holes in the matrix which are either empty or filled with quartz. Some of the holes have well-developed gibbsite crystals, while others contain a mixture of quartz and gibbsite. The quartz grains are the only primary mineral observed, and it is believed that the replacement of these quartz grains by gibbsite may have been only one of the ways in which the concretions were formed. The thin skin of this concretion is an amorphous, dense, light gray material. The second concretion of this type is redder in color and in contrast to that just described does not have quartz grains or gibbsite.

The concretions with concentric shells have alternating layers of lighter and darker red opaque material which may be gibbsite and boehmite, respectively.

HARUYOSHI IKAWA
G. DONALD SHERMAN
University of Hawaii
Honolulu, Hawaii

4. Volatilization Losses of Soil and Fertilizer Nitrogen

In the past ten years four different research groups have reported significant deficits of nitrogen applied as fertilizer to soil, after cropping, leaching, and fixation losses had been taken into account. These deficits, presumed to represent volatilization losses, have varied with type of fertilizer applied, type of soil, and degree of soil acidity, and have amounted in some cases to 85 per cent of the fertilizer nitrogen applied. Such losses from aerobic acid systems are thought to result largely from reactions of the nitrite ion, which in acid medium may be decomposed or reduced to produce four gases: nitric oxide, nitrogen dioxide, nitrous oxide, and nitrogen. In the studies reported here, soils variously treated with nitrogen fertilizers or nitrite were incubated under a helium-oxygen atmosphere and the evolved nitrogen containing gases identified and measured on a gas chromatograph. The data showed little evidence for nitrogen losses as nitric oxide or nitrogen dioxide. Nitrous oxide was evolved in trace amounts from some soils, but not from others similarly treated. There was little indication that nitrite reacted with ammonia to form nitrogen gas, but there was strong evidence that nitrite was reduced to nitrogen gas by some component of the soil complex, probably of the soil organic matter.

DONALD H. SMITH
Pineapple Research Institute
Honolulu, Hawaii

5. The Battle Against Blindness in Asia

Asian or preventable blindness has for centuries been linked to social and economic problems. Ignorance, apathy, poverty, and malnutrition are some of the primary causes.

The shortage and maldistribution of trained medical personnel, great distances to the nearest hospital, with poor transportation facilities further contribute to the high incidence of eye diseases and blindness.

Despite overwhelming odds, noteworthy forward strides have been made. These gains are due to modern medical discoveries, emphasis on health education, the collective efforts of physicians, universities, local, national, international, scientific, charitable and missionary, and governmental organizations. In addition to local governments, representatives of foreign governments have discovered that an effective way to win the friendship of people is to aid them in restoring their vision and health.

It is hoped that, in the future, improved means of communication and continued aid from Western countries will enable educators, public health officers, and eye surgeons in the underdeveloped areas of Asia to apply the medical discoveries made in the West.

It is also hoped that more attention will be paid to the prevention of blindness rather than caring for the blind. In the words of Helen Keller:

> "If a tenth of the money we now spend to support the unnecessary blindness were spent to prevent it, society would be the gainer in terms of cold economy, not to mention considerable happiness and humanity."

WILLIAM JOHN HOLMES
Honolulu, Hawaii

6. Genetic-Environmental Control of Flowering in *Trifolium repens*

Trifolium repens occurs in Hawaii chiefly at elevations above 2,000 feet where it has been introduced from the temperate zone. Field collections of Hawaiian clones of *Trifolium repens* indicated wide differences due to genetic variation.

Most notable differences among clones grown at low altitude (Honolulu) were flowering potential. Clones were classified as flowering or nonflowering. Flowering clones exhibited a wide range of blossom production from sparse to profuse, indicating a precise genetic control of the flowering mechanism.

Experiments were conducted at four different elevations in order to determine differentials of reaction of genotypes to different environments. When grown at the high elevation station, all clones came into flower, regardless of their behavior at low elevation. Differences between clones attributable to genetic effects were manifest in degrees of flowering.

A second series of experiments was conducted with four of the clones used in the original studies. Plants were grown in cans to exclude contamination of clones. The cans were located at 2,000 and 6,700 feet. Similar results were obtained as in the field plots. All clones came into flower at the high elevation station but not at the 2,000 foot station.

A third series of experiments using controlled environment cabinets showed that when grown even at sea level conditions of Honolulu, the "nonflowering clones" were induced to flower by treatment with low night temperatures. Crosses among flowering and "nonflowering" clones have been obtained for further genetic study.

Acknowledgement is made to D. M. Kinch, Hawaii Agricultural Experiment Station, for design of the controlled environment cabinets; to personnel of the Haleakala Branch Station and the Hawaii National Park, Haleakala Section, for obtaining certain data; and the Haleakala Ranch and Western Regional Technical Committee W-58 for facilities and support.

E. J. BRITTEN
University of Hawaii
Honolulu, Hawaii

7. Relationship Between Slaughter Weight and Carcass Characteristics in Swine

Fifty-six barrows of mixed breeding ranging in weight from 119 to 204 pounds were slaughtered to determine the relationship between slaughter weight and certain carcass characteristics. The barrows were started on feed at an average weight of 53.5 pounds and were hand-fed a high molasses ration until slaughter. A slaughter weight was randomly assigned to each animal at the beginning of the feeding period.

When the animals reached their pre-assigned slaughter weights, they were taken off feed and held 20 hours without feed and water and a shrunk live weight was obtained (slaughter weight). The hogs were dressed a modified shipper style and chilled 6-8 hours prior to cutting. Backfat measurements were taken opposite the first rib, last rib, and last lumbar vertebrae. The carcasses were cut mainland style. The yields of ham, loin, Boston butt, picnic, and belly were determined by expressing the weights of each of these cuts as a per cent of the carcass weight. In addition, per cent of lean cuts and per cent of primal cuts were calculated. Per cent of lean cuts refers to the combined yield of the ham, loin, Boston butt, and picnic. Per cent of primal cuts refers to the combined yield of the ham, loin, Boston butt, picnic, and belly as a per cent of the carcass weight.

The carcasses from the heavier hogs were fatter than those from the lightweight hogs as indicated by a thicker backfat, a lower per cent of lean cuts, a lower per cent of ham, a lower per cent of picnic, and a higher per cent of belly. The regressions of these traits on slaughter weight were all statistically significant.

Each 10-pound increase in slaughter weight was associated with a 0.15 percentage point decrease in per cent of ham, 0.09 percentage point decrease in per cent of picnic, 0.16 percentage point increase in per cent of belly, 0.35 percentage point decrease in per cent of lean cuts, and 0.045 inch increase in average backfat thickness. The regressions of per cent of loin, Boston butt, and primal cuts on slaughter weight were small and not statistically significant.

ESTEL COBB
K. K. OTAGAKI
I. I. IWANAGA
University of Hawaii
Honolulu, Hawaii

8. Air Pollution: An Educational Problem

Air pollution affects all of us. It may either have a direct effect on our health or well-being, or may affect us indirectly. Air pollution control is expensive and this is reflected in our cost of living.

Many facets of the air pollution problem are thought of as being within the scope of what we refer to as "science." However, in our schools, teaching and learning activities are, for the most part, enclosed in neat little compartments. Few opportunities are provided for seeing relationships between the subject matter of science and human activities and problems.

Since air pollution is in many situations a serious community problem, our schools, as the primary agency in the community engaged in the process of education, ought to contribute in some way to the solution of the problem. By working along with other agencies in the community, the school can help young people and adults gain a better understanding of, and become better able to cope with, the variety of problems associated with air pollution.

Air has been thought of and referred to as an "inexhaustible and immutable" resource. Today we realize that air is not an immutable resource and perhaps sometime in the future we may be forced into realizing that it is not quite as inexhaustible as we would like to think.

The contaminants present in the atmosphere may be either gases or aerosols. The general methods used in removing gases from the atmosphere, either as part of a control program or for determination and measurement, are absorption, adsorption, condensation, and mechanical retention. In the removal of aerosols, sedimentation, impingement, filtration, centrifugation, and precipitation are the methods commonly used.

The effects of atmospheric contamination vary widely from situation to situation. The effects on human beings, plants, animals, structures, and materials must be examined in an adequate consideration of the problem.

The nuisance effects of air pollution on human beings are well known. Reduced visibility, eye irritation, nose and throat irritation, malodors, and the like do produce harmful psychological and sometimes physical effects in man. However, there is a lack of information about the effects of prolonged exposure to low-level concentrations of atmospheric contaminants.

The air pollution problem lends itself easily to the techniques of "scare journalism" and the efforts of ill-informed pressure groups. There is a great need for more research, especially in the area of the health effects of air pollution, and any attempts at inaugurating action or reform should be based on the best scientific information available.

ALBERT B. CARR, JR.
University of Hawaii
Honolulu, Hawaii

9. One Phase of Liesegang Ring Research

In 1896 the German photographer R. E. Liesegang observed that when an aqueous solution of silver nitrate was allowed to diffuse into a layer of gelatin gel containing a small amount of potassium chromate, periodic bands or rings of silver chromate formed as the silver nitrate spread outwards.

A plate on which rings have been formed shows, first, an area of continuous reaction (initial reaction area); then, second, alternate bands of precipitated silver chromate and gelatin; finally, on the outer edge of the precipitated bands, a hazy ring (called the outer diffusion area) can be seen.

The behavior and characteristics of Liesegang rings have been studied under various conditions by varying such factors as gel or gel electrolyte (potassium dichromate) concentrations, photographing them, and using the photographs as a basis for measurement and study.

Experimental Series I: Variation of diffusant ($AgNO_3$) concentration. Results: (a) The higher concentrations of silver nitrate were observed to diffuse faster than the lower concentrations; (b) the initial reaction area width increased rapidly as concentration increased, leveling off and decreasing slightly as the concentration approached 50 per cent; (c) the width of the outer diffusion area remained fairly constant as diffusant concentration varied; (d) the spaces between rings decreased as diffusant concentration increased.

Experimental Series II and III: Variation of gel and gel electrolyte ($K_2Cr_2O_7$) concentrations. Results: (a) Ring spacing increased as gel concentration decreased; (b) high gelatin concentrations produced better formed rings than low concentrations; (c) gel electrolyte concentrations above 1 per cent did not form rings.

Experimental Series IV: Microanalysis of banding. Results: (a) Precise microrings of a deep rose-red color formed extending outwards from the initial area of precipitation; (b) the numerous minute particles on the outer edge of the rings and the few large particles on the inside indicate that a ring is formed by precipitation beginning at its outer edge and moving inwards.

Experimental Series V: Periodic banding on smoked glass. Periodic banding is observed when oil is allowed to spread on smoked glass. This may be caused by either one or a combination of two things: (a) The instability and coagulation tendency of the sols of the elements, and (b) the electrodynamically induced charges that carbon smoke particles should gain as oil flows past them.

JACK SEMURA
Roosevelt High School
Honolulu, Hawaii

10. Observations of Surface Ozone at Mauna Loa Observatory

Meteorologists and other geophysicists are interested in atmospheric ozone because of its contribution to the earth's heat balance and the atmosphere's physical structure, and as a tracer material for the large and small scale circulations of the atmosphere.

Observations of ozone at the U. S. Weather Bureau's 11,150-foot observatory on Mauna Loa began in 1957 as part of the IGY. Total atmospheric ozone is determined by a Dobson spectrophotometer and the ozone content of the ambient air by the quantitative liberation by ozone of iodine from potassium iodide. The chemical analysis is performed automatically by an ozone recorder recently developed by V. H. Regener, and produces a continuous trace of ozone concentration. Ozone is discriminated from other oxidants—a perennial problem in ozone analysis—by separating the incoming air into two branches, one of which is then heated to 300° C. to dissociate its ozone. Since heating does not affect the other oxidants, the difference between the reactivities of the heated and unheated samples is attributable to ozone.

Total and ambient ozone data are presently being studied for seasonal, diurnal, synoptic, and other variations. The two-month lag of surface behind total ozone apparent at Arosa, and often cited as evidence of the transport of air from the stratosphere to the lower atmosphere, is not found in the Mauna Loa observations. On the contrary, although obscured by breaks in the record, seasonal changes in surface ozone appear to precede by several months those in total ozone. Both surface and total ozone also fluctuate widely from day to day, although less in summer than at other seasons; but no obvious correlation exists between these variations.

The rapid destruction of ozone in the lower atmosphere by catalysis and oxidation processes requires discussing its short-term variations in terms of the observing site's topography and the other physical features which govern local air motions and, hence, ozone destruction rates. Daily radiative heating and cooling of Mauna Loa (which has more than 128 square miles of dark lava surface above 10,000 feet) generate upslope and downslope currents along the mountain's flanks. These, in turn, give rise to characteristic diurnal shifts in wind direction and the other weather elements and usually, although not invariably, to peak values of ozone at night and minima during the day. This daily course of surface ozone is unlike what is observed at other mountain stations where interchange of air with the surrounding free atmosphere is sufficient to keep ozone values relatively stable.

Whether the daytime decline in ozone represents its destruction by vegetation, aerosols, and water droplets during the ascent of air from lower levels, or simply the expected vertical gradient of ozone, can be determined only from further observations; it is planned to make these in the free atmosphere and along the mountain slopes as suitable instruments become available.

It is hoped that comparison of surface and total ozone values at Mauna Loa with one another and with similar observations made elsewhere will contribute to our understanding of the general circulation of the atmosphere and of local air movements in the vicinity of Mauna Loa.

SAUL PRICE
U. S. Weather Bureau
Honolulu, Hawaii

11. Uptake of Sr^{85} and Ca^{45} Through Epithelia of Fresh-Water and Sea-Water Adapted *Tilapia mossambica*

The electrolyte concentration in the body fluids of teleost fish falls between that of fresh water and sea water. Such fish living in either medium are faced with the problem of maintaining their internal medium at a relatively constant level. When fish migrate in either direction from water of one salinity to another, they must adjust their hydromineral regulation accordingly.

In order to obtain an insight into how fish accomplish this task, it is necessary to isolate experimentally the various surfaces of exchange and means of excretion of both water and ions.

To achieve this, a compartmentalized tank has been constructed which enables us to separate all epithelia exposed to environmental water except those of the gills, mouth, and head. Further separation of ion and water transfer routes is achieved by esophageal ligation and anal and urinary papillae cannulation.

In a series of experiments, using the euryhaline cichlid, *Tilapia mossambica,* the rate of movement of Ca^{45} and Sr^{85} through various epithelia has been measured. We have found that the skin of the body of *Tilapia* is only slightly less permeable than that of the gills. The rate of movement of calcium and strontium in fresh-water adapted *Tilapia* is about one third the rate of transfer of the same ions when the fish are adapted to sea water.

The urine excreted by the fresh-water adapted individuals contains less calcium and strontium than is contained in their blood; whereas the calcium and strontium in the urine excreted by the salt-water adapted fish is the same as the concentration in the blood.

When these fish are transferred from fresh water to sea water, the rate of excretion of urine falls from an average of 12 ml. per twenty-four hours to about 3 ml. for the same period. However, the fish in fresh water swallow almost no water; whereas they swallow as much as 15 ml. for the same period when placed in sea water.

These results prove the value of the technique and indicate that we will be able to formulate a valid picture of the hydromineral regulation in *Tilapia* when we have studied the several ions contained in their environment.

DELLA F. REID
SIDNEY J. TOWNSLEY
WINIFRED T. EGO
University of Hawaii
Honolulu, Hawaii

12. Fish Schooling: A Possible Factor in Reducing Predation

This paper considers the possibility that fish schooling is a mechanism for protection against predation. There are two factors operating at cross-purposes: Regarding a single fish as a group of size one, schooling (a) reduces the number of groups and consequently the chance of detection, and (b) increases the size of groups, thus increasing the chance of detection. A third factor which may give an advantage to schooling is the limitation of capacity of the predator.

An expression is developed for the probabilities that a predator sights (and therefore eats) a nonschooled forage fish and a schooled forage fish. From these probabilities, an expression is found for the expected number of forage eaten when they school and when they do not school. Other things being equal, if the expected number of schooled forage eaten is less than the expected number of nonschooled forage eaten, then schooling is advantageous to the forage.

Since the number of forage a predator can eat is never more than the number present but may be less, the formulae can be simplified somewhat, leaving the advantage or disadvantage to forage through schooling as an inequality of probabilities. The probability distributions of the variates are found so that the probabilities in the inequality may be evaluated; such probabilities depend on four constants: average distance between predator and forage, standard deviation of this distance, sight range of the predator, and a size measure of a school of forage.

It is shown that for any reasonable values of these constants, the probability of detecting any particular forage fish is approximately the same whether it is schooled or not so that the meaningful consideration in the number of forage eaten when schooled vs. when not schooled is the reduced frequency of the predator's encounter with schooled forage. For example, if the predator meets 70 forage a week and can hold 10 at one feeding, he eats optimally if he finds 10 nonschooled forage a day; however, he may starve if he finds one school of 70 in the week, at which time he can hold only 10. Thus the meaningful factors in schooling advantage are (1) predator capacity, (2) the period of association of predator and school, and (3) school size. It is shown that as the number of forage fish in a school increase (total forage held constant), the consumption rate of forage by the predator will decrease.

VERNON E. BROCK
Bureau of Commercial Fisheries
Honolulu, Hawaii

ROBERT H. RIFFENBURGH
Bureau of Commercial Fisheries
and University of Hawaii
Honolulu, Hawaii

13. A Report on the Development of Conscience in 140 Sixth-Grade Children

In the early socialization of a child, conformity to social rules is achieved solely by the development of fear of external punishment. Later a more complicated process occurs, the origin of which, Freud traces to a process which he calls identification. Through identification a child learns to accept the parents' standards of conduct as his own. The term conscience is applied to this kind of inner control, which can be recognized in a child by two behavioral characteristics: (a) the maintenance of self-control in the face of temptation, and (b) occurrence of guilt feelings after transgression of a standard of conduct.

The present study employed the concept of identification as an intervening variable to make predictions from child-training practices to the child's responses of resistance to temptation on a behavioral measure. Subjects were a sample of 140 children from the 379 families investigated by Sears, Maccoby, and Levin (1957). In the latter study measures of the kinds of child-training practices relevant to the development of identification were obtained. The children were 5 or 6 years old at the time of the study. When these children were 10 or 11 years in age they were given the behavioral tests of resistance to temptation.

Measures of resistance to temptation were obtained with a simulated shooting gallery. The apparatus consisted of a "ray-gun," and a 15″×15″×10″ box housing an electrical system of relays, on the front of which were revolving illuminated rockets and five large pilot lights. Scores from 0 to 5 were registered on the pilot lights by pulling the trigger of the "ray-gun." Subjects were instructed to record their score per shot, and to cumulatively total their score each time for 20 shots. They were told that if they obtained 35 points they would be awarded a marksman badge, 40 points a sharpshooter badge, and 45 points or more an expert badge. The experimental sequence was pre-arranged, however, and totaled 32 points when *only* obtained scores were recorded. Subjects were shown how to play the game in a group. They were then taken out of their classroom individually, led to the experimental room, and at the door each subject was told that the experimenter was busy working on some "things" down the hall. Each subject was asked to play the game alone, and to bring his score sheet to the experimenter when he finished. Rapport was high for all subjects.

Forty-two subjects resisted temptation. Twenty-five subjects were classified as low-yielders, 34 as moderate yielders, and 39 as high-yielders.

A preliminary analysis of the data suggests that, in general, hypotheses drawn from identification theory were supported. It was expected that a warm mother, who creates socialization anxiety in the five behavior systems—oral, anal, sexual, aggressive, and dependent —(Whiting and Child, 1954), would develop in a child strong identification and therefore resistance to temptation. Significant relationships were obtained with antecedents from each of these systems.

ROBERT E. GRINDER
University of Hawaii
Hilo, Hawaii

14. Leaderless Group Discussion as a Selection Technique

A definite need for further probing into problems of leaderless group discussion technique validity as a selection device was felt following a selective review of the literature. This study proposes to examine the relationship which intelligence, aptitude, experience, and social and personality skills have to individual success in a group discussion.

Eighty-seven candidates for admission to the Honolulu Police Academy were administered the usual battery of selection devices including application blank, intelligence test, police aptitude test, and leaderless group discussion evaluation. In addition the Heston Personal Adjustment Inventory was administered.

Significantly related to success in the leaderless group discussion were the variables of intelligence (as measured by the Otis Test of Mental Ability), police aptitude test score, and the "Confidence" scale of the Heston. Failing significance at the prescribed 5 per cent level but being significant beyond the 10 per cent level was the "Emotional Stability" scale of the Heston.

Age, experience in related occupations, and the Heston scales of "Sociability," "Personal Relations," and "Analytical Thinking" were not significantly related to group discussion performance.

The correlates, however, are low enough to exclude any assumption that the group discussion technique may be duplicating other selection devices. The technique apparently selects as successful candidates those subjects with a higher degree of intelligence, aptitude for the area being appraised, confidence, and—perhaps—emotional stability. These appear to be qualities having face validity for success as a policeman.

The variables that did not correlate significantly did nonetheless have positive correlations in the expected direction. Failure to find significance might be due to a lack of relationship between indicated qualities, a lack in the construction or naming of the various scales, or a chance lack of relationship on this particular sample.

RALPH J. KIESSLING
RICHARD A. KALISH
University of Hawaii
Honolulu, Hawaii

15. A Survey of Freshmen Values and Educational Choices

This study reports on the first phase of a projected systematic investigation of values and related variables among young people in Hawaii as they may influence educational and vocational choices. Three checklists, arbitrarily grouped into general values, external influences, and specific interests, were constructed following analysis of senior college student responses to the open ended question, "What led you to select the major or curriculum which you have been following in college?" These check lists were administered to 1,321 University of Hawaii freshmen in the fall of 1958, 73 per cent of those registered, and also to 650 graduating seniors in spring 1958, 92 per cent of those registered.

When the proportions of values, external influences and interests reported by the freshmen sample as a whole were compared with those reported by the seniors, a majority of them differed significantly at the 99 per cent level of confidence. However, when the rank orders of the reported influences on educational choice were compared, there was high stability of values (Rho .91) and interests (Rho .93) and moderate stability of external influences (Rho .64) between the student samples. Satisfaction from the field and security of employment were the most popular values of both groups; but the freshmen checked satisfaction significantly less frequently and security significantly more often. High school courses and parents were the most popular external influences indicated by the freshmen; work experience and aptitude and interest tests were most popular among the seniors. Both freshmen and seniors were influenced most in their choices by interest in work with children and youth, ideas, science, and adults.

The results of this study were considered tentatively to be consistent with the theory of Super and others that the adolescent by the time he reaches college age has developed a relatively permanent self-concept and that educational choices are the product of complex, interacting, internal, and external forces.

A more detailed report of this investigation has been prepared: Caroline F. Will and Arthur A. Dole, "A Survey of Freshmen Values and Educational Choices, I." B.T.G. Research Report No. 4. University of Hawaii, mimeographed, 1959.

CAROLINE F. WILL
ARTHUR A. DOLE
University of Hawaii
Honolulu, Hawaii

16. Neonatal Maturity and Responsiveness

Investigation directed at determining the relationship between neonatal responsiveness and neonatal maturity. Neonatal responsiveness defined in terms of total score on scales dealing with sensorimotor characteristics of behavior. Three indices of neonatal maturity selected were recumbent length, birth weight, and wrist roentgenograms. Subjects were clinically normal white infants considered of the same socioeconomic strata measured within 24 hours after birth. Testing period ranged from 20 minutes after feeding until 60 minutes prior to next feeding. Statistical treatment of data by means of Spearman rank difference correlation. Analysis showed significant intercorrelations between weight, length, composite length of the four bones of the palms, and composite area of the four phalanges adjacent to the palmar metacarpals. Intercorrelations between maturation, vision, weight, length, composite length of four bones of palms, and composite area of four phalanges adjacent to palmar metacarpals not significant and either of zero or inverse direction. Suggestive evidence for existence of independent factors.

DAVID H. CROWELL
University of Hawaii
Honolulu, Hawaii

17. On the Ability of Schizophrenics to Play "Normal"

Recent research has suggested that role playing or empathic ability is related to general adjustment. Working with college populations, a number of investigators have found that better-adjusted students play roles and empathize with greater facility than those who are less well adjusted. By logical extension it might be assumed that "normals" generally are more skilled in this function than neurotics and psychotics. However, some very recent studies have shown that certain schizophrenic groups have considerable role-playing skill.

The present investigation attempted to throw further light on role playing in schizophrenia. On the basis of previous research, the following hypotheses were formulated:

(1) Acutely ill schizophrenics are better able to play the normal role than chronically ill schizophrenics.

(2) Whether acutely or chronically ill, schizophrenics who subsequently improve are better able to play the normal role than those who do not.

The subjects of the investigation were 25 acutely ill and 29 chronically ill schizophrenic women who were patients at the Territorial Hospital. Each of these two groups was divided into fast and slow improvement subgroups on the basis of an evaluation of subsequent hospital course.

Each subject was tested in two sessions of the same day. In the first session the subject was administered the Rorschach and schizophrenia scale of the Minnesota Multiphasic Personality Inventory (MMPI Sc) under standard instructions. In the second session these two tests were administered again with special role-playing instructions to the subject to respond in the way that a "typical, average, ordinary" person would.

Each Rorschach protocol was scored for Schafer's "principal indicators of schizophrenic disorganization." The MMPI Sc was scored in the usual manner. On both tests, high scores were regarded as evidence of schizophrenia, and reduced scores under role-playing instructions were considered to be evidence for the ability to play the normal role.

Three of the four main results were in the predicted direction but only one achieved statistical significance. The first hypothesis, that acutely ill schizophrenics are better able to play the normal role than chronically ill ones received little support; the Rorschach results were in the predicted direction and approached statistical significance; however, the two groups did not appear to differ on the MMPI Sc. The second hypothesis, that schizophrenics who subsequently improve are better able to play the normal role than those who do not, received somewhat more support; both the Rorschach and the MMPI Sc results were in the predicted direction and the former proved to be statistically significant.

BERNARD I. BLOOM
Territorial Hospital
Kaneohe, Hawaii
ABE ARKOFF
University of Hawaii
Honolulu, Hawaii

18. Soils and the Food Problem

In many underdeveloped countries population is growing faster than resource development for food. This is not because of any general lack of soil resources; it is because public health measures and the desire for better living are far ahead of scientific research and agricultural development. If all soils in the world that are suitable for food crops were used as efficiently as those in Holland, for example, world population could be several times the present number.

Then too, in many countries the food situation is no worse than it ever was. But recently people have heard about the abundance in the United States and are more conscious of their own situation than before.

In underdeveloped countries the agriculturist faces several serious handicaps:

(1) Low social status of farm people, even including professional agriculturists;

(2) low political standing of agriculture;

(3) lack of machines, chemicals, and transport;

(4) lack of basic data, especially about the soil resources.

After all, we cannot transfer agricultural practices from one kind of soil to a contrasting one in a different social organization. We can transfer only basic principles and skills. Most of the actual techniques of soil use and conservation must be invented on the spot to fit the local kinds of soil and social systems. Usually changes in these systems can be made only slowly.

Somehow many of the key people responsible for food production in these countries, including some of their American and European advisors, assume that agriculture is relatively simple. They assume that "someone" knows what are the best practices. It is only necessary to find this "someone," have him explain them, and set up an extension program to carry the good word to the cultivators.

What they fail to appreciate is that we have been studying the soils of advanced countries many years. Soil surveys have been made, often two or three times in the past 75 years, as our knowledge increased.

Even though there are more kinds of soil in the tropics than in all the rest of the world, little is known about great soil areas occupied by many hundreds of millions of farm people.

Without this essential scientific background, substantial progress is impossible. Had I the time and you the patience I could pile up examples of both little and great schemes going to ruin for lack of local soil knowledge—knowledge that we are beginning to take for granted in all advanced countries.

Actually we have hardly begun to put science to work for improving agriculture. I don't know whether we can have world peace even if we do solve the food problem. But I am sure there will not be peace while millions live on the edge of starvation.

With a fraction of the money and brains now used in the world for celestial mechanica alone, the battle of food can be won while there is time.

I wanted to make this point here, in Honolulu. You have developed to a high level some aspects of tropical agriculture. You have the facilities and experience on which to build a tropical soil research institute that can begin to develop the basic soil data needed for an efficient agriculture in many countries. The need is very great and, I fear, the time is running out.

CHARLES E. KELLOGG
Soil Conservation Service
Washington, D. C.

CONTRIBUTORS

I *Individuals* ($10.00 or more)

R. A. Anderson
Anonymous
Mrs. Cyril Damon
A. G. Marcus
A. J. Mangelsdorf
Philip S. Platt
Atherton Richards

II *Firms, Foundations, and Organizations* ($50.00 or more)

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Society of Sigma Xi, Hawaii Chapter
Straub Clinic
Territorial Association of Plantation Physicians
U. S. Army Advisor Group, Headquarters
U. S. Navy

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† Fellow, American Association for the Advancement of Science.
‡ Member, Hawaii Division, Hawaiian Academy of Science.

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FISHERIES AND THE FUTURE

Vernon E. Brock[1]

The population of the world is increasing rapidly and the concurrent demands on the natural resources of this planet grow even faster. The exploitation of natural resources is accelerated not only because there are more people, but because they desire, and to some degree attain, higher standards of living.

Among the natural resources subject to accelerated harvest are the fisheries. The use of the world fisheries in a fashion best designed to sustain yields of increasing magnitude in future years will generate a series of problems of great difficulty and interest. I propose to speculate about the nature of these problems and some possible solutions.

Fisheries belong to a group of natural resources that are living and, by virtue of being alive, are self-renewing. In contrast, most mineral resources are not being regenerated—at least at a sufficiently high rate to effectively postpone the date of their exhaustion. Some nonliving resources, such as soil or water, are renewed.

For the renewable resources, both living and non-living, the harvest must not, on a sustained basis, exceed the rate of replenishment. The replenishment of that taken by harvest is analogous to interest, but for most of the living resources it, unlike interest, cannot be effectively used to increase capital. If it is not used, it disappears and the failure to recognize this fact has distorted some thinking concerning the management of renewable resources.

Nonrenewable natural resources produce no interest; our use constitutes a consumption of capital, with the likelihood of its ultimate exhaustion. Patterns of use that tend to recirculate would serve to extend the supply as would the use of substitutes. Ultimately, on a self-contained earth, with the energy of the sun as its only significant extraterrestrial import, all resources must be renewable; minerals must be circulated rather than dissipated. Of course, the importation of minerals from extraterrestrial sources would reduce this requirement.

The problems of management of the renewable resources, such as fisheries, are essentially problems of controlling the magnitude of harvests so that replenishment by reproduction is not consistently exceeded and of managing the resource and the associated environment so as to maximize replenishment.

Insofar as our needs are satisfied by yields below that added annually by reproduction and recruitment, the task of managing a fishery is one of monitoring the effects of exploitation, to see if indeed the yields are less than can be safely sustained. In addition, work designed to reduce the effort of harvest or to increase the utility of the catch may be desirable under some circumstances.

Those fisheries which are exploited at their highest maximum sustained yield, and thus should be regulated, are the fully exploited or "mature" fisheries. Such fisheries are in the minority; most of the existing fisheries can apparently sustain some increases in yields, while others are but lightly fished.

Implicit in the statement that mature fisheries should be regulated is the assumption that it is a legitimate activity of government to manage a resource so as to sustain its productivity. If the responsibility for fishery regulation is a governmental responsibility, then obviously it is also a governmental responsibility to measure adequately the consequence of regulation. If such measures are inadequate or lacking, justification for regulation disappears. Regulation without adequate evaluation of the consequences is not uncommon, especially at the state government level.

Since many fisheries are neither within the jurisdiction of any one nation nor exploited by citizens of one nation, management may involve treaties among the governments concerned. These treaties usually establish an international commission to manage the fishery or to handle the various questions which arise concerning its exploitation. The international regulation of fisheries by commissions or other analogous groups will certainly increase in the future.

THE NATURE OF THE SEA FISHERIES

Fisheries are a food-harvesting activity akin, in certain respects, to agriculture. Some portions of the catch are used for needs other than food (oils, stock feeds, fertilizers) which, in a fashion, again parallels the use of certain agricultural products.

While the production of the world fisheries is increasing, the yields, as indicated earlier, can doubtless be yet increased by many times, principally perhaps by the development of fisheries for those organisms lightly or not presently exploited.

The 1958 yield of world fisheries, both freshwater and marine, was about 33 million metric tons, substantially less than world meat production and far less than the total yield of animal protein from land. Galtsoff (1952) gave the following yields for certain fisheries:

[1]Fishery Research Biologist, U. S. Bureau of Commercial Fisheries, Honolulu, Hawaii.

TABLE 1

YIELDS OF FISHERIES FOR SELECTED AREAS

Area	Lb/Yr/Acre
Sea of Azov	70.3
Sea of Japan	25.3
North Sea	21.9
Mediterranean	13.4
Atlantic	.6
Pacific	.5

Nelson Marshall (1951) estimates that the yields of the fisheries of North Carolina contain only .08 to .06 per cent of the carbon initially bound up by marine plants. These yields vary from 8 to 21 pounds per year per acre. In terms of an efficient utilization of marine productivity, fisheries do very poorly. However, this is due to the nature of the community of living organisms of which the fish are a part.

The economy of the biotic community is based on the growth of plants. Feeding on the plants are various kinds of herbivorous animals, and in turn the herbivores are eaten by predators which may also be prey for yet others. The generation of foodstuffs by feeding and growth drops rapidly from the plants to the herbivores, and from the herbivores to the predators, being least for the climax predators at the end of the food chain. This is true because food dissipated as energy cannot be used for growth and a portion of what is eaten is not digested.

The majority of our more important commercial fish species are predators and are for that reason among the less abundant species in the sea. Their size, their ease of capture, and their palatability are reasons for their being the object of fisheries.

Fishing differs in a fundamental way from farming in that a fisherman harvests but does not cultivate. Progress in fisheries has been, in the main, improvements in methods for harvesting. Such improvements are essential for the expansion of the fisheries and for their profitable pursuit, but will not give any increase in yield for mature fisheries. For such fisheries, improvements may permit the catch to be taken for less cost and/or in less time.

A POSSIBLE PATTERN OF SEA FISHERIES DEVELOPMENT

As our demands for food from the sea increase, additional fisheries will tend to become mature and to acquire thereby a body of regulations designed to control the catch. Ultimately, it may become desirable to consider means of increasing the yield beyond the point of the maximum sustained yield obtained from the unmodified environment. To do this we must increase the productivity of our fisheries and this in turn implies some changes, carefully designed and controlled, in the environment. These changes can be made in either the physiochemical environment or in the biological one, the biotic community. Let us consider this latter suggestion first.

A simple approach would be to fish the lower trophic levels and to fish less selectively; in short, to harvest in a general, rather than a specific way. It may be suggested that the supply of foodstuffs generated in the sea tends to remain more uniform than the individual abundance of the organisms generating and sustained by it. Therefore a broader harvesting base would result in yields less subject to fluctuations than those of individual species, and by being broader, would produce yields of greater magnitude. However, much of the catch may be of little value.

It may be more effective, however, to fish in a fashion that would improve the biotic community as a habitat for the more desirable species. A pattern of fishing designed to reduce predators and competitors and increase the prey of the desired species would have this effect. By such tactics, we would, in a sense, be cultivating the sea and would approach the pattern of agriculture. The magnitude of the maximum sustained yield of the desirable species should, thereby, be increased.

The manipulation of the biotic community requires the development of fishing techniques of sufficient scope and power to substantially reduce the populations of presently unwanted and comparatively valueless species. While such techniques are certainly not at hand, perhaps some now in their beginnings, such as electrofishing, will provide adequate means, singly or in combination with others, to accomplish this.

Should we succeed in manipulating the biological environment to an adequate degree, further increases in the yield of fisheries may be attained through the development of high yield varieties by selective breeding. Such an accomplishment, together with the manipulation of the biotic community, would thus add two important techniques of agriculture to the management of fisheries. This would represent a technological level equivalent to cattle ranching.

If we could change or manipulate the sea itself in some fashion, the effect on fisheries could be enormous. Some slight shifting of the flow of ocean currents would change water temperature and the character of the environment profoundly. The stabilization of current flow to prevent long or short term shifts may be as important.

The decade of lower than normal sea temperatures off southern California, through the late nineteen forties and fifties, has been considered as an important factor in the virtual disappearance of the California sardine and the collapse of its fishery. The incursion of warm water off Peru, the "El Nino," has a destructive effect on the marine biota of this area, often causing a tremendous reduction in the guano bird population by reason of the unavailability of the Peruvian anchovy, its principal food.

While the warm surface waters of the tropics supply an ideal environment for life, the loss of nutrient elements to the depths where light is insufficient for the growth of plants often makes the upper sunlit waters comparatively barren. A means of bringing the waters from the dark, cool depths to the surface would restore the lost nutrients and thereby multiply the productivity of the surface waters.

In a sense, the manipulation of the physical environment of the sea itself, together with the manipulation of the biological environment and of the genetic constitution of the stock of organisms subject to a fishery, would give the fisherman the major techniques of the farmer, and fisheries would begin to approach the technological level of agriculture.

I have discussed some ways in which the productivity of the sea may be increased; let us consider some means of accomplishing these ends. What do we need to know, and what must we be able to do to bring about such changes? For some the magnitude of the task is so great that I can suggest very little as to how we may go about it. I am like a cave man attempting to plan a space ship—the plans are likely to be rather vague.

Presently our ability to manage a fishery is restricted to the regulations of fishing effort, useful for mature fisheries. The usefulness of these regulations, however, is dependent on how well we can establish the maximum sustained yield for a fishery. This is a figure arrived at by the examination of the effects of catches made in the past on the stock and on recruitment. If variations other than fishing have little effect on recruitment, the magnitude of this figure may adequately be established. However, where recruitment responds significantly to environmental fluctuations as well as to the number of spawning fish, the efficient utilization of the fishery will necessitate measurements of the effects of these environmental fluctuations. In short, we need better and more accurate measures of the magnitude of the stock of fish and better understanding of the effects of both fishing and environment.

Beyond this, we need to understand the effects of fishing, not alone on the species fished, but on the associated species. The reduction in the numbers of a species must impose adjustments on its prey, its competitors, and its predators, thereby altering its own habitat favorably or otherwise.

Given an understanding of the effects of fluctuations in the abundance of some members of a biotic community on the abundance of others, we need capture methods of sufficient scope to make it feasible to manipulate the abundance of these members in a pattern that will maximize the abundance of the more valuable ones.

Granting the possession of fishing methods of the requisite scope, the establishment of high yield characteristics by selective breeding of the desirable species may provide a further means of increasing productivity.

And possibly, by means I hesitate to suggest, we may manipulate the weather and the sea, which could have enormous biological consequences through changes in the atmospheric and marine climate.

These hypothetical stages are given in Table 2.

We have reached stage two for some fisheries, but many are yet in stage one. Whether or not the remaining stages are reached will depend upon the need for food so pressing that even the restless sea must be tamed and its productivity directed towards that end.

REFERENCES

GALTSOFF, P. S., 1952. Food Resources of the Ocean in World Production and Future Resources of the Ocean. Paul K. Hatt, ed. New York: American Book Co., pp. 108-118.

MARSHALL, NELSON, 1951. Hydrography of North Carolina Marine Waters in Survey of Marine Fisheries of North Carolina by Harden F. Taylor. Chapel Hill: University of North Carolina.

TABLE 2

STAGES IN THE DEVELOPMENT OF OPEN SEA FISHERIES

Stage	*Condition of Fishery*	*Method of Maximizing Yield*
1	Catch insufficient to reduce recruitment. Immature fishery.	Development of markets. Development of more efficient capture methods.
2	Catch sufficient to reduce recruitment. Mature fishery.	Regulate magnitude of catch.
3	Catch increased by increase in recruitment and survival.	Manipulation of fishing effort to alter relative species composition of the biotic community.
4	Catch increased through development of high yield varieties.	Manipulation of the genetic constitution of the stock.
5	Catch increased through improved physical environment.	Manipulation of the physical environment.

ANNUAL REPORT 1959-60

The thirty-fifth year of the Academy ended with a total membership of 830. There were three Council meetings held during the year at which the chairmen of the special and standing committees were in attendance. We record with regret the death of five members during the past year: Dr. Harold Palmer, Dr. Eric Reppun, Dr. J. C. Ripperton, Dr. Warren White, and Dr. John Loughborough.

Ruth C. Kirby, Secretary, pro tem.

FINANCES

Balance on hand March 31, 1959			
Bank of Hawaii		$ 864.96	
Cash not deposited		6.00	
First Federal Savings & Loan		574.43	
		1,445.39	
Less checks outstanding		481.07	$ 964.32
Receipts			
Dues		1,473.00	
AAAS Grant		100.00	
Annual Dinner, 1959, 109 reservations		381.50	
Donations		10.60	
Dividends, First Federal Savings & Loan		21.72	
National Science Foundation Grants			
G-8432, Teachers' Science Seminars	$ 4,160.00		
G-8494, Museum in Miniature	3,500.00		
G-8871, Hawaiian Science Clubs Service	22,000.00	29,660.00	
Reprints sold		369.34	
Teachers' Science Seminar Workshop			
Hawaii Science Clubs Service	500.00		
Hawaii Chemical	40.00		
Ticket sales for lunch & banquet	190.00		
Refund of Petty Cash advanced	30.00	760.00	32,776.16
			33,740.48
Disbursements			
AAAS donation to operational fund			
1959	18.40		
1960	16.76	35.16	
Annual Dinner, 1959, 112 reservations		392.00	
Complimentary Memberships (28)		56.00	
HAS-Hawaii Division		27.75	
Mailing operations		130.03	
Postage		324.79	
Post Office box rental		9.00	
Proceedings, 1958/59		524.75	
Programs (2 times)		77.83	
Reprints		310.37	
Science Education Fund		200.00	
Student Research Grants		100.00	
Supplies		271.74	
National Science Foundation Grants			
G-8432, Teachers' Science Seminars—Travel Expenses	$ 540.70		
Workshop Transportation	179.20		
Per diem (50 teachers @ $30)	1,500.00		
Stipend to instructors (5 @ $15)	75.00		
Petty Cash advance	30.00		
Announcements	22.05		
Hawaiian Village	373.92	$ 2,720.87	
G-8494, Museums in Miniature Bishop Museum		3,500.00	
G-8871, Hawaiian Science Clubs Service—University of Hawaii		22,000.00	
		28,214.30	
Miscellaneous			
Refreshments (2 sessions)	29.67		
Science Conference	33.80		
Leis	15.35	78.82	$30,759.11
Balance April 30, 1960			$ 2,981.37

Balance on hand April 30, 1960		
Bank of Hawaii (4/27/60)	$ 2,475.07	
Cash not deposited	11.00	
First Federal Savings & Loan	596.15	
	3,082.22	
Less checks outstanding	100.85	$ 2,981.37

Status of Dues Payments:

	March 1959	April 1960
Advance	$233.00	$163.00
Arrears	367.00	300.00

Audited and found correct, May 16, 1960

(s) W. M. Bush
(s) Chester A. Wismer

SCIENCE EDUCATION FUND
(Administered by Cooke Trust Company, Ltd.)

Balance April 1, 1959 .... $ 9,042.17

Receipts		
American Chemical Society	$ 100.00	
F. C. Atherton Trust	250.00	
Juliette M. Atherton Trust	1,000.00	
Bank of Hawaii	100.00	
C. Brewer & Co.	100.00	
S. N. & Mary Castle Foundation	1,000.00	
Castle & Cooke	100.00	
Council for Elem. Sci. International	6,811.58	
Charles M. & Anna C. Cooke Trust	500.00	
Dairymen's Association	100.00	
First National Bank of Hawaii (Bishop)	100.00	
Frear Eleemosynary Trust	400.00	
Hawaii Medical Association	100.00	
Hawaiian Academy of Science	200.00	
Hawaiian Electric Co.	200.00	
Hawaiian Telephone Co.	200.00	
Honolulu Construction & Draying	100.00	
Honolulu Electrical Products	100.00	
Institute of Radio Engineers	475.00	
McInerny Foundation	1,000.00	
Pacific Chemical & Fertilizer	100.00	
Pantheon Co.	500.00	
Rotary Club of Honolulu	100.00	
Alexander Young	100.00	
von Hamm-Young Co.	100.00	
Watumull Foundation	100.00	
Miscellaneous Contributions	1,007.75	14,944.33
		23,986.50

Disbursements				
Brochures		183.00		
Postage & supplies		113.25		
Student Science Seminars		700.00		
CESI				
Badges	$ 34.79			
Meals & entertainment	4,508.90			
Membership fees	1,350.00			
Printing	68.75			
Supplies	22.87			
Telephone & radiograms	40.76			
Transportation	231.80			
Miscellaneous	90.20	6,348.07		
Institute of Radio Engineers				
Transportation & hotel expenses re Western Electronics Show & Convention		664.43		
Miscellaneous		101.22		
Science Fairs (Second & Third)				
Awards	$ 187.11			
Catalogues & posters	545.00			
Entry fee—11th National Science Fair	100.00			
Exhibit expenses	96.59			
Janitor service	235.00			
National Science Fair International Science Service	50.00			
Meals & entertainment	1,804.35			
Postage & Supplies	165.32			
Printing	432.67			
Secretarial Service	30.00			
Telephone and radiograms	68.75			
Transportation & travel expense	4,666.32			
Miscellaneous	233.89	$8,615.00	$16,724.97	
Balance April 30, 1960			$ 7,261.53	

HAWAIIAN SCIENCE CLUBS SERVICE

NSF Grant G-8871
(Administered by University of Hawaii)

Receipts		
Hawaiian Academy of Science (NSF)		$22,000.00
Disbursements		
Communication (postage, telephone, etc.)	$ 309.05	
Equipment (including books)	747.88	
Field trips	130.00	
Printing & binding	3.73	
Publicity (TV)	99.68	
Repairs, maintenance, insurance	1,137.85	
Salaries & wages	6,381.62	
Shipping & freight charges	195.75	
Supplies	825.28	
Travel expenses	2,075.37	
Miscellaneous (indirect cost allowance)	871.19	12,777.40
Balance April 30, 1960		$ 9,222.60

MUSEUMS IN MINIATURE

NSF Grant G-8494
(Administered by Bishop Museum)

Receipts	
Hawaiian Academy of Science (NSF)	$3,500.00
Disbursements	
Honorarium	100.00
Balance April 30, 1960	$3,400.00

Eleanor S. Anderson, Treasurer

MEMBERSHIP

During the current year 58 applicants were elected to membership and 12 individuals were awarded honorary membership in the Academy in recognition of their efforts in behalf of students receiving awards during the Third Annual Hawaiian Science Fair.

Many of the 58 applicants were from Hawaii Island and thanks are due to Mrs. Violet Hansen of the Academy's Hawaii Division for her activities in recruiting new members. Special thanks are also extended to the members of the membership committee for their assistance throughout the year.

Robert T. B. Iversen, Chairman

Philip Helfrich	Vernon E. Brock, ex officio
Thomas A. Jones	Sterling Wortman, ex officio
Hugh Lytle	Ruth C. Kirby, ex officio

AAAS FELLOWS

The individuals nominated for Fellowship in the AAAS were: Arthur R. Keller, O. A. Bushnell, Joel B. Cox, Fred I. Gilbert, Sidney C. Hsiao, and Shosuke Goto.

The above nominees' names were submitted to Dr. Dael Wolfe, Executive Officer of AAAS on September 25, 1959.

C. E. Pemberton, Chairman

A. J. Mangelsdorf John N. Warner

AAAS REPRESENTATION

As an affiliate of the AAAS, the Academy is authorized to nominate each year one boy and one girl for honorary one-year junior membership in the AAAS. The 1960 memberships were awarded to the Science Fair finalists, George Leeper of Iolani School and Mimi Yee, Punahou School.

The administration of the funds remitted by the AAAS to the Academy to provide grants-in-aid for research has been transferred to ISSEC. During the past year, grants-in-aid have been awarded to Kenneth Chang and Alan Fukunaga of Niu Intermediate School in support of their respective projects.

A. J. Mangelsdorf, Representative

CONSERVATION COUNCIL FOR HAWAII

The Conservation Council for Hawaii was formed August 9, 1950, under the auspices of the Pacific Science Board and the Bernice P. Bishop Museum, with the objective of furthering conservation on its various aspects on the Hawaiian Islands to the end of human welfare.

During 1959 various technical studies were carried out by the committees of Land, Water, Flora, Fauna, and Sites. These studies were culminated at the annual meeting in February, 1960, by reports from the committees; also, speakers presented talks on forest conservation.

Richard H. Cox, Representative
J. H. Christ, Alternate

INDEX

A preliminary draft of a questionnaire concerning information and activities of the membership was circulated among the Academy Council members for their suggestions and criticisms, after which a final draft was made and sent to Dr. John M. Digman, University of Hawaii, for his comments. The questionnaire now is ready to be sent to the general membership to be filled out.

Upon return of the questionnaires, the committee will then decide upon the most suitable means for filing the accumulated information for quick reference.

Eleanor S. Anderson

INTER-SOCIETY SCIENCE EDUCATION

The Inter-Society Science Education Committee, established in May, 1958, changed its name from Committee to Council and expanded its activities during the second year of its existence.

Organization. During the past year four organizations were added to the original ten groups associated with the Academy in ISSEC. The membership now includes the following societies:

American Chemical Society, Hawaii Section
American Society of Agronomy, Hawaii Section
American Statistical Society, Hawaii Section
Anthropological Society of Hawaii
Engineering Association of Hawaii
Geophysical Society of Hawaii
Hawaii Dietetics Association
Hawaii Medical Association
Hawaii Psychological Association
Hawaii State Dental Association
Hawaiian Botanical Society
Hawaiian Entomological Society
Institute of Food Technologists, Hawaii Section
Society of Sigma Xi, Hawaii Chapter

Meetings. Monthly meetings of ISSEC were held throughout the year to review and initiate projects and to receive progress reports of committee chairmen.

Activities. The support given to ISSEC activities by members of the scientific community, teachers, students, and the community at large has been very gratifying. The following brief mention of ISSEC's projects does not do justice to the many people who gave generously of their time in helping science education.

1. Science Fair.

The Third Annual Science Fair was held at the Kaiser Dome on March 12–14. Attendance was estimated in excess of 14,000. The 118 exhibits were selected from more than 6,000 projects judged at the school level. Some 8,000 students participated in science fairs at 72 public and private schools in the state. The two finalists, Mimi Yee and George Leeper, took their exhibits to the National Science Fair held in Indianapolis, Indiana, on May 11–14,

1960. They were accompanied by Mrs. H. Ivan Rainwater, Chairman of the Exhibits Committee, and Dr. Jimmie B. Smith, Assistant Director of this year's Third Annual Science Fair and Director of the Fourth Annual Science Fair to be held early in 1961.

2. Science Library Resources.

During the 1959–60 school year, three AAAS Traveling High School Science Libraries were in circulation. One set was circulated among the smaller Catholic high schools, one on Kauai and one among rural Oahu high schools. The stimulation offered by these traveling libraries and book lists has been in part responsible for wider use of National Defense Education Act, and other funds, for the purchase of science books for school libraries.

3. Teachers' Science Seminars.

With the help of a National Science Foundation grant, this program of lectures for science teachers was expanded to include a series on each of the islands of Molokai, Lanai, and Maui and to two series on Hawaii in addition to the two Honolulu series. A very successful science teachers' workshop was held during the science fair with 50 neighbor island science teachers and 100 from Oahu in attendance.

This program will be continued during the next school year when it is hoped a lecture series will be added on Kauai and in rural Oahu. Funds are not available for a science teachers' workshop but it is hoped that satisfactory arrangements can be made to add this activity to the program for 1960–61.

4. Counseling and Scholarships.

This activity has provided speakers for several Career Day programs and is in the process of assembling a roster of scientists available for counseling.

5. Science Clubs Service.

Science Clubs Service, set up with the aid of a substantial National Science Foundation grant provides speakers, field trips and program material for science clubs in the schools. It has been at least partially responsible for a doubling of the number of active science clubs during this school year. This activity has made a notable contribution towards increasing interest in science through a weekly half-hour TV program aimed at students interested in science. It also has established a Film Service which has purchased some films and acts as a booking agent for others borrowed from mainland sources.

This activity will continue through the 1960–61 school year with the help of a National Science Foundation grant.

6. Student Science Seminars.

During the year a group of 25 highly selected Oahu students met one evening a week with guest scientists. It is hoped that this highly successful program can be expanded next year.

7. Traveling Museums in Miniature.

With the help of a National Science Foundation Grant, through ISSEC, this Bishop Museum activity has been evaluated during the past year. Further traveling exhibits will be prepared during the coming summer for use next year.

8. Teachers Coordination.

This committee, organized during the past year and made up of Oahu science teachers met monthly with the object of providing for the exchange of ideas and improved liaison between ISSEC and the science teachers.

9. Public Relations and Community Participation.

These activities, closely linked to the Science Fair but working for ISSEC as a whole, made admirable progress during the year. Funds raised locally for the support of ISSEC activities, were approximately double that of the previous year. While newspaper coverage remained satisfactory, there was a noticeable improvement in radio and TV coverage of science and science education activities.

10. Allied Activities.

While not its direct concern, ISSEC notes with pleasure the increasing interest in NSF-supported science teacher institutes of various types which are administered by the University of Hawaii. A new program, called "Hawaii Junior Science Apprenticeships," will involve 60 or more high school students interested in science working for seven weeks during the summer of 1960 with scientists at the Hawaii Agricultural Experiment Station.

In conclusion I would like to add that the willingness of members of the Academy, and other interested persons in the community, to contribute to the success of ISSEC's activities has been most gratifying. The extent to which ISSEC can achieve its objectives will depend on continued enthusiasm and support. We feel that a good beginning has been made but much more needs to be done.

ISSEC Council
John N. Warner, Chairman
Dorothy T. Rainwater, Secretary
Dwight H. Lowrey, Treasurer

ISSEC COMMITTEES

Budget
John H. Payne, Experiment Station, HSPA
Community Participation
Leslie A. Hicks, Hawaiian Electric Company
Student Science Seminars
Albert B. Carr, University of Hawaii
Legislative
Wilfred Greenwell
Elementary Science Texts
Doak C. Cox, Experiment Station, HSPA
Sister Mary St. Lawrence, 1508 Alexander Street
Science Teacher Coordination
Edwin Y. H. Chinn, Office of District Superintendent, DPI
Public Relations
Seabron Calhoun, Hawaiian Telephone Company
Science Library Resources
Robert W. Clopton, University of Hawaii
Carolyn Crawford, University of Hawaii
Science Fair
Director, George E. Sloane, Experiment Station, HSPA
Associate Director, J. B. Smith, University of Hawaii
Secretary, Setsuko Nakata, Bishop Museum
Treasurer, Dwight H. Lowrey, Cooke Trust Company

Awards, Gerald G. Dull, Pineapple Research Institute
Exhibits, Dorothy T. Rainwater
Sites and Props, Noel S. Hanson, Experiment Station, HSPA
Judging, Jules Fine, Agricultural Research Service, USDA
Hospitality, Chester Holtwick, Experiment Station, HSPA
Public Relations, Seabron Calhoun, Hawaiian Telephone Company
Teachers' Science Seminar Series
Sterling Wortman, Pineapple Research Institute
J. B. Smith, University of Hawaii
Counseling and Scholarships
Arthur H. Lange, Pineapple Research Institute
Science Clubs
Donald C. McGuire, University of Hawaii
Donald Li, University of Hawaii

Associated Societies, their presiding officers and representatives on the Inter-Society Science Education Council follow in that order.

Amer. Chem. Soc., Hawaii Sec.:
John J. Naughton, L. J. Rhodes, John H. Payne (alternate).
Amer. Soc. Agron., Hawaii Sec.:
A. S. Ayres, Bruce Cooil, E. J. Britten (alternate).
Amer. Stat. Soc., Hawaii Chap.:
Charles F. Congdon, Otto Orenstein, Richard Takasaki (alternate).
Anthro. Soc. Hawaii
Leonard Mason, Dorothy T. Rainwater, H. Ivan Rainwater (alternate).
Engineering Assoc. Hawaii
Robert Britten, Kenneth P. Chapson.
Geophys. Soc. Hawaii
Thomas S. Austin, Saul Price, Thomas S. Austin (alternate).
Hawaii Dietetics Assoc.
Nobuko Shiraki, Mabel Walker.
Hawaii Med. Assoc.
T. H. Richert, Nils P. Larsen, Clarence E. Fronk
Hawaii Psych. Assoc.
George F. Harding, A. Leonard Diamond, Edgar Vinacke (alternate).
Hawaii. Acad. Sci.
Vernon E. Brock, John N. Warner, John J. Naughton (alternate).
Hawaii. Bot. Soc.
E. J. Britten, Gerald G. Dull, John N. Warner (alternate).
Hawaii. Ent. Soc.
C. R. Joyce, Minoru Tamashiro.
Hawaii State Dental Assoc.
F. A. Sandberg, Manuel Kau, Ralph Akamine (alternate).
Soc. Sigma Xi, Hawaii Chap.
Donald C. Matthews, Donald C. Matthews

Associate Members

A. J. Mangelsdorf, Experiment Station, HSPA
Teruo Masatsugu, Department of Public Instruction
J 1 Division CINCPAC, Box 17, Fleet Post Office, San Francisco, California

PROGRAM

The thirty-fifth annual meeting of the Academy was held in two sessions, the first on November 11–12, 1959, and the second on May 26–28, 1960. A symposium on "Changing Trends in Public Health" by members of the State Board of Health, and eight professional papers, were presented at the first session. Eleven professional papers, and two outstanding scientific papers written by high school students, were presented in the spring session. At the Annual Banquet, which was held at the Queen's Surf, the retiring president gave his address.

A Special Symposium, Hawaii and the Geophysical Year in Retrospect, with six speakers, was held on February 24, 1960. Two joint meetings with the Hawaii Geophysical Society were also held in 1960, one on January 28 to hear Parker D. Trask of the University of California at Berkeley talk on "Peacetime Uses of Underground Nuclear Explosions" and one on May 12 to hear Francis P. Shepard of the Scripps Institute of Oceanography speak on Submarine Canyons.

Donald P. Gowing, Chairman

Gerald G. Dull	John J. Digman
Paul C. Ekern	Donald H. Smith

NOMINATIONS

The Nominating Committee makes the following report for the 35th Academy year, 1959–60. As a consequence of the resignation of Dr. Fred I. Gilbert, the President-elect, it was necessary to nominate candidates for the office of President as well as that of President-elect. The following nominations were made: President, Dr. H. Wayne Hilton and Dr. John N. Warner; President-elect, Dr. Jimmie B. Smith and Dr. Alexander Spoehr; Secretary, Dr. Donald P. Gowing; Treasurer, Mrs. Eleanor S. Anderson; Councilors, Mr. William M. Bush and Mr. Thomas K. Hitch.

The Committee recommended the inclusion of title and place of employment in notices of nominations to members for identification purposes.

Doak C. Cox, Chairman

Harry L. Arnold, Jr.	Andrew W. Lind
Willis A. Gortner	A. J. Mangelsdorf

OFFICERS

1959–1960

Vernon E. Brock	President
Fred I. Gilbert	President-Elect
Sterling Wortman	Secretary (6 months)
Ruth C. Kirby	Secretary, pro tem.
Eleanor S. Anderson	Treasurer
Gordon A. Macdonald	Councilor (2 years)
Kenichi Watanabe	Councilor (1 year)
Doak C. Cox	Councilor (ex officio)

1960–1961

John N. Warner	President
Alexander Spoehr	President-Elect
Donald P. Gowing	Secretary
Eleanor S. Anderson	Treasurer
William M. Bush	Councilor (2 years)
Gordon A. Macdonald	Councilor (1 year)
Vernon E. Brock	Councilor (ex officio)

HAWAII DIVISION

Election of officers, conducted by past Chairman, John A. Easley, Jr., was held in July, 1959. Elected were:

Wayne U. Ault, Chairman
Violet Hansen, Secretary-Treasurer
Chester K. Wentworth, Council Representative

Committees appointed were:

Program Committee, Wayne U. Ault, Chairman

William Bonk	Kaoru Noda
Harry C. Chuck	Jack C. Pales
John A. Easley, Jr.	Ronald L. Walker
James A. Mitchel	William Waters

Membership Committee, Violet Hansen, Chairman

Ray Bushnewsky	Mark M. Sutherland
M. L. Chang	Shiuchi Tanaka
William Dunmire	Maurice Tatsuoka
Richard Penhallow	

The Membership Committee was active in bringing the membership list up-to-date, deleting names of members who had moved away and in conducting a membership drive which increased the membership from 57 to 77.

The Hawaii Division in cooperation with the Community Program for Arts and Sciences again sponsored a Hawaii County Science Fair with over a hundred exhibits. The County Fair was well attended by people from all over the island. It was preceded by seven high school and ten intermediate school fairs. From the County Fair the best ten high and eight intermediate exhibits were selected to compete at the State Science Fair. In addition, elementary schools submitted laudable noncompetitive exhibits. Advisers were made available to the schools and a judging panel was provided for each school fair.

Hawaii County Science Fair Committee

Aheong L. Chuck, Chairman
Ronald L. Walker, Vice-Chairman
Juliette Wentworth, Judging and Advisers
Susan Case, Publicity
William Bonk, Finance
Shiuchi Tanaka, Buildings and Facilities
Alexander Aki, Registration, Secondary Division
Nora Nabeta, Registration, Elementary Division
Mrs. Mclarty, School Visitation Schedules
Mary Lou Bean, Hostesses

The Hawaii Division conducted a series of nine monthly lectures both in Hilo and in Kona which, with the cooperation of the DPI and the NSF, also doubled as Science Seminars for the teachers of the Big Island.

Expenditures for 1959–60 were $42.29 for postage and office supplies. The budget for 1960–61 is $50.00.

New Officers elected in April will take office on June 1.

Chester K. Wentworth, Chairman
Violet Hansen, Secretary-Treasurer
Henri Minette, Council Representative
Kaoru Noda, Representative, East Hawaii
William Waters, Representative, West Hawaii

In the wake of the May 23, 1960, tidal wave disaster in Hilo when 57 people lost their lives and many more narrowly escaped, the Hawaii Division has begun a questionaire survey of tidal wave victims. Principal participants are from the University of Hawaii, Hilo Campus, from the Hawaiian Volcano Observatory with the Academy of Science membership, teachers from the DPI, and friends in Hilo volunteering to help in the survey. The factual survey is for the purpose of ascertaining how the people of Hilo responded or did not respond and why.

Wayne U. Ault
Chairman, Hawaii Division
Hawaiian Academy of Science

THE 35th ANNUAL MEETING 1959-60

Program

FIRST SESSION

November 11, 1959, Experiment Station, HSPA, Honolulu

A Symposium

Changing Trends in Public Health

1. Richard K. C. Lee: Introduction—Trends in Public Health
2. B. J. McMorrow: Environmental Sanitation
3. Robert Nekomoto: Air Pollution Control
4. Sadamoto Iwashita: Radiological Health
5. Walter B. Quisenberry and Gordon D. Wallace: New Concepts in Preventive Medicine, Comparative Medicine, and the Zoonoses
6. George F. Harding: Mental Health in Hawaii Today

November 12, 1959, Experiment Station, HSPA, Honolulu

7. Leabert R. Fernandez: Double Eyelid Operation in the Oriental in Hawaii
8. Joseph E. Alicata: Importance and Treatment of *Cooperia* Infection of Calves in Hawaii
9. Studies on the Effect of Ionizing Radiation Upon Developing Sea Urchins. Sidney C. Hsiao and Walter K. Fujii: Action of Beta Radiation on *Tripneustes gratilla* Eggs
   Sidney C. Hsiao and Patricia C. Daniel: Action of X-Irradiation on the Development and Ionic Uptake of *T. gratilla* Eggs
10. Paul G. Comba: A Heuristic Computer Program for 3-Dimensional 4 × 4 × 4 Tic-Tac-Toe
11. John M. Digman and Daniel W. Tuttle: Statistical Analysis of Oahu's 1956 General Election: Patterns Emerging from Sample Ballots
12. Bessel D. van't Woudt: Erosion Studies on Strip-mined Soils in Hawaii
13. J. C. Moomaw and M. Takahashi: Natural Vegetation on Hawaiian Gibbsitic Soils

SPECIAL SESSION I

Sponsored jointly with the Geophysical Society of Hawaii

January 28, 1960, Experiment Station, HSPA, Honolulu

Parker D. Trask: Peacetime Uses of Underground Nuclear Explosions

SPECIAL SESSION II

February 24, 1960, Experiment Station, HSPA, Honolulu

A Symposium

The International Geophysical Year in Retrospect

1. Paul C. Ekern: The General Scope of the IGY Program
2. Gordon A. Macdonald: The Sub-Pacific Crust
3. James W. McGary: IGY Oceanographic Program and the Development Concerning the Pacific Equatorial Undercurrent
4. Saul Price: The Meteorological Program and the Results from Mauna Loa Observatory
5. Elmer J. Harger: The Solar Flare Patrol and Cosmic Ray Monitoring
6. Walter Lang, Jr.: The Satellite Tracking Station, Haleakala

SPECIAL SESSION III

Sponsored jointly with the Geophysical Society of Hawaii

May 12, 1960, Experiment Station, HSPA, Honolulu

Francis P. Shepard: Submarine Canyons

FINAL SESSION

May 26, 1960, Experiment Station, HSPA, Honolulu

1. Steve Walther: Seeing with Sound
2. Susan N. Kotomori: Determination of Orchid Seed Maturity by Embryo Culture
3. John C. Marr: Causes of Major Variations in the Catch of the Pacific Sardine, *Sardinops caerulea* (Girard)
4. Eugene L. Nakamura: Confinement of Skipjack in a Pond
5. H. Y. Young: Instrumental Methods for the Analysis of Food Additives
6. Donald P. Gowing: Pesticide Residues in Foods

May 27, 1960, Experiment Station, HSPA, Honolulu

7. John M. Digman and JoAnn Zaynor: The Structure of Social Attitude in Hawaii
8. Roy Lachman: Automated Research of Animal Discrimination Learning
9. Donald H. Richter and Kiguma J. Murata: Xenolithic Nodules in the 1800–1801 Kaupulehu Flow of Hualalai Volcano and their Petrologic Implication
10. John J. Naughton and Emerson F. Heald: Collection and Analysis of Volcanic Gases by Means of Gas Chromatography
11. Sister Julie Patrice: A Scoring Technique—Its Application to the Epicanthic Fold
12. Charles R. Joyce: Quarantine Interceptions of Insects and Arthropods of Public Health Importance on Aircraft and Potential Dangers to Hawaii
13. Arthur A. Dole: Concern with Achievement as Measured by a Sentence Completion Blank

HAWAII DIVISION

MONTHLY SCIENCE SEMINARS

1. Irwin Lane: Ornamental Trees and Shrubs of Hawaii, October 8, 1959
2. L. W. Bryan: History of Hawaiian Forestry, October 8, 1959

3. Ronald L. Walker: Wildlife Management Research in Hawaii, November 12, 1959
4. Jack C. Pales: The Ozone Layer and Its Importance to Life, November 12, 1959
5. Earl J. Anderson: Microbiology: A Big World of Little Things, December 10, 1959
6. A. J. Bernatowicz: Plants and the Sea, January 14, 1960
7. George Burr: Peaceful Uses of Atomic Energy, February 11, 1960
8. Saul Price: Weather Prediction, Past, Present, and Future, March 11, 1960
9. George H. Mills: Recent Progress in Diagnosis and Treatment of Heart Disease, April 21, 1960
10. Alexander Spoehr: Recent Progress in the Knowledge of Man in the Pacific, May 13, 1960

Abstracts

FIRST SESSION

CHANGING TRENDS IN PUBLIC HEALTH
A Symposium

1. INTRODUCTION—TRENDS IN PUBLIC HEALTH

Public health is the science and art of preventing disease, prolonging life, promoting physical health and efficiency through organized community efforts. The World Health Organization defines human health as "A state of complete physical, mental and social well being, and not merely the absence of disease and infirmity."

Public health has many facets. It is made up of many specialties such as medicine, nursing, education, law, bacteriology, sanitary science, statistics, sociology, mental health, entomology, virology, veterinary medicine, and research. Many professions have to be integrated and coordinated to produce the team that is so necessary to carry out the objectives of public health. These objectives apply to every person in a community and not to any one group of the population.

Public health is also a product of community action. The public health team must develop the organization and the program to provide maximum health services for the people of a community. Citizen participation and understanding are necessary for the success of any public health program. Public health moves no faster than public opinion.

Levels of health in communities are measured by morbidity and mortality statistics. Other measures are the level of nutritional status of children and adults, the number of correctable defects that have been found in examination of school children, and the amount of tooth decay that has been found and corrected. Another measure is the added life span of our population which has increased 20 to 25 years since 1900.

Factors affecting public health trends in a community include population increase, changes in the age distribution of the population, migration, scientific developments, the availability of medical services and of professional personnel and physical facilities to meet the public health needs and demands of the public for certain services.

In 1919 the population of Hawaii was 263,666 with 50 per cent on Oahu. Today the population is 597,910 with 78 per cent on Oahu. The urbanization of Oahu has affected public health problems and trends. There are problems of housing, sewage disposal, garbage disposal, the provision of adequate water supplies and the control of the pollution of streams, beaches, harbors, and of the air. Other problems include juvenile delinquency, mental health, and increasing numbers of accidents causing disability and death. Important reasons for the increasing population in Hawaii include the high birth rate, a definite excess of births over deaths, the improved care of pregnant mothers, and reduction in infant mortality due in part to the large number of babies delivered in hospitals.

As people live longer, they succumb to the degenerative diseases of man. Heart disease, cancer, and cerebral hemorrhage are now leading causes of death. Deaths from tuberculosis, pneumonia, influenza, diarrhea, and enteritis have dropped markedly.

The migration of people from the Philippines and Samoa affected the rate of decline of Hansen's Disease and tuberculosis in Hawaii. The migration of elderly persons from the mainland is expected to affect the public health program which will have to be adjusted to meet the needs of that age group.

Scientific developments that affect health trends are represented by the sulfa drugs and antibiotics which have favorably affected the incidence and mortality rates of diseases in Hawaii. Polio vaccine has reduced the incidence of poliomyelitis in Hawaii.

Changing conditions have brought problems in morbidity control. A public health program for mental illness and mental retardation can be approached in the same manner as we attacked tuberculosis, through community mental health clinics, through the utilization of private resources, physicians and general hospitals, and through the caretakers of health and social services in the community. We can do more for mental illness than we are doing now and have done in the past. Tuberculosis is still the leading killer in the communicable diseases. We have not yet conquered this disease; it will be a long time before we can do so and we must keep up the attack. Hansen's Disease is declining. We have to maintain the program until the disease is eventually eradicated.

Accidents also constitute a major problem today: accidents on the road, in the homes, and at work. Poison control activities in conjunction with Children's Hospital is an approach. A research program to test individuals involved in auto accidents to get information on the human factor is another approach. Alcoholism, crippling conditions, heart disease, cancer, diabetes, arthritis, and epilepsy are other problems that exist in the community. The program for the mentally retarded can be organized in a more integrated and coordinated manner than is done at the present time.

Dental decay is our number one public health problem today in Hawaii. The tooth decay rate is twice that of most mainland communities, according to studies being done by the school department and the health department. Fluoridation of public water supplies is still the most important public health measure to reduce tooth decay in Hawaii. We need more community support and a more organized and active program. The military services have been providing fluoridated water for children in their communities for a number of years. No civilian area has adopted fluoridation; yet fluoridation is carried on in most of the states of the union today. Many countries in the world are carrying on fluoridation of community water supplies. We are quite behind.

Public health must be constantly attended to. Although we have conquered many of the communicable diseases, we are still susceptible to outbreaks of diseases such as smallpox. We lose immunity to smallpox and I am quite sure an outbreak in Hawaii could occur under certain conditions and would affect particularly the adult population. Outbreaks of diphtheria and typhoid can occur, and vigilance and constant attention to epidemiological control measures are necessary. Outbreaks of food-borne diseases will continue to occur with increasing tourism in Hawaii. And as larger numbers of people eat in restaurants and public facilities, we must be constantly on guard in restaurant sanitation.

Public health must be a dynamic program in every community. It must be constantly aware of the advances in science and changes in techniques in the administration of health programs. It must keep its professional workers constantly trained and up to date on what is happening in the health field throughout the nation and the world. Achievements attained by other communities in attacking certain health problems are utilized and applied here. Our successes are being copied elsewhere in other communities. Any progress that we make in public health will help other communities and ourselves. Advances in the medical sciences due to research and investigations conducted by professional workers on the mainland help us, too. We can use the experience of others to help ourselves advance our program for our people.

RICHARD K. C. LEE
President, Board of Health
Honolulu, Hawaii

2. ENVIRONMENTAL SANITATION

Environmental sanitation in public health means a program designed to protect and promote the health of the public through the control of environmental factors that influence health. These include such things as air, water, food, housing, wastes, radiation, and the vectors of disease.

The control of the environment is one of the oldest of the several programs that make up public health. Its age reflects the concern that people have felt since earliest times about their environment and its effect on their well being.

The environment is not static or inanimate. It is a living entity and reacts to the impacts of the constant changes that are the essence of life. These changes may be due to physical, economic, social, or philosophical forces. As a consequence, permanent solutions to environmental sanitation control problems are never found. It is necessary to adjust control methods and program emphasis repeatedly to provide solutions to the constantly changing problems.

Another factor that affects trends in the environmental sanitation phase of public health is the increasing demand on the part of the members of the public for relief from undesirable environmental conditions which they are unable to secure for themselves on an individual basis. These conditions may only have indirect health implications and may not involve the transmission of disease but they do interfere with the full enjoyment of life which comes within the broad definition of public health.

The health agency recognizes these influences and adjusts its program accordingly. For example, the physical quality of the water produced by small rural water systems using surface run-off as a source of supply is no longer acceptable to consumers. The water is colored and turbid, especially after rainy periods. The sanitary quality of the water sources is protected by restricting human access to the watersheds and these systems have not been implicated in outbreaks of water-borne disease. However, the mobility of our people is increasing and they wish to use the mountain and forest areas in which the sources are located for recreational and economic purposes. It is therefore necessary to find economical treatment methods for the water produced by these systems to improve its physical quality and increase its factor of sanitary safety.

Another changing trend concerns the disposal of refuse. Open dump burning is no longer tolerated by the public, particularly on Oahu, because of its contribution to air pollution. To find an economical and sanitary replacement for the open dumps is a major problem faced by the local government on Oahu today.

Another illustration of the problems in environmental sanitation created by our dynamic society concerns the control of the quality of the community's milk supply. The sanitary control of the supply to prevent the spread of infection through milk is a program of long standing which is changed from time to time to adjust both to changes in milk production techniques and to advances in sanitary science. In recent years however antibiotic drugs are being increasingly used to treat dairy cattle for disease control purposes, particularly mastitis. The antibiotic substance may appear in the milk supply unless the treated animal is kept out of the commercial milking herd for a certain period of time after treatment. A successful control program for this purpose is being carried on with the full support and cooperation of the milk industry.

Mosquito control is another good example of a program that reflects current changing trends in environmental sanitation. Basically, a double requirement exists for adequate mosquito control: (1) to protect the public from mosquito-borne diseases, and (2) to protect the public from severe mosquito pestiferousness. The former need is readily justifiable on the basis of the vector-potential of all three of the mosquito species in Hawaii, *Aedes aegypti, Aedes albopictus* and *Culex quinquefasciatus*. All three are capable of transmitting more than one of such mosquito-borne diseases as dengue, yellow fever, filariasis, and encephalitis. The greatest public demand however for mosquito control measures is to secure relief from the pestiferous effect of mosquitoes and the program of the health agency must reflect this demand.

Rodent control is still another program in environmental sanitation which reflects the effect of changing concepts in public health philosophy. Plague has been endemic in the Hamakua District, island of Hawaii, since 1910. A total of 112 human infections and 1,161 infections in rodents and rodent fleas has been reported to date. The protection of the human population is effected by a control program designed to reduce their contact with rodents and their fleas as completely as possible. Immunization of the residents of the District is also practiced.

However, increased emphasis is now being placed by plague experts throughout the world on the determination of the basic factors that relate to the mammals, the insects, and the environment involved in the complex epidemiology of this disease. It is believed that when a knowledge of these basic factors is obtained, a sounder approach to plague control or eradication will be available. Accordingly a five-year research program on the ecology of this disease in Hawaii has been initiated by the health agency in recognition of this changing trend in public health.

B. J. MCMORROW
State Department of Health
Honolulu, Hawaii

3. AIR POLLUTION CONTROL

Air pollution is a by-product of civilization. In an area of increasing industry and growing population, it is natural to expect increases in air pollution. Today, the breathing of filthy air is a problem to all who live in urbanized communities of the world. This problem is of particular concern because the air about us is limited in its capacity to absorb and transport air contaminants. These two properties of the atmosphere vary in different communities, but man has no control of the atmosphere's ability to receive and transport these wastes. However, man can control the amount of pollutants he discharges into the atmosphere.

Polluting of the air is not a new activity of man. With the development of a mechanized civilization, the problems of air pollution have increased to such a point that today many manifestations of air pollution are very much in evidence. Of concern to the public health agencies is the effect of air pollution on health.

Air pollution episodes of acute exposures have caused death in certain instances, but for chronic exposures lung cancer is the disease most often linked with air pollution. Lung cancer rates are much higher among city dwellers as compared to those living in nonurban areas. Analyses of city air show the presence of carcinogens and the injection of particles found in city air into certain laboratory animals produces cancer.

Other manifestations of air pollution are irritation of the eyes and respiratory tract, damage to plants and property, creation of haze, soiling of clothes, and general nuisances to man.

The air pollution levels for the city of Honolulu are typical of many other cities in the nation. At times they approach the levels found in the air of California cities for days with severe air pollution. Maximum levels of pollutants found in Honolulu air are 22.3 ppm of carbon monoxide, 0.24 ppm of formaldehyde, 1.26 ppm of gasoline (total hydrocarbon), 0.11 ppm of nitrogen dioxide, 0.14 ppm of ozone and 0.27 ppm of sulphur dioxide.

The total emission of air pollutants in Honolulu is approximated at 301 tons per day. The true value is much higher because this estimate does not include emissions by the military services and certain civilian operations for which computation methods have not been developed. An inventory of the emissions from various sources in 1956 includes in tons per day: incineration, 3.45; open burning, 14.99; fuel oil burning, 128.38; oil and water gas burning, 2.43; handling of gasoline, 11.57; automobile exhaust, 102.03; diesel oil, 38.42; chemical and allied industries, 0.24; lumber, 0.21. Another method of grouping the sources reveals that 5 per cent of the emissions are from domestic sources, 50 from transportation sources and 45 per cent from industrial sources.

Another measure of the pollution burden carried by Honolulu's air is provided by the air sampling stations operated by the State Department of Health as a member of the National Air Sampling Network of the Federal Public Health Service. These stations reveal that the amount of suspended particulate matter in the air, expressed as micrograms per cubic meter of air, is gradually increasing. The average value was 38 in 1956, 45 in 1957, and 55 in 1958.

The present program of the Department of Health is designed to control the emission of dense smoke and particulate matter. In view of the increasing discharge of invisible pollutants and the increasing occurrence of air pollution manifestations, the need to extend the program to control invisible discharges is indicated.

ROBERT S. NEKOMOTO
State Department of Health
Honolulu, Hawaii

4. RADIOLOGICAL HEALTH

This paper reviews the radiological health problems in Hawaii and discusses the measures the State Department of Health is taking to meet these problems.

All persons are exposed to radiation from natural sources such as cosmic rays, radium in the rocks, etc.

This is called natural background and averages about 0.05 rem per year to a person.

Medical and dental X rays contribute an average of another 0.1 rem of radiation per year. In Hawaii, there are about 500 such units; it is estimated that by 1970 there will be at least 1,000 units in Hawaii.

Radionuclides are gaining increasing usage in research, industry, and medicine. The Atomic Energy Commission has already distributed about 600,000 curies and wastes are estimated to be at least 50,000 curies. In Hawaii there are already two industrial firms utilizing radioisotopes and 12 mainland units licensed to use such materials. This is in addition to medical and research laboratories utilizing these substances.

There are approximately 150 reactors in the U.S. in existence or under construction. In 1958 there was one civilian power reactor; in 1965 it is estimated that there will be at least 25 in operation, one probably in Hawaii.

Another source is fallout from nuclear bombs detonated in various parts of the world. At least 250 such bombs have already been detonated. Scientists tell us that we will be exposed to fallout for many more years. The average rate of exposure from this source is approximately 0.01 rem per year.

During the past several years the maximum permissible limits for radiation exposure has undergone changes to conform to the data obtained by research workers. In 1930 this dose was 50 rems per year; in 1940 it was reduced to 25 rems per year; in 1950 to 15 rems a year and this year, in June, it was set at 5 rems per year. This indicates the growing awareness of the dangers from this source.

The President of the Board of Health has appointed an Advisory Committee on Radiological Health to advise and assist Department of Health personnel in problems dealing with radiological health. This committee, made up of radiophysicists, radiologists, radiochemists, engineers, physicists, businessmen and others concerned, is presently assisting the staff of the Department of Health in drafting a set of regulations to control the use, storage, and disposal of radioactive substances in Hawaii.

The department staff has conducted surveys of X-ray installations in hospitals, clinics, dispensaries, and physicians' offices. These studies included radiological examinations of area, personnel, and equipment with recommendations and consultation in making corrective measures.

During the past year, a survey of all dental X-ray installations in Hawaii was made using film badges. More than 500 film badges were distributed, worn, and evaluated.

The Health Department conducts, in cooperation with the Atomic Energy Commission and federal Public Health Service, a daily, 24 hour sampling of the air in Honolulu for fallout contamination.

All the sources of water supplies in the State have been sampled and radiological examinations made to determine the extent of radiological contamination. No excessive amounts of radioactive materials have been noted to date.

The department is cooperating with the AEC in collecting and preparing samples of milk for the determination of strontium 90 content.

Radiological examinations of water sources, fallout sampling as part of the National Radiation Surveillance Network, survey of X-ray and radioisotope installations and other studies will be continued, as part of the department's radiological health program. In addition, it is planned to conduct examinations to determine the presence and amounts of such radioisotopes as Sr 90, I 131 and C 14 in water, food, milk, and soil; to adopt the radiation regulations and enforce their provisions; and in preparation for the eventual installation of a nuclear reactor in Hawaii, to make studies to obtain background information as to the radiological content of the air, water, soil, and sea water in the locality of the proposed reactor site.

It is also planned to train the staff of the department to adequately meet the requirements of the AEC, which was given the authority by Congress to pass on the responsibility for the inspection and licensing of radioisotope users to the states.

SADAMOTO IWASHITA
State Department of Health
Honolulu, Hawaii

5. NEW CONCEPTS IN PREVENTIVE MEDICINE, COMPARATIVE MEDICINE, AND THE ZOONOSES

The field of comparative medicine is new to many people. It simply deals with the matter of studying the etiology, epidemiology, or the pathology of naturally occurring diseases common to man and animals with the objective of preventing the diseases in both animals and human beings. Those diseases which may be transmitted from animals to man or vice versa are known as the zoonoses. Over 25 per cent of all diseases reported to the National Office of Vital Statistics of the Federal Government are those which may be transmitted from animals to man.

Naalehu Disease

It is well known that heart disease among humans causes more deaths than any other disease in the United States today. It has increased very greatly as a cause of death in the last 25 years.

The type of heart disease that has increased more than any other is the arteriosclerotic type, especially as it involves the coronary arteries. The area which seems to be receiving most attention is diet.

A chronic disease affecting the circulatory system of range cattle has been recognized for more than 60 years in certain areas on the Island of Hawaii. It has been given the place name of "Naalehu disease" and is not known to occur elsewhere in the United States. This condition has been under periodic observation by the Board of Agriculture and Forestry veterinarians for nearly 20 years.

Post-mortem lesions are basically arteriosclerosis accompanied by mineral deposits in the lungs and calcification of certain areas of the heart. Symptoms resembling those of coronary occlusion in man have been reported. An excess of calcium and a deficiency of phosphorus in the natural diet of cattle have been shown to be contributing factors.

The possible relationship between Naalehu disease and atherosclerosis and arteriosclerosis of man has been recognized by the medical profession. A study of the etiology and natural history of this disease is being undertaken by interested persons in the medical and veterinary professions. This study is being financially supported by the National Heart Institute of the Public Health Service and will be conducted through the Board of Agriculture and Forestry, Division of Animal Industry.

Staphylococcal Disease

It is an established fact that antibiotic-resistant staphylococcal infections are on the increase in the United States. A survey of Honolulu hospitals shows that from 25 to 63 per cent of all staphylococci of known types sent to the Department of Health laboratory belong to the antibiotic-resistant phage type 80/81.

Staphylococcal infections, especially hospital-acquired infections, are considered a serious public health problem of national significance, and health agencies at all levels are greatly interested in their control. We are carrying on some projects here in Hawaii with some of the hospitals. However, we also have a special project which involves animals.

Staphylococci of bacteriophage type 80/81 were found in the milk of dairy cattle during a survey recently conducted by the departments of Health and Agriculture and Forestry. To our knowledge, human epidemic type 80/81 staphylococci had not previously been found in cattle.

Investigations revealed that a dairy employee and his family had been suffering from infections caused by the type 80/81 staphylococci. The relationship of human and animal infections and the public health and economic importance of this organism in dairy cattle are being studied.

Leptospirosis

Since the early 1940's, leptospirosis in animals and man has received very little attention in Hawaii. Studies conducted on the mainland United States have shown that the epidemiology of leptospirosis has changed considerably over the past few years. Rodents were usually incriminated as the source of human infection, and one serotype, *Leptospira icterohemorrhagiae,* predominated. Today, cattle, pigs, and dogs account for the majority of human infections on the mainland, and more than 12 leptospira serotypes have been identified in animals and man. Bovine leptospirosis is estimated to cause a 113-million-dollar annual loss to the cattle industry.

A cooperative investigation is currently being conducted by the Department of Health and the Department of Agriculture and Forestry in an effort to determine serotypes present in Hawaii, prevalence of disease in animals and man, and important animal reservoirs.

Atypical Acid-Fast Organisms

There has been a notable reduction in the number of cases of tuberculosis in Hawaii as well as throughout the United States in recent years. As we have reduced the incidence of this disease, atypical acid-fast organisms have been observed which are refractory to treatment. It has been difficult to diagnose and identify these. One example is the "battey" type of mycobacterium. In Hawaii we do not know how prevalent these organisms are. We have at least three cases in which bacilli similar to the "battey" type have been identified. Battey organisms are bacteriologically similar to those found in avian tuberculosis.

Through the use of the skin test, the incidence of bovine tuberculosis in Hawaii has been reduced from 32 per cent in animals tested in 1932 to less than 1 per cent in 1959. The skin test remains the only practical method of detecting tuberculosis in a herd of cattle, but sometimes apparently healthy animals will react to this test and will not show visible lesions or evidence of disease at slaughter. It is understandable that cattle raisers confronted with this situation may oppose the skin testing and slaughter control program. A better diagnostic tool is definitely needed.

As previously indicated, a tuberculosis-like disease in humans has been associated with organisms very similar to the avian tuberculosis bacillus. The epidemiology of these and other human infections caused by the so-called atypical acid-fast organisms is very poorly understood.

These problems are receiving attention in Hawaii. Several groups of investigators are pooling their resources in various phases of these studies. These groups include: Leahi Hospital, the Board of Agriculture and Forestry, the Health Department, the University of Hawaii, the Olive View Sanatorium in Los Angeles, and the University of Iowa School of Medicine.

Arthropod-Borne Virus Encephalitis

Encephalitis in human beings is a very serious disease. Even though the person recovers, he may be left crippled either mentally or physically. Hawaii is considered to be in a hazardous position in regard to the introduction of arthropod-borne encephalitis. Rapid air travel and increasing numbers of airplanes and passengers arriving have multiplied the danger of hosts or vectors of disease being brought in. An isolated outbreak of Japanese B encephalitis on Guam in 1948 showed that transoceanic transportation of the disease can occur.

Arthropod-borne animal viruses are able to infect certain vertebrates—mammals and birds—and to multiply in the body of arthropods—mosquitoes, ticks, etc. It has been stated that "except under unusual circumstances, these viruses are not capable of spreading from vertebrate to vertebrate without the agency of an arthropod."

Human infection generally is only incidental to the perpetuation of arthropod-borne encephalitis infection. The most important epidemiologic procedure is to identify the biological circumstances on which the parasite depends for survival. The pattern of disease in human populations thus takes a position of secondary epidemiologic importance. The viruses may be recovered from arthropods before any accompanying infections or disease can be identified in vertebrate hosts.

Health agencies in Hawaii are continuously guarding against the introduction of arthropod-borne encephalitis viruses, but we are not certain that Hawaii is free of these agents.

Since 1954, 15 cases of viral or infectious encephalitis in humans have been reported, but until this year when the Health Department established a virus diagnostic laboratory, most of them have not received laboratory confirmation. It is possible that small foci of infection exist in nature in avian or mammalian hosts and only an occasional human case occurs. Like other agents that have adapted themselves to their hosts, the arthropod-borne encephalitis viruses usually do not cause symptomatic disease in birds.

Health Department personnel are currently conducting a serological survey of humans and wild birds to determine if arthropod-borne viruses are active in Hawaii. Mosquitoes are also being collected and tested for the presence of virus. These studies should provide the basic knowledge necessary for prevention and control measures.

WALTER B. QUISENBERRY
GORDON D. WALLACE
State Department of Health
Honolulu, Hawaii

6. MENTAL HEALTH IN HAWAII TODAY

Developments in the field of mental health have only recently begun to take on the status of scientific study equivalent to most other public health functions of the departments of public health. We are a new science not yet fully integrated into the "older" and established picture of preventive public health systems. Mental health is an important challenge to social and physical scientists and is expanding at a much more rapid rate than the training of professional mental health workers or the development of scientific knowledge upon which to base our policies and procedures. The identification of the mental health movement with public health has provided an orientation toward preventive rather than after-the-fact treatment, both of which are important and necessary services, each being dependent upon the other. Some of the more recent philosophical changes have been from the intense expenditure of time and energy for the treatment of seriously ill persons to the treatment of family units, agencies, and communities. To educate family or agency to utilize positive rather than negative mental health principles is admittedly a slow process. The fruits of these efforts may take generations to mature. It is nonetheless our basic and perhaps only hope for the future.

Some of the techniques we are now utilizing, which were ignored in the past, are those of providing consultation in which a professional mental health worker attempts to assist a teacher, physician, minister, or other professional worker to better relate himself to his clients with emotional problems. Another is the introduction of a mental health worker into a social system for the purpose of improving communication and allowing the multiple and unique personalities within any grouping to function with greater tranquility and effectiveness. The device of providing workshop series is being utilized; that is, the mental health worker emphasizes a series of interrelated discussions rather than a one-shot "sermon" approach to informing the public about this complex field. Research activities of an epidemiological type rather than of an intra-personality analysis type are becoming increasingly common. These will ultimately demonstrate to us some of the cultural—etiological forces which intensify and predetermine the development of pathological behavior symptoms.

We have come to recognize in the treatment situation that, in addition to intra-personality strife, interpersonality factors must be dealt with. It is often best to bring together the members of a family and help them to communicate, both on the intellectual and emotional level rather than intensely treat one individual.

There are many suggestions that the pendulum has swung away from pure functionalism as a basis for understanding the behavior of people and has now reached a point where necessary recognition is given to physiological and neurological factors relating to the adaptive capacity of a human being. Some studies now indicate that certain delinquent patterns amongst young adults are related to faulty neural maturation and that these conditions are subject to control by the use of psychic stimulant drugs.

The conquering of mental ill health and the development of positive mental health in our communities so as to enable individuals to be reasonably adaptive, creative, and happy have just begun. There is much we do not know about the causes, nature, and communicability of mental-emotional problems. The first positive step to be taken in a number of years has been the integration of public health concepts and principles into the mental health field. Success in this venture will require the efforts of all people, especially those involved in education, research, and government.

GEORGE F. HARDING
State Department of Public Health
Honolulu, Hawaii

7. DOUBLE EYELID OPERATION IN THE ORIENTAL IN HAWAII

There is a growing tendency in Orientals to have folds in the upper eyelids. Fifty per cent of Orientals in Hawaii normally have these folds. Increasing numbers of the other 50 per cent (called "single eye") desire the double eyelid operation. The report dealt with the technique of operation, including before and after slides, and with the psychological and physical benefits to the patients.

LEABERT R. FERNANDEZ
Honolulu, Hawaii

8. IMPORTANCE AND TREATMENT OF *Cooperia* INFECTION OF CALVES IN HAWAII

Studies have been conducted recently to determine to what extent internal parasites may account for the unthrifty condition seen among some of the locally raised calves. In this study 15 newly born calves were reserved from each of two beef ranches and two dairies. These animals were raised under normal conditions and were slaughtered in groups of five at the ages of 4, 8, and 12 months. At necropsy the following internal parasites were found: *Haemonchus placei, Ostertagia ostertagi, Trichostrongylus axei, Bunostomum phlebotomum, Cooperia punctata, Cooperia spatulata, Moniezia benedeni, Oesophagostomum radiatum, Strongyloides papillosus, Trichuris* sp., *Dictyocaulus viviparus,* and *Fasciola gigantica.* Of the above parasites, *Cooperia punctata* was the most abundant and was present in 95.0 per cent of the 60 calves examined. Of the various age groups examined, *C. punctata* was most prevalent among beef calves at 8 months of age. This may be explained by the fact that beef calves stay with their dams and do not graze extensively during their first few months of life. As they grow older and graze more, they are likely to ingest more parasite larvae found on the grass. With exposure to heavy infection the calves acquire an immunity and show less parasites as they grow older. Young dairy calves, on the other hand, which are frequently raised in infected paddocks are likely to become infected early in life. In this study, heavy infections with *C. punctata* were found among calves at 4 and 8 months of age. Cooperid worms are considered harmful to calves and are known to produce scouring and debilitation. Because of their abundance among some of the local calves they are believed to contribute to the unthriftiness frequently noted among these calves.

Various drugs including phenothiazine, toluene, piperazine citrate, piperazine dihydrochloride, and three organic phosphate compounds available commercially under the trade name of "Trolene," "Bayer L 13/59," and "Ruelene" have been critically tested against *Cooperia punctata* infection in calves. Of these the piperazines and "Ruelene" were very effective against the parasite and were best tolerated by the calves.

JOSEPH E. ALICATA
University of Hawaii
Honolulu, Hawaii

9. STUDIES ON THE EFFECT OF IONIZING RADIATION UPON DEVELOPING SEA URCHINS

Action of Beta Radiation on *Tripneustes gratilla* Eggs

The aim of this study is to make a quantitative examination of the effect on the development of *T. gratilla* eggs subjected to continuous beta radiation from calcium-45 which has a moderate radiation energy of 0.254 Mev. By culturing newly hatched eggs in 5μc Ca-45 per ml. of medium, all the organisms were killed in 2 hours. At lower dosage levels, less than 5 μc per ml., they survived for 4 days but without showing noticeable development. At a still lower dosage there was definite retardation of growth and differentiation. Thus, when kept in medium containing 3.52 μc per ml. Ca-45, the eggs developed up to gastrular stage with mesenchyme masses in 4 days while the control developed to typical plutei with ventral arms longer than the body. At 3.18 μc per ml. level there was differentiation and growth, but the rate was slower than that of the control so that the plutei of the same age appeared smaller than the control and there also were more retarded and abnormal organisms than in unirradiated cultures. At still lower dosage, e.g., below 0.011 μc per ml., there was no measurable difference between irradiated and control cultures. The abnormal individuals appeared to have their endodermal and mesenchymal cells pushed to one pole and the whole animal looked like a pear with a thick mass of cells at its smaller end.

SIDNEY C. HSIAO
WALTER K. FUJII
University of Hawaii
Honolulu, Hawaii

Action of X-Irradiation on the Development and Ionic Uptake of *Tripneustes gratilla* Eggs.

Newly hatched *T. gratilla* eggs were subjected to graduated doses of X ray, in a single dose, from 250r to 16,000r and their development observed for 5 days. Three days after irradiation all the eggs which received 250r developed into prisms showing the beginning of arms, indistinguishable from the control, but only 50 per cent reached this stage in cases where the eggs received 500r to 2,000r. Half of the eggs which received 3,000r and 4,000r only developed into the spheric stage, while 84 per cent of the eggs which received 8,000r were at spheric stage or earlier. At 16,000r dose level 82 per cent of the eggs were small, showing no increase in size and abnormal in structure, while the remaining 18 per cent only developed as far as the spheric stage. Five days later eggs which received 500r or 1,000r all developed into plutei with ventral arms equal or longer than the body and indistinguishable from the control as far as rate of growth and structural features were concerned. Among eggs which received 2,000r, 50 per cent reached this stage also, but 40 per cent were still in the early pluteus stage with arms shorter than the body and the rest were at prism stage. None of the eggs which received 8,000r or more developed beyond the prism stage. At 8,000r level 75 per cent of the eggs were still at the spheric stage, only 15 per cent developed as far as the prism, while at 16,000r level again 82 per cent were spheres and 18 per cent abnormal and very small in size showing no growth and abnormal morphogenesis.

The effect of X-irradiation upon the uptake of calcium ions was tested by culturing eggs irradiated with graduated dosages of X ray in filtered sea water containing calcium-45 in concentrations previously shown to have no effect on the growth and differentiation of *T. gratilla* eggs. All irradiated eggs took up less Ca-45 as compared with the control. At the lower dosage level, 8,000r, the uptake of Ca-45 by the developing eggs was more than twice that of eggs which received high X-irradiation. Immediately after X-irradiation, e.g. within 18 hours, eggs which received lower doses took up Ca-45 more rapidly than the control, but this was only transitory and the rate of uptake dropped below that of the control later. Eggs which were irradiated with high doses of X ray did not show this phenomenon.

SIDNEY C. HSIAO
PATRICIA C. DANIEL
University of Hawaii
Honolulu, Hawaii

10. A HEURISTIC COMPUTER PROGRAM FOR 3-DIMENSIONAL 4×4×4 TIC-TAC-TOE*

The use of electronic computers in ordinary scientific and business calculations depends, for its success, on three conditions: (1) the existence of an algorithm, i. e., a sequence of operations and decisions guaranteed to produce a solution of the problem at hand; (2) the possibility of translating the algorithm into a detailed computer program; (3) the ability of the computer to execute the program in a reasonable time. In many problems one or more of these conditions are not met. One such problem is that of solving the game of 4×4×4 tic-tac-toe. By solution of a game of perfect information, such as this, is meant the discovery of either (a) a strategy whereby one of the players can always win (as is the case, for example, in 3×3×3 tic-tac-toe), or (b) a pair of strategies whereby each player can insure a draw (as in ordinary 3×3 tic-tac-toe). There is indeed an algorithm which could be programmed: that of examining all possible strategies; but the execution of the program would take centuries of computer time.

In this situation one is led to attempt a solution by using the techniques of machine learning or heuristic programming. Here the program fed into the computer consists of: (1) a set of heuristics, i. e., hints or rules of thumb—procedures which may reasonably be expected to solve or simplify the problem, but are not guaranteed to do so; (2) the ability to form combinations of them; (3) a method for evaluating the relative effectiveness of these combinations and retaining only the more successful ones.

One heuristic that suggested itself in trying to apply these concepts to 4×4×4 tic-tac-toe is that of determining whether any given board position is such that one of the players can win by repeatedly forcing the opponent. A program was written for the IBM 709 computer to answer this question. The program tests a given position to determine whether it is a forcing position; if it is, it generates the subsequent positions resulting from the forced moves and tests them similarly; in this manner a tree of positions is generated, the terminal nodes of the branches representing either non-forcing or winning positions; if the tree contains a winning position, the question is answered affirmatively. This program consists of about 1,700 machine instructions, and it tests and generates positions at the rate of about 5 per second. On one occasion, it has generated a winning sequence involving 12 successive forced moves.

PAUL G. COMBA
University of Hawaii
Honolulu, Hawaii

*The work reported here was carried out, in part, while the author was an IBM Research Associate in residence at the Western Data Processing Center, University of California, Los Angeles. Use of the Center's facilities is gratefully acknowledged.

11. STATISTICAL ANALYSIS OF OAHU'S 1956 GENERAL ELECTION: PATTERNS EMERGING FROM SAMPLE BALLOTS

Prior to their destruction, a stratified sample of 985 Honolulu City and County ballots from the 1956 general election was made available to the authors for study. The Fourth District was represented by 500 ballots; the Fifth, by 485. Of the 24 candidates, five were eliminated for technical reasons from the analysis: each was involved in a contest with a single opponent (e.g., the mayor's race), such that anything inferred from the analysis regarding the one member of such a pair would have certain implications for the other (but with reversed sign). The 19 remaining candidates were intercorrelated, all possible 171 pairs, by means of the tetrachoric correlation coefficient, and the resulting matrix subjected to a centroid-type factor analysis. Two correlation matrices were thus available for analysis, one from either district.

From both matrices four factors were extracted. Rotation of the centroid values obtained was accomplished graphically. A general factor seemed evident and was permitted. All other factors were taken orthogonally to this general factor. An obviously oblique solution seemed indicated in the case of Factors II and III for both matrices, and was permitted.

Identification of the factors obtained was made by inspection of the candidates with high positive and negative values in respect to the several factors. Factor I is obviously a general Party Factor, inasmuch as it groups candidates according to whether they are Republican or Democrat. Factors II and III are probably dimensions of electorate interest in candidates according to ethnic extraction, although they may be complicated by campaign tactics adopted by several candidates (e.g., appearing together at rallies). Factor IV may represent a dimension of interest depending on whether the candidate is an "Old Timer" or a "New Face." Finally, assuming .95 reliability for the "candidate-variables," Candidate Uniqueness values were computed.

For the Fourth District, the Party Factor accounted for 51 per cent of vote variance; the two Ethnic Factors, 17 per cent; the "New Faces" Factor, 4 per cent; and Candidate Uniqueness, 19 per cent. In the case of the Fifth District, the Party Factor accounted for 45 per cent of vote variance; the combined Ethnic Factors, 22 per cent; the "New Faces" Factor, 5 per cent; and Candidate Uniqueness, 23 per cent.

In general, the results of the analysis were quite similar to the results obtained from a prior study of the 1954 election.

JOHN M. DIGMAN
DANIEL W. TUTTLE
University of Hawaii
Honolulu, Hawaii

12. EROSION STUDIES ON STRIPMINED SOILS IN HAWAII

As part of a study of the potential value of stripmined soils in Hawaii, soil erosion to be expected after such mining has been investigated. The work has been carried out on a 2½ acre experimental bauxite reclamation area in the Game Refuge Area on the east side of Kauai, as part of a program of the Hawaii Agricultural Experiment Station, University of Hawaii.

The study has been carried out in plots 8 $\times$ 80 feet on a 5 per cent slope. The effect of various surface treatments on erosion has been compared on compacted subsoil about 15 feet below the original ground level. Controls have been installed on original surface soil in undisturbed native vegetation in an area nearby.

From January to November of 1959 virtually no soil losses were measured to occur under native vegetation, pangola grass cover, and under bagasse (sugar cane waste trash). On the bare soil plots, erosion has been twenty times as high as on the surface-protected plots.

These results should be looked at critically, as actually the erosion study has been a model study of what happens on a larger scale beyond the plots. There is evidence that the similitude is not a good one. The reason for this resides in the boundary conditions existing in small erosion plots. The boundaries cause water to concentrate in channels on the lowest side not only in the lengthwise but also in the crosswise direction of the plots, some cross slope usually being unavoidable. On the bare soil plots this had led to channeling and gullying and the removal of quantities of soil probably in excess of losses that would have taken place under natural conditions. Therefore, in measuring the soil losses, more attention needs to be given to the mass movement of soil down the slope than to the actual soil losses intercepted and measured by the installed measuring devices. In assessing losses, this has been done.

In the case of the surface-protected plots, the situation seems reversed. There is evidence that the measuring devices measure less soil losses than occur beyond the plot boundaries. For instance, under native vegetation no soil losses at all occurred during 11 months of measurement, even though heavy storms occurred during the period of measurement. Indeed, infiltration rates of the soil in question are high (probably between 1 and 5 inches per hour), but deep dissection of the local terrain betrays significant geologic erosion. Similarly, on the artificially surface-protected plots, the virtual absence of measurable erosion makes one wonder as to the efficiency of measurement.

Some answer is provided by the observations made on the bagasse-covered plots. During rain it can be seen that water is held in place (ponded) by the stalks, stems, and mulch as small pools. When water flow does take place over the surface upon continuance of rain, removed soil is caught lower down the slope by the mulch and the water is clear upon reaching the measuring flume. The thickness of the bagasse was originally two inches. However, this thickness was gradually reduced upon decomposition till crescent-shaped bare soil spots were exposed locally. This crescent shape seemed induced by soil deposited on the concave side of the crescent on the up-slope side. Thus, under a protective surface cover there seems to occur some soil movement, but the roughness at the surface causes gradual displacement of soil down the slope.

Yet, the results from the experiments seem sufficiently clear in that it may be said with some certainty that erosion on stripmined soil can be controlled by rapid surface protection. Some further work is required on techniques of providing such a rapid surface protection.

BESSEL D. VAN'T WOUDT
University of Hawaii
Honolulu, Hawaii

13. NATURAL VEGETATION ON HAWAIIAN GIBBSITIC SOILS

As a part of the study of reclamation of potential bauxite mining areas in Hawaii, studies were initiated in early 1958 of the vegetation on soils containing high amounts of gibbsite, a hydrated aluminum oxide clay mineral, on Kauai. These studies, centered on the Wailua Game Reserve, consisted of reconnaissance traverses of the major soil series, collection and identification of plants, and quantitative evaluation of vegetation on detailed transects through the major plant associations. Vegetation studies were designed to (1) obtain the ecologic information and floristic inventory with which reclamation results could be compared, and (2) to ascertain whether or not any relationship between plants, either species or combinations, existed with the aluminum content of the soils.

Of about 100 species collected in three major habitat types on several different Aluminous Ferruginous Latosolic soils, only 6 were endemic. The great majority of species were introduced (65 per cent) and about 30 per cent were fairly common indigenous species. The endemics found were all vigorously reproducing species of wide island distribution.

The area studied on Kauai has a long history of use for grazing and of burning, presumably to improve grazing and game habitat as well as accidental firing during the war when it was used as an artillery range. Fire in this vegetation type causes a pronounced decrease in the cover of shrubby species such as *Lantana* and *Melastoma* as well as herbs like yellow foxtail (*Setaria*), lace fern (*Stenoloma*), and the ground orchid (*Spathoglottis*), while increasing markedly the cover of bare soil, Japanese tea (*Cassia*), tar weed (*Cuphea*), *Emelia, Elephantopus,* and others. In the valleys and drainageways where fire has not penetrated, a more mesic vegetation association occurs, and most of the endemic and indigenous species are found.

In general no direct relationship was found between species distribution and soil aluminum levels because of the high degree of disturbance by man and the high proportion of introduced species. Nearly all the species present, however, were those adapted to a moist environment with a shallow root zone on soils of high acidity and low levels of available nutrient elements.

For production of forage and crop plants these soils require fertilizer and lime in large amounts.

J. C. MOOMAW
M. TAKAHASHI
University of Hawaii
Honolulu, Hawaii

SPECIAL SESSION I

PEACETIME USES OF UNDERGROUND NUCLEAR EXPLOSIONS

Underground nuclear explosions are advantageous in that they do not introduce radioactive products in the air, because they are all contained within the ground. The rocks in the vicinity of the explosion are compressed (if they have some pore space), and also are cracked and fractured. Almost all of the radioactive products are fused in a glasslike shell at the outer edge of the cavity formed by the explosion. Very little gaseous radioactive material is produced. Hence the explosions offer opportunities of nonhazardous peacetime uses.

PARKER D. TRASK
Berkeley, California

SPECIAL SESSION II

A Symposium

THE INTERNATIONAL GEOPHYSICAL YEAR IN RETROSPECT

1. THE GENERAL SCOPE OF THE IGY PROGRAM

No abstract available.

PAUL C. EKERN
Pineapple Research Institute
Honolulu, Hawaii

2. THE SUB-PACIFIC CRUST

The most important developments in solid earth science during the last few years have been: (1) The demonstration of the thinness of the earth's crust in the ocean basins, (2) the measurement of heat flow through the ocean floor, and (3) the demonstration of the absence of continental-type "granitic" crust between the continents of Asia and Australia and the outlying island arcs facing the Pacific. None of these are primarily the results of the IGY, but all have been added to by IGY expeditions.

The basaltic crust is only about 5 km. thick beneath much of the Pacific basin. Granitic crust is absent, and about 0.5 km. of sedimentary rock overlies the basalt. The Mohorovicic discontinuity, separating the earth's crust from the mantle, is thus very close to the surface, and a drill hole—the "Mohole"—is being planned to penetrate the crust and sample the material of the mantle, the nature of which is as yet known only by inference.

On theoretical considerations, it was expected that the flow of heat through the ocean floor would be much less than that through the continental surface. Instead, it proves to be essentially the same. This may mean that deductions on the nature of the material making up the mantle are erroneous.

The lack of continental-type crust between the island arcs such as the Tonga and Mariana islands and the continents means that these arcs, and the "andesite line" running through them, can no longer be considered geologically the edge of the continents. The andesites and related volcanic rocks occurring in them cannot be the result of assimilation of sialic ("granitic") crust in rising basalt magma.

GORDON A. MACDONALD
University of Hawaii
Honolulu, Hawaii

3. IGY OCEANOGRAPHIC PROGRAM AND THE DEVELOPMENT CONCERNING THE PACIFIC EQUATORIAL UNDERCURRENT[1]

Most of the commitments and plans for oceanographic research in the Pacific submitted at preliminary IGY meetings were completed. The most intensive coverage was in the coastal areas off North America and Asia. There were no quasi-synoptic surveys such as the 1955 NORPAC[2] and 1956 EQUAPAC[3] surveys. Two important strictly IGY projects were the studies to obtain data on the age and rate of replacement of the deep and bottom waters and studies of the circulation and mass transport in the eastern equatorial Pacific.

[1] Published by permission of the Director, U. S. Bureau of Commercial Fisheries.

[2] NORPAC was a multiship survey of the Pacific Ocean north of 20°N. latitude during July–September 1955 by vessels of Canada, Japan, and the United States.

[3] EQUAPAC was a multiship survey of the equatorial Pacific Ocean, 20°N. to 20°S. latitude and west of 130°W. longitude, during August–September 1956 by vessels of France, Japan, and the United States.

The deep circulation studies consisted of direct current measurements from the Russian "R/V Vitiaz" at numerous stations around the entire North Pacific and deep water sampling in the eastern Pacific from vessels of Canada's Pacific Oceanographic Group from Nanaimo, B. C., the University of Washington, and Scripps Institution of Oceanography. The sampling program extended from 50°N. to 45°S. latitude.

The studies of the circulation and mass transport in the eastern equatorial Pacific consisted of two multiple ship surveys. One was the study of the Equatorial Countercurrent (Doldrum Expedition) by Scripps Institution of Oceanography and the Colombian Navy and the other was the study of the Pacific Equatorial Undercurrent (Cromwell Current) by Scripps Institution of Oceanography and the Honolulu Biological Laboratory.

The Countercurrent Survey disclosed an average transport of 60 million cubic meters per second, which was two to three times that computed from previous observations. The reason for the increase was the transport between 200 and 800 meters which was revealed by direct measurement of the currents[4].

The Pacific Equatorial Undercurrent (Cromwell Current) survey yielded an estimate of its volume transport and eastern limit. It was found to extend from at least 140°W. to 92°W. longitude and to be completely embedded beneath the surface in the westerly flowing South Equatorial Current. The core of the current was centered on the equator where velocities of 2–3½ knots occurred between 140°W. and 95°W. On 140°W. the current occurred between 30 and 300 meters with the maximum velocities occurring at about 100 meters. It was symmetrical about the equator; thinning and weakening to the north and south so that at 2°N. and 2°S. it was only 30 m. thick and had maximum velocities of only 0.6 knots. The average transport of current on 140°W. was 30 million cubic meters per second or more than that previously given for the Equatorial Countercurrent itself[5].

The importance of the undercurrent studies were that they showed a need for reconsideration of the water balance in the equatorial Pacific and perhaps other areas as well in order to determine the role submerged currents play in the water balance of the oceans and transport of pelagic organisms.

JAMES W. McGARY
U. S. Bureau of Commercial Fisheries
Honolulu, Hawaii

4. THE METEOROLOGICAL PROGRAM AND THE RESULTS FROM MAUNA LOA OBSERVATORY

No abstract available.

SAUL PRICE
U. S. Weather Bureau
Honolulu, Hawaii

[4] J. A. Knauss and R. Pepin, Nature 183: 380 (1959).
[5] J. A. Knauss and J. E. King, Nature 182: 601-602 (1958).

5. THE SOLAR FLARE PATROL AND COSMIC RAY MONITORING

No abstract available.

ELMER J. HARGER
University of Hawaii
Honolulu, Hawaii

6. THE SATELLITE TRACKING STATION, HALEAKALA

No abstract available.

WALTER LANG, JR.
Satellite Tracking Station
Haleakala, Maui

SPECIAL SESSION III

SUBMARINE CANYONS

No abstract available.

FRANCIS P. SHEPARD
Scripps Institution of Oceanography
La Jolla, California

FINAL SESSION

1. SEEING WITH SOUND

"Seeing with sound" is a sonar system, using the basic principles of radar. It is capable of detecting and indicating the direction and distance of an object by utilizing specular sound reflections.

This system differs from radar in that it uses sound, having a range of approximately 50 feet, instead of radio waves. It will detect objects that offer a flat reflective plane at right angles to the direction of its longitudinal sound waves. The beam of high intensity sound waves used to detect objects is approximately 15 inches across, corresponding to the diameter of the parabolic antenna dish. The wave length of the high frequency pulse is about one tenth that required for such an antenna structure. The repetition rate is about twenty per second.

The process of measuring the distance from the antenna to an object utilizes the speed of sound. This system transmits a short pulse of sound in a high intensity beam. After the pulse is generated, the transducer is switched to the input of a video amplifier as it waits for an echo. Meanwhile, the sound encounters an object from which an echo is returned to the transducer (depending upon the properties of that object). Upon its arrival, the distance is found by measuring the time it takes for the sound to return.

The azimuth of a particular object is determined simply by noting the direction of the antenna with synchronous motors.

The various data on distance and direction are combined and presented on a cathode-ray indicator. The final result is a complete picture of the surrounding area, including, for example, the shape of the room and the position of persons and objects.

The value of such a system has been extensively proven at sea by the Navy for detecting underwater objects such as submarines, rocks, shore lines, or fish. Its brother, radar, has proven even more valuable to detect and locate aircraft, surface ships, and land masses. Various exciting applications may find increasing use in the future. Applied to the braking and steering mechanisms of automobiles, driverless cars without need for headlights could become feasible. Perhaps, some day, even the blind will be "seeing with sound."

STEVE WALTHER
Punahou School
Honolulu, Hawaii

2. DETERMINATION OF ORCHID SEED MATURITY BY EMBRYO CULTURE

No abstract available.

SUSAN N. KOTOMORI
McKinley High School
Honolulu, Hawaii

3. CAUSES OF MAJOR VARIATIONS IN THE CATCH OF THE PACIFIC SARDINE, *Sardinops caerulea* (GIRARD)[1]

From its position as one of the world's largest fisheries, the Pacific sardine fishery decreased by an order of magnitude in both area and landings.

This decline cannot be shown, directly or indirectly, to be attributable to the fishery. Rather, the decline was probably associated with the effects of the environment upon year-class size.

A model which is consonant with the features of sardine biology and the fishery and which offers an explanation of the decline is:

1. Sardines which support the United States and Canadian catch are produced off southern California and central Baja California;
2. those produced off southern California migrate as far north as British Columbia, support the fishery there, and contribute to the fisheries at San Francisco, Monterey, and San Pedro;
3. those produced off central Baja California migrate as far north as central California and contribute to the California fisheries, especially at San Pedro;
4. lack of spawning success on the southern California spawning grounds since about 1943 could account for the observed changes in the fishery;
5. the postulated lack of spawning success off southern California is attributed to the below average temperature regime, which has delayed spawning by one or two months;
6. below average temperatures are associated with an upwelling regime and above average temperature with an advection regime;
7. under the upwelling regime, it is suggested that the sardine is unable to compete successfully with the anchovy.

JOHN C. MARR
U. S. Bureau of Commercial Fisheries
Honolulu, Hawaii

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4. CONFINEMENT OF SKIPJACK IN A POND[1]

The skipjack tuna (*Katsuwonus pelamis*), locally known as aku, is the most important commercial fish in Hawaii. This species of tuna, which is distributed throughout the warmer seas of the world, represents a resource of protein capable of a much greater yield than the amount presently being harvested. One phase of the research at the Honolulu Biological Laboratory is the development of more efficient methods of harvesting this resource. Clues for the development of such methods are being sought through investigations of skipjack behavior.

One part of the behavior investigations is the study of skipjack responses to various stimuli. A requisite for this study is the control of environmental conditions of the test fish. Such control can be achieved best with captive skipjack maintained in tanks or ponds.

A pond, 23 feet in diameter and 4 feet deep, was installed at Kewalo Basin. This circular pond was filled with water from an adjacent salt water well. This water is less saline and more acidic than open ocean water and practically devoid of oxygen. It is oxygenated by allowing it to cascade through an aerator of special design.

Initial attempts to establish skipjack in this pond were unsuccessful. The fish, which were caught at sea by the live-bait method, were transported to the pond in the live-bait wells of the "Charles H. Gilbert," research vessel of the HBL. The transfers from the sea to the bait wells and from the bait wells to the pond involved considerable amounts of manual handling of the fish. None of these fish survived for more than two days.

A new method was tried in February, 1960. Skipjack were captured at sea by the same method but from a commercial fishing vessel. Immediately after capture and while still suspended from the hook, the fish were lowered into a portable steel tank, 6 feet wide, 8 feet long, and 25 inches deep. At Kewalo Basin, the tank was lifted off the vessel and lowered into the pond. A hatch in the side of the portable tank was opened and the fish allowed to swim out.

Skipjack handled in this manner soon adapted to conditions of captivity and were successfully induced to feed on dead food. Five skipjack of about 3 pounds

[1] Published by permission of the Director, U. S. Bureau of Commercial Fisheries.

in size have been held in confinement for over 12 weeks and have been feeding daily on pieces of shrimp and squid.

EUGENE L. NAKAMURA
U. S. Bureau of Commercial Fisheries
Honolulu, Hawaii

5. INSTRUMENTAL METHODS FOR THE ANALYSIS OF FOOD ADDITIVES

New amendments to laws governing the use of food additives require that any chemical added or applied to food must be shown to be either absent or present in nontoxic concentrations.

The task of demonstrating the existence of micro-amounts of chemicals in food falls on the shoulders of the analytical chemist. To review current methods of analysis and to demonstrate the newer instrumental methods, a symposium and workshop on instrumental methods of analysis sponsored by various food and food packaging companies together with Michigan State College were held at Lansing on March 26–28. This report summarizes the information presented.

Essential steps preliminary to the instrumental analysis of food usually involve the extraction of the additive and the purification or cleanup of the extract. The importance of these steps, particularly the cleanup was emphasized.

Recording spectrophotometric instruments either alone or in conjunction with the gas chromatograph, can be successfully employed for the identification and quantitation of various pesticides. New inexpensive recording spectrophotometers usable in the ultraviolet and visible regions are now available and more expensive instruments extend this wave-length range through the near infrared and infrared.

While the newer spectrophotometers are capable of making light absorption measurements over a greater wave-length range, the colorimeter using filters is still being employed in most procedures requiring measurements in the visible region.

Of the newer methods, gas chromatography holds great promise for residue analysis. Separation of a mixture of chlorinated insecticides at elevated temperatures followed by direct thermal conductivity or coulometric assay was demonstrated. Collection of the effluent gas in a solvent and characterization by infrared spectrophotometry was shown to be feasible. Increased sensitivity in instrumentation may be achieved by the use of new detectors such as the flame and beta-ray ionization units which are claimed to have at least a thousand fold greater sensitivity.

The use of radioactive isotopes for the determination of residues by isotope dilution was advocated. The advantages of radioactivity methods lie in their exceptional sensitivity and specificity. However, the need for purification of isolates may be a decided disadvantage. Nevertheless, consideration of this technique and particularly its newer modifications is definitely indicated for residue analysis.

H. Y. YOUNG
Pineapple Research Institute
Honolulu, Hawaii

6. PESTICIDE RESIDUES IN FOODS

Recently, pesticide residues in foods have received considerable publicity in the press. The most dramatic case was the occurrence of an herbicide, amino-triazole, in cranberries last fall. This spring, the condemnation of several lots of canned milk containing traces of chlorinated hydrocarbons used as insecticides has been reported. These instances are evidence of operation of laws which in actuality guarantee that the nation's food supply is among the world's safest. Starting at the turn of the century with the Pure Food Act of 1906 (and subsequent special laws respecting meat, fish, etc.), the character of legislation regulating the food supply has changed from a post-facto punishment for harmful acts to the present system, which is essentially a licensing of the use of a nonnutritive substance, following a showing that the material is indeed safe for use.

The five laws of major importance that have accomplished this are (1) the Federal Food, Drug, and Cosmetic Act of 1938; (2) the Federal Insecticide, Fungicide, and Rodenticide Act of 1947; (3) the Pesticide Chemicals Amendment of 1954; (4) the Food Additives Amendment of 1958; and (5) the Nematocide, Plant Regulator, Defoliant, and Desiccant Amendment of 1959. These statutes regulate products moving in interstate commerce; the state laws are in alignment with the federal laws.

Currently, in order to market a food containing a nonnutritive substance, the sponsor must show the necessity for its use in producing the technical effect, must provide analytical methods for determination of any residue which results from its use, and show to the satisfaction of the Food and Drug Administration how much occurs in the food product and the degree of hazard on the basis of extensive feeding trials with laboratory animals. Failure to provide this information for approval by the FDA means that the materials can be used in production or processing only if it results in *no* residue in the food. Moreover, products that have produced carcinogenic or "other alarming effects" in laboratory animals will be accepted for use on a no-residue basis only, irrespective of whether it can be shown that there is a safe level for use.

It is this latter provision that resulted in the condemnation of cranberries and of the milk products. There has been no showing that the levels of residue actually found in the products were in fact harmful. In these instances, the term "unsafe" derived from statutory, not scientific, considerations. The very occurrence of *any* residue was illegal.

The points to be made are that there are actually adequate safeguards for the protection of the public and its food supply, and that there is no good reason for panic or loss of confidence in food manufacturers.

DONALD P. GOWING
Pineapple Research Institute
Honolulu, Hawaii

7. THE STRUCTURE OF SOCIAL ATTITUDE IN HAWAII[1]

Previous studies of the interrelationships existing among measures of social attitude have suggested that a very small number of basic variables (technically, *factors*) underlie and are responsible for the observed relationships. Ferguson, using factor analysis, isolated three factors from the intercorrelations among ten attitude scales, naming the dimensions Humanitarianism, Religionism, and Nationalism. Later, Eysenck suggested that but two factors (Radicalism *vs.* Conservatism, and Toughmindedness *vs.* Tendermindedness) were responsible for the relationships observed among 40 questionnaire items assessing social attitudes in a variety of areas (e.g., religion, war, birth control, government control of industry).

The present study was suggested by the work of Eysenck. A very reasonable hypothesis was that the results obtained from a Hawaiian sample might be rather different from the results obtained from Western European samples, the source of Eysenck's data. In addition, it was suspected that the principal reason for Eysenck's two-factor solution was the tremendous labor involved in carrying the analysis further. The facilities of the University of Hawaii Statistical Center, with its IBM 650 computer, seemed admirably suited for the data processing involved in a repetition of the Eysenck study.

Thirty-nine statements of social attitude, most of them from the original Eysenck list, were placed in questionnaire form and administered to a sample of 126 individuals of many walks of life and socioeconomic levels. All ethnic groups of importance in the islands are represented in the study, although there was no effort made to secure a stratified sample. University of Hawaii students constituted about one-third of the sample. For each item on the questionnaire, five degrees of agreement were provided, ranging from complete disagreement to complete agreement. Following collection of the data, inter-item correlations were obtained by use of an IBM 650 program designed especially for this purpose. The resulting 39-order correlation matrix was factored by the principal-components method of Hotelling. Factors were extracted until a latent root of less than 1.00 was obtained, at which point the extraction process was terminated. Sixteen factors were retained for further analysis.

Rotation to simple structure for the first two factors yielded a solution similar to that of Eysenck, although our factors are perhaps better labeled "Fascism *vs.* Traditional American Liberalism" and "Laxity *vs.* Strictness."

Rotation for the first eight factors resulted in a considerably better solution, indicating dimensions of Cultural Rigidity *vs.* Cultural Permissiveness, Toughmindedness *vs.* Tendermindedness, Egalitarianism *vs.* Own-group Superiority, Organizationism *vs.* Misanthropic Individualism, Religionism *vs.* Anti-religionism, a possible factor representing Youthful Views *vs.* Older Views, and Radicalism *vs.* Conservatism. One factor has been left unlabeled.

Further analysis is planned, including rotation of the variables in the sixteen-dimension space suggested in the preliminary factor extraction process.

JOHN M. DIGMAN
JOANN ZAYNOR
University of Hawaii
Honolulu, Hawaii

[1] The authors would like to express their appreciation to Dr. Calvin E. Wright of the University of Washington, and Mrs. Lois Matsunaga, Programmer of the University of Hawaii Statistical Center, for invaluable assistance.

8. AUTOMATED RESEARCH OF ANIMAL DISCRIMINATION LEARNING

For almost 50 years, American psychologists have intensively studied the acquisition of spatial, brightness, and pattern discrimination by infra-human organisms. Experimentation is generally conducted with mazes or jumping stands that require a costly outlay of research time and personnel.

An automatic learning-discrimination apparatus (ALDA) was recently developed at New York University. ALDA consists of four independent Y-mazes with remote programming, control, and recording instruments. The device increases research productivity at a minimum by a factor of four.

Uncorrectable operator error is virtually eliminated. Research programs that were previously impossible are now routine.

Several experiments were conducted on brightness discrimination problems utilizing the automatic apparatus. The study reported here employed albino rats trained with either transparent or opaque maze doors and a high or low level of thirst. A third factor investigated was the influence of different ratios of responses to the rewarded (S+) and nonrewarded (S—) stimulus. This was accomplished by programming blocks of four trials, one free choice and three forced choice trials. Contingent programming was employed for the forced responses so that the animals' choice on the free trial determined whether responses were forced to S+ or S— on the forced choice trials. Thus, three groups of animals responded to S+ and S— in ratios of 3/1, 1/1, and 1/3.

Level of thirst failed to influence the choice behavior in discrimination learning. However, thirst level produced a sizable and statistically significant effect upon speed of locomotion. Modifications of Hull-Spence theory are required in order to reconcile the theory with the present results.

Discrimination learning was improved by the presence of both relevant stimuli at the choice point during forced trials.

The rate of acquisition for the discrimination was decreased by the relatively larger ratio of responses to the rewarded stimulus. Conversely, discrimination learning was enhanced by a greater proportion of responses to the nonrewarded stimulus. This finding indicates a limitation of both the contiguity and reinforcement models of learning. The group responding at a S+/S— ratio of 3/1 had a greater absolute number of trials to S+, all of which were rewarded. Both models, therefore, require that a superior rate of learning occur for this group. Exactly the opposite of this prediction was observed. The group with three-quarters of their choices forced to the unrewarded stimulus demonstrated the superior rate of learning.

ROY LACHMAN
University of Hawaii
Hilo, Hawaii

9. XENOLITHIC NODULES IN THE 1800–1801 KAUPULEHU FLOW OF HUALALAI VOLCANO AND THEIR PETROLOGIC IMPLICATION

The 1800–01 Kaupulehu flow from Hualalai Volcano, on the island of Hawaii, has long been noted for its remarkable content of xenolithic nodules (Stearns and Macdonald, 1946, Geology and Groundwater Resources of Hawaii, Hawaii Div. of Hydro., Bull. 9). The nodules, which consist of angular to subrounded crystal aggregates of pyroxene, olivine, and feldspar, range in size from a fraction of an inch to over one foot in diameter. They are found both scattered and in concentrations throughout most of the flow.

Recent geologic investigations by the U. S. Geological Survey on Hualalai Volcano have disclosed a possible greater abundance of nodules than heretofore realized and a significant difference in their aggregate composition. In one locality studied, pure nodule beds with a total thickness of about 25 feet, including individual beds up to 9 feet thick, underlie an area of approximately 50 acres. In many exposures the matrix lava is seen to have drained away leaving only a thin selvage of basalt coating the nodules, giving the beds the appearance of a cobble beach deposit. On the basis of their macroscopic mineralogy four general types of nodules are recognized: pyroxene, pyroxene-olivine, olivine, and pyroxene-feldspar nodules. Pyroxene, as determined from random sampling of over 200 nodules, is by far the most abundant mineral present.

The Kaupulehu flow is the youngest lava of the alkalic olivine basalt series which mantle Hualalai Volcano. The main bulk of Hualalai, as is the case with all Hawaiian volcanoes, is composed principally of picrite, olivine basalt, and basalt of the tholeiitic series. Tholeiitic rocks, characterized by a saturated (with respect to silica) groundmass, are erupted rapidly and vigorously during the youthful and mature stages of volcanic activity. The alkalic basalts and their differentiates, on the other hand, are an undersaturated series of rocks that are erupted intermittently and in minor volume during the decadent stages of volcanism. Xenolithic nodules are only known to occur in these later alkalic rocks, not only on Hualalai but on other volcanoes of the Hawaiian Islands. This circumstance suggests that the minerals of the nodules, in some manner, play a role in the genesis of alkalic magmas.

The mineralogy of the Kaupulehu nodules, together with their abundance, supports the theory that a saturated tholeiitic magma is the primary Hawaiian magma and that fractional crystallization of pyroxene is the principal mechanism for producing the undersaturated alkalic magmas. The nodules therefore, represent fragments of subterranean consolidated deposits of crystals whose precipitation brought about the fundamental change in magma type. Their angularity and lack of pronounced magmatic reaction rims strongly suggest that the processes of fractional crystallization occurred far above the original source of the magma—probably in relatively shallow magma reservoirs within the volcano.

Experimental phase equilibria data on the quaternary system, forsterite-diopside-anorthite-silica, which includes the principal mineral phases of both the tholeiitic and alkalic basalts, also appear to support the theory of one fundamental magma.

DONALD H. RICHTER
KIGUMA J. MURATA
U. S. Geological Survey
Hawaii National Park, Hawaii

10. COLLECTION AND ANALYSIS OF VOLCANIC GASES BY MEANS OF GAS CHROMATOGRAPHY

Although much attention has been lavished on the study of volcanic rocks, relatively little work has been done with the associated gas which is an equally important factor in volcanic eruptions. This slight has been due mainly to the ephemeral nature of the material involved, and to the danger and difficulty of collecting samples. An attempt has been made to overcome some of the difficulties of collection and study by the application of the recently developed technique of gas chromatography.

If a mixture of gases is passed through a long tube containing a solid adsorbent such as silica gel, certain gases will be adsorbed in successive sections of the tube in the order of their affinity for the gel. In the case of volcanic gas mixtures at high temperatures (100°–1000°C.) this separation will effectively "freeze-in" the high temperature equilibrium of the gases and prevent the interaction which normally occurs on cooling. The composition of the mixture then can be interpreted with some confidence in light of the known thermodynamic properties of the gases and the gas-solid systems.

Such sample collecting tubes have been constructed and have been tested on artificial mixtures of gases, and on collections in fumaroles and volcanic vents. They are easily portable and convenient to handle, and perform well even when used under the rather unfavorable conditions prevalent in volcanic areas. Such collections seem at least to approach the true gas composition which exists in the high temperature vents.

A similar system of adsorption on a column has been applied to the analysis of volcanic gases in the laboratory. Small samples of the gaseous mixture are passed through the chromatographic tube with helium or argon as carrier gases. The components are separated and may be measured as they emerge from the column by means of a suitable detector such as a thermal conductivity cell. The output of the detector can be applied to a recording potentiometer so that a qualitative and quantitative analysis is depicted in a series of peaks. The method is capable of detecting concentrations in the range of a few parts per million, with a precision of about 10 per cent. Analyses are very simple and results can be unambiguously interpreted.

JOHN J. NAUGHTON
EMERSON F. HEALD
University of Hawaii
Honolulu, Hawaii

11. A SCORING TECHNIQUE—ITS APPLICATION TO THE EPICANTHIC FOLD

The epicanthic fold begins on the inner or medial part of the upper eyelid, covers the free edge of the inner part, and extends downward concealing the coruncula lachyramalis, an island of skin which contains oil and sweat glands. The coruncula lachrymalis is usually clearly visible in Caucasian eyes. The epicanthic fold is a characteristic of Oriental eyes.

Genetic studies of such traits as the epicanthic fold have been few. The bulk of human traits whose inheritance has been studied is composed of pathological conditions and physical abnormalities. This situation is due first of all to the difficulty of arranged experimentation and, secondarily, to the length of the human life span.

Some of these difficulties have been solved by reaching beyond the technique of pedigree analysis which concerns the genetics of individuals, to the genetics of populations through the application of statistical methods to population dynamics. Thus it becomes possible to test hypotheses of manner of inheritance by application of mathematical probabilities to allelic distributions.

The scoring technique, whose description follows, was used to obtain the data needed for the subsequent statistical analysis.

The subjects of my investigation consisted of the members of 28 families. The children of these families, 35 boys and 57 girls, together with their parents constituted a random sample of our Hawaiian population. The racial strains represented in the children are: Japanese, Chinese, Japanese-Caucasian, Chinese-Caucasian, Caucasian.

At the close of the individual interviews a photograph was taken of each person's left eye to obtain a picture for scoring. These pictures were taken at a distance of 16 inches with Royal-X-Pan film in a Minolta Autocord camera. This film has an ASA rating of 800 and was most satisfactory for the securing of pictures of eyes unaffected by glare and tension.

These pictures were then number-keyed and arranged in order of phenotypic variation from a definitely Caucasian eye to a definitely Oriental eye with three gradations between.

From the population of children's photographs, three representative samples for each step of the five-place gradations were selected to serve as scoring standards for the total population.

Three judges made independent decisions for scoring the population. The scoring system ranged from the very Caucasian effect, placed at "1" to "5" for the extremely Oriental appearance. The scores of "2," "3," and "4" served to categorize the intermediate gradations.

From the net result of this study it does not seem that the concept of simple dominance validly describes the manner of inheritance. At least two sets of genes are involved and the intermediate hybrid scores are suggestive of additiveness.

SISTER JULIE PATRICE, S.N.D.
Honolulu, Hawaii

12. QUARANTINE INTERCEPTIONS OF INSECTS AND ARTHROPODS OF PUBLIC HEALTH IMPORTANCE ON AIRCRAFT AND POTENTIAL DANGERS TO HAWAII

A number of hitchhiking insects are found aboard aircraft coming to Hawaii. In spot checks during the period 1955–1959, 2,341 planes were thoroughly inspected with a recovery of 10,835 insects. The insects were found on 56.5 per cent of those inspected, with an average of 8.19 per positive aircraft. Only 5.4 per cent of those recovered were recorded as alive or knockdown.

The insects recovered were distributed into 17 separate orders with the order Diptera comprising 70.1 per cent of the total. A total of 31 families of Diptera are represented in the recoveries. Of the Diptera, 41.3 per cent were in the family Tendipedidae with the families Muscidae and Culicidae ranking second and third respectively.

Many species of public health importance are included in the list. The housefly is the most common insect encountered indicating poor sanitation at some ports. The German cockroach is second in abundance. Several species of filth inhabiting and myiasis producing flies have also been recovered, some of which are exotic. Some recoveries of health interest are chicken mites, primary sheep maggot flies, the tropical bedbug, cat and human fleas, and the human crab louse. The American dog tick, *Dermacentor variabilis,* a vector of rocky mountain spotted fever, has been found on dogs from the Mainland. Some exotic species of biting gnats are also included in recoveries. Rats and mice have only rarely been encountered on aircraft.

A total of 54 species of mosquitoes have been recorded to date as being taken from aircraft, only 2 of which are already present in Hawaii. Less than 3 per cent of the mosquitoes were alive when recovered. Included in the list are 15 *Anopheles,* 12 *Aedes,* 13

Culex, 7 *Mansonia*, 3 *Culiseta*, 1 *Psorophora*, 1 *Aedeomyia*, 1 *Chaoborus*, and one of undetermined genus. The most common mosquito encountered is the cosmopolitan *Culex quinquefasciatus* followed by *Culex whitmorei*, an abundant pest species in the Philippines. *Anopheles subpictus indefinitus* which recently gained entrance to Guam is the most frequently encountered anopheline.

Some of the mosquito recoveries of vector importance are as follows: *Anopheles freeborni*, a malaria vector of the western United States, five other malaria vectors from the orient and southeast Asia, *Aedes dorsalis*, a possible vector of encephalitis in the U. S., *Aedes vigilax*, a vector of filariasis in New Caledonia, *Culex annulirostris*, the suspected vector of Murray Valley encephalitis of Australia, *Culex tarsalis*, the principal vector of western equine encephalitis in the United States, and *Culex tritaeniorhynchus*, the principal vector of Japanese "B" encephalitis.

Although many species of insects and arthropods of public health importance do get aboard aircraft, their numbers are not great and most are dead when recovered. The introduction of exotic species is a potentiality but the danger is not acute with the precautions currently employed, sanitation and control about airports, treatment and inspection of aircraft, and surveillance to detect new introductions.

CHARLES R. JOYCE
Public Health Service Quarantine Station
Honolulu, Hawaii

13. CONCERN WITH ACHIEVEMENT AS MEASURED BY A SENTENCE COMPLETION BLANK

The Dole Vocational Sentence Completion Blank is a semiprojective counseling aid. Concern with achievement, 1 of 24 categories scored on the Dole Vocational Sentence Completion Blank, is defined as an expressed need for goal attainment. Approximately 4 per cent of scoreable responses on this 46-stem free-response inventory are classified achievement on an average protocol. A scorer's data is considered acceptable for research when his average overlap of agreement with a second trained scorer exceeds 75 per cent in the independent categorization of each response.

The coefficient of stability of the achievement category over a two week period was .85 for 24 tenth-grade boys and .56 for 26 girls. Males expressed significantly more achievement concerns than females in samples of Hawaii high school students and of continental college students under 21. But samples of older male students and of Hawaii public school teachers did not differ significantly from females. Of three male student groups in business curricula, the means of two were significantly higher than the mean of a college norm group. Students in engineering at Ohio State University and a group of Micronesian males attending the University of Hawaii did not differ from the norm group. Female students in mainland business curricula, and in nursing and home economics at the University of Hawaii did not differ from the female college norm group.

It is concluded that these findings contribute evidence on the concurrent and content validity of the Dole Vocational Sentence Completion Blank achievement category; however, establishment of predictive validity might be difficult and impractical. Also the construct of achievement seems rather complex. In sum, achievement concern, as defined and scored, may lead to useful comparisons in terms of the respondent's public, perceived, cultural, developmental, and sexual role.

ARTHUR A. DOLE
University of Hawaii
Honolulu, Hawaii

HAWAII DIVISION

1. ORNAMENTAL TREES AND SHRUBS OF HAWAII

No abstract available.

IRWIN LANE
University of Hawaii
Honolulu, Hawaii

2. HISTORY OF HAWAIIAN FORESTRY

The Hawaiian Islands are located at the northern edge of the Torrid Zone in the Pacific Ocean 2,100 miles southwest of San Francisco. They are of volcanic origin and contain 6,425 square miles.

The first settlers, ancestors of the present Hawaiians, migrated to Hawaii probably about 150–200 A. D. They brought with them many of their food and utility plants.

After the arrival of the white man in 1778 many changes took place: A new type of agriculture was introduced; grazing and browsing animals were brought in; sandalwood was cut and exported; untold damage was done to the native forest, particularly by cattle.

About the middle of the nineteenth century, this damage had become so great that conservationists became alarmed and an organized effort was started to counteract it. Reforestation was begun and valuable exotic trees were introduced. Planting took place on all of the main islands.

The first government forester was David Haughs, who took office in 1893 and served under the monarchy. He later became Forest Nurseryman in which capacity he served for many years.

In 1903, a Division of Forestry was established. Ralph Sheldon Hosmer became the first Superintendent of Forestry, and served for ten and one-half years. He organized the present forest service, established thirty-seven forest reserves containing nearly 800,000 acres, fenced the reserve boundaries, removed wild stock, and planted trees.

Charles Sheldon Judd succeeded Hosmer on January

16, 1915, and served until his death in 1939. He carried on the work started by Hosmer. He left behind records which are proving of value to today's foresters. Judd completed the work of fencing the forest reserve boundaries. He planted millions of trees, and removed and eradicated destructive wild animals.

From 1918 to 1949, Dr. Harold L. Lyon of the Hawaiian Sugar Plantation Association did invaluable work in reforesting the important watersheds. He introduced thousands of new plants for this purpose. During his lifetime, he probably contributed more to Hawaiian forestry than any other individual.

Since Judd's time, William Crosby (1939–1955), and Walter Holt (1955–1960) have carried on the work started by their predecessors.

Of recent years, the production of timber has received considerable attention. It is estimated that there are at least 500,000 acres on the island of Hawaii suitable for this purpose. Several species which produce good quality lumber are known to do well. However, water has always been the most important product of Hawaiian forests.

The preservation of rare native trees has received attention. Over forty different species have been planted in five different arboreta.

LESTER W. BRYAN
Deputy State Forester
State of Hawaii

3. WILDLIFE MANAGEMENT RESEARCH IN HAWAII

No abstract available.

RONALD L. WALKER
Board of Agriculture and Conservation
Hilo, Hawaii

4. THE OZONE LAYER AND ITS IMPORTANCE TO LIFE

No abstract available.

JACK C. PALES
Mauna Loa Observatory
Hilo, Hawaii

5. MICROBIOLOGY: A BIG WORLD OF LITTLE THINGS

The field of microbiology covers all studies of microscopic living things. There are many specialties within it. Vast numbers of different microscopic organisms are known. Contrary to popular conception, most of these are beneficial or, at least, harmless to man. Higher plant and animal life would be virtually impossible in the continued absence of microorganisms. One gram of good soil may contain 1,500,000,000 bacterial cells, 50,000,000 yeast cells, 300 nematodes and several thousand other living organisms. All the bacteria in the soil of an area equal to Oahu to a depth of 1 foot would fill 200 five-ton trucks and amount to about 171 septillion cells. Microorganisms do a large amount of work because of their high ratio of surface to volume and have many digestive enzymes. They are useful in industry, in hygiene, and in furnishing food for higher plants and animals. Research to make greater use of this big world of little things is of great importance.

E. J. ANDERSON
Pineapple Research Institute
Honolulu, Hawaii

6. PLANTS AND THE SEA

Apart from their intrinsic scientific interest, marine plants merit the attention they are currently receiving for two reasons which have public importance. First, as photosynthesizers they are among the primary producers of organic matter, and their habitat comprises about twice the area occupied by the other primary producers, the land plants. Second, even though we may temporarily increase the photosynthetic yield of the land areas by fertilizing marginal farms or by raising *Chlorella* in mass culture, there is a steady loss of nutrients from land to the sea by erosion. Again, it is the marine plants to which we must look for possible salvage of these lost nutrients.

The macroscopic algae have for centuries been harvested for food, especially in Asia. Shortages of potash in World War I and of agar in World War II turned the attention of the western countries to their marine resources, and modest industries have developed. The interest in potash was short-lived; carragheenin and agar (from red algae) and algin (from brown algae) are the main products now processed. Estimates of the standing crops of commercially useful seaweeds range in the millions of tons for the Pacific coast of North America, the British Isles, and Norway, with lesser though still economically valuable quantities elsewhere. However, when all shores are considered and allowance is made for the distance offshore to which the shore vegetation extends, it appears that the macroscopic algae inhabit no more than 2 or 3 per cent of the euphotic zone of the oceans. The photosynthesizers in the rest of the euphotic zone are the phytoplankton.

Whereas estimates of the macroscopic algae have been almost completely in terms of standing crops, studies of the phytoplankton have emphasized the rate of production. From such investigations we hope to obtain useful figures concerning the sea's potential. At present we are far from unanimity, but the range of estimates suggests that somewhere between 15 and 50 billion tons of carbon per year are "fixed" by the phytoplankton in all oceans. Productivity of the land, on the other hand, is estimated at 24 billion tons of carbon per year. Unfortunately, the water masses which would have to be filtered render it unfeasible to harvest the phytoplankton directly, even in localities where growth is richest. Exploitation of this potential will apparently continue by the same means as in the past, i.e., by fishing, but it is expected that fishery technology, like livestock farming, will increase in efficiency as knowledge concerning the base of the food pyramid increases.

ALBERT J. BERNATOWICZ
University of Hawaii
Honolulu, Hawaii

7. PEACEFUL USES OF ATOMIC ENERGY

No abstract available.

GEORGE BURR
HSPA Experiment Station
Honolulu, Hawaii

8. WEATHER PREDICTION, PAST, PRESENT, AND FUTURE

No abstract available.

SAUL PRICE
U. S. Weather Bureau
Honolulu, Hawaii

9. RECENT PROGRESS IN DIAGNOSIS AND TREATMENT OF HEART DISEASE

No abstract available.

GEORGE H. MILLS
Honolulu, Hawaii

10. RECENT PROGRESS IN THE KNOWLEDGE OF MAN IN THE PACIFIC

No abstract available.

ALEXANDER SPOEHR
Bishop Museum
Honolulu, Hawaii

NECROLOGY

HAROLD SCHJOETH PALMER

Harold S. Palmer, a charter member of the Academy and its fifth President, died October 24, 1959, at his home in Honolulu.

Dr. Palmer was born in Cleveland, Ohio, June 4, 1890. He received his B.S. from Yale in 1912 and his Ph.D. in geology from the same university in 1923. He also studied at the University of Vienna. His early professional experience was with the U.S. Geological Survey, mostly in ground-water work in New England.

In 1920 Dr. Palmer came to Honolulu to become Assistant Professor of Geology at the University of Hawaii and also to undertake ground-water studies for the Honolulu Board of Water Supply. His connections with both of these institutions persisted throughout his life.

At the University, Dr. Palmer became Professor, later Senior Professor, and in 1955 Emeritus Professor of Geology. He was Director of Graduate Work from 1925 to 1934. It is estimated that his students numbered over 5,000. In 1959 he was awarded an honorary certificate for his service to the University.

Dr. Palmer early recognized the applicability of the Herzberg principle, whereby fresh ground water floats upon salt ground water, in the basal aquifers of Honolulu. His studies for the Board of Water Supply of basal and high-level ground water resources in Honolulu were added to in later years, particularly those following his retirement from active teaching, by a large number of studies of ground-water resources in various parts of the island of Oahu and on other islands. Besides his ground-water studies, Dr. Palmer published on a large number of geologic topics.

A number of scientific societies in Hawaii owe a great deal to Dr. Palmer's organizing abilities. He was active in the original formation of the Academy, and besides serving as its president in 1929-30, was Councilor for one year. He was also an organizer of the Academy's predecessor, the Natural Science Club of Hawaii, of which he served as secretary-treasurer, and of the Academy's associated society, the Hawaii Chapter of the Society of Sigma Xi.

His students and his colleagues alike will always remember Dr. Palmer with affection and respect, and the effects of his work will remain of great significance for a long time.

CARL ERIC REPPUN

C. Eric Reppun died at Hilo, Hawaii, on December 5, 1959. He was 44 years of age.

He was born at Terlyan, Russia, on November 13, 1915. He escaped from the Bolsheviks with his parents and older brother, Frederick, through Siberia to Vladivostok and then to Japan. The family arrived in Hawaii in August, 1920.

Mr. Reppun graduated from Punahou School in 1934 and attended Harvard University until 1938. With but three months remaining before graduation, he left Harvard and returned to Honolulu because of family difficulties and responsibilities occasioned by an automobile accident involving his father.

In February of 1938 he joined the Research Department of the Hawaiian Pineapple Company, Ltd. He left Hawaiian Pineapple Company in 1946 to start the Pacific Pineapple Company on Molokai with Philip E. Spalding, Jr., and Randolph Crossley.

He was appointed president of the Board of Commissioners of Agriculture and Forestry in July, 1956, and, following Hawaii statehood, Commissioner of Public Lands in August, 1959.

He was a trustee of Punahou School and served on the Athletic Council and Alumni Association. He was a member of the Board of Directors, Mental Health Association, and of the Hawaii Heart Association. He served as chairman of the Hawaii Soil Conservation Committee and of the Governor's Committee on Better Farm Communication. He was a member of the following committees: Advisory Committee to the Land Study Bureau at the University of Hawaii; Committee on Civil Service Problems; Committee, Hawaii Development Council; Governor's Salary Studies Committee; and Shade Tree Council.

C. Eric Reppun undertook his many responsibilities with intelligence, energy, and enthusiasm. His abilities were of a high order and he was called upon to serve in many capacities. He responded freely to such calls, giving whatever measure of strength he had to all the demands and responsibilities that came his way, counting not the cost nor the return.

While he delegated responsibility well, yet he became familiar with and sufficiently competent in each of the many aspects of his work as president of the Board of Commissioners of Agriculture and Forestry and as Commissioner of Public Lands so that his decisions were based on his own considered judgment as well as advice from his staff. He explored the forests and public hunting grounds with forest rangers and game biologists, and dove to the ocean floor using an aqua lung with fishery biologists. His knowledge of Hawaiian lands and resources was wide and he used this knowledge forcefully and well in representing the needs and problems of his agency at legislative hearings.

He was a warm and friendly man, well liked and appreciated by those who worked for him and with him. His dedication to his family, his friends, and his work, and his complete honesty and intelligence made his passing difficult to bear.

Mr. Reppun is survived by his wife, Molly; children, Karen May, Carl Eric, Jr., Nina Elizabeth, and Arthur Fredrick; his mother; and two brothers.

JOHN C. RIPPERTON

John Carson Ripperton was born February 16, 1891 in Belle Plaine, Kansas. Graduating from Fairmount

College in Wichita, he obtained his master's degree at Kansas State University. Following teaching assignments at the University of Nebraska and Texas A and M, he joined the U. S. Department of Agriculture and moved to Washington in 1916. After serving in the Army's Chemical Warfare Division in World War I, he moved to Hawaii with his bride and served for 16 years on the staff of the Federal Experiment Station on the slopes of Punchbowl.

When that activity was transferred to the University of Hawaii in 1936, he continued his research as an agronomist in the Agricultural Experiment Station for the following twenty years. He retired in 1956 as Professor Emeritus and head of the Department of Agronomy.

His thirty-six years of service to the Territory of Hawaii left a lasting mark on the agriculture of the islands. His published reports included the mapping of climatic zones adapted to various forage crops, the feeding value of koa haole, and the suitability of new pasture grasses.

Widely respected for his technical accomplishments, he was also highly regarded by his associates as a warm, generous and steadfast friend. John Ripperton was one of Hawaii's agricultural stalwarts whose memory will be cherished by all who appreciate the lasting value of such a leader when enriched with human compassion and fine judgment.

J. WARREN WHITE

J. Warren White, orthopedic surgeon, died September 12, 1959, of a heart attack while photographing the San Souci shoreline from a rubber raft off Waikiki. He was 67 years old. He had considerable professional ability and mechanical ingenuity. In 1955 he was elected to the presidency of the American Orthopaedic Association. He had a bouncing drive coupled with an ever-present sense of humor. His car was an office away from the office, equipped with electric fan, scratch pads, and if I am not mistaken a reading rack. All of these were attached in the forward part of the car by various mechanical devices utilizing suction, magnets, etc. Driving from place to place was either a great nuisance or challenge—I could never decide which. At any rate, his driving was always the quickest time between two points.

Last year he won the El Toro sailboat racing contest, even though he turned over once during the race. A few years ago he propelled his one-man outrigger canoe by a giant kite high in the sky. He abandoned this after a troublesome experience with a strong off-shore breeze. He enjoyed greeting the New Year with the longest string of firecrackers that he could hoist up the flagpole at his home on Ualakaa Street. He looked forward to starting a new year because every year was for him better than the last. When enough of his friends had gathered around the vicinity of the flagpole, he would quietly light the long chain of firecrackers. There were only near casualties. On one occasion while dictating late at night around 11 o'clock or so, I heard a fierce pounding coming from the unfinished basement of the Straub Clinic. Going downstairs that warm summer evening to investigate, I found Dr. White, shirtless and beaded with perspiration, making the necessary alterations on the small shoes of his young patients whose parents could not afford special orthopedic shoes. The next day, he would exhaust a group of colleagues from the Mainland by personally conducting them to the very top of Diamond Head. For him, even watching the setting sun was an exciting adventure, especially rewarding if he could spot the green flash as the sun sank below the horizon beyond Kaena Point.

He belonged to countless lay and professional organizations, not as a passive onlooker, but as an active participant. Just a few years ago, he presented an exhibit before this organization on the surgical treatment of complications of leprosy. He was a gifted and conscientious physician. On many occasions in the parking lot in front of The Queen's Hospital, I passed his wife, Helen, reading a book by flashlight as Warren made his late hospital rounds.

He was a contagious personality, and it was impossible not to share some of his enthusiasm for medicine and life.

FRED I. GILBERT, JR.
Straub Clinic
Honolulu, Hawaii

CONTRIBUTORS

Earle M. Alexander Company
American Association for the Advancement of Science
American Chemical Society, Hawaiian Section
American Institute of Electrical Engineers
American Society of Agronomy, Hawaii Chapter
American Statistical Association, Hawaii Chapter
Anonymous
Anthropological Society of Hawaii
Armed Forces Communications and Electronics Association
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Institute of Radion Engineers
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Naomi Kuniyuki
Mr. and Mrs. J. Guy Lewis, Detroit, Michigan
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The Medical Group
Frank Midkiff
National Association of Naval Technical Supervisors
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Pacific Chemical and Fertilizer Company
Palolo Lions Club
Pearl Harbor Rotary Club
Pineapple Research Institute
Rotary Club of Waikiki
Alfred P. Sloan, Jr. Foundation
Society of the Sigma Xi, Hawaii Chapter
R. M. Towill Corporation
United States Army
United States Navy
Von Hamm-Young Company
Wahiawa-Waialua Kiwanis Club
Waikiki Kiwanis Club
Waikiki Lions Club
Watumull Foundation
West Honolulu Rotary Club
Alexander Young Company, Ltd.

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Akau, Thelma I.
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Alberts, Albert A.
Aldrich, W. W.
Alexander, Henry A.
Alexander, W. P.
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†Anderson, Earl J.
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Doi, Misugi
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---
* Member, American Association for the Advancement of Science.
† Fellow, American Association for the Advancement of Science.

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Nakagawa, Yukio
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*Palafox, A. L.
*Palmer, Clarence E.
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Pang, L. Q.
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†Payne, John H.
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†Sanford, Wallace G.
†Sanford, Wallace G. (Mrs.)
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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE...

THIRTY-SIXTH ANNUAL MEETING . . . . 1960 - 1961

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CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

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PRESIDENTIAL ADDRESS 1961

PLANT BREEDING TODAY

John N. Warner[1]

Five years ago, as his presidential address before this Academy, Dr. Willis Gortner delivered a memorable message entitled "Biochemical Pathways to the Infinitesimal." In his address, Dr. Gortner described new methods of biochemical analyses which enable scientists to recognize and study minute quantities of matter and to relate them to their function in complex biological systems.

If we were going to dwell on the subject of modern genetics this evening, we might well have considered a title similar to Dr. Gortner's. Recent advances in genetics, in the area of chromosome and gene structure and gene action, might well have been described under the title "Infinitesimal Pathways to Biochemical Functions." For, indeed, modern geneticists are making tremendous strides in gaining an understanding of the complex pathways through which the genes control life in all of its diverse forms.

The gene, a hypothetical unit of heredity, was well understood, we thought, at the end of the first four decades of this century. It was just that—a hypothetical unit of heredity—which caused predictable things to happen in plants and animals. Today, modern geneticists are no longer as sure of what the ultimate gene is or how it functions. Nevertheless, the classic concept of a gene is useful, and is satisfactory from an operational standpoint.

This divergence between those who are working to understand the gene and those who accept the operational concept of the gene is, in effect, the divergence between the geneticists and the breeders, both plant and animal. Similar divergences have developed in other disciplines between the fundamental and the applied scientists; between biochemistry and biophysics on the one hand and physiology on the other; between the nuclear physicists on the one hand and the applied chemists and physicists on the other. Those working on basic questions in their respective fields lead the way to providing new insights into fundamentals, while on the operational level the applied scientists put to practical use the new discoveries for the more direct benefit of mankind.

This evening we will focus for a short while on one of these operational areas, that of plant breeding, and explore briefly its present status and its future prospects.

First of all we might raise the question as to why we should be devoting millions of dollars and precious scientific man-hours in this area of plant breeding while we spend billions of dollars to accumulate and store agricultural surpluses. Offhand this appears to be a curious anomaly and, as taxpayers, we have a right to raise questions as to the soundness of trying to increase yields in an era of overproduction. It is only when we examine the world requirements for increased food production today and, in fact, the predictable needs of our own country in the years just ahead, that the activity in question becomes justified. In the first place it is impractical to consider cessation of plant breeding until the need is more apparent and then step up the activity to meet a new demand. This course of action is impractical both from the standpoint of maintenance of breeding stocks and maintenance of an adequate number of trained plant breeders. Also it is impossible from the standpoint of the time lag between the initiation of crossing work in a breeding program and the final release and utilization of improved varieties, often 10–20 years, or longer.

But consider for a moment the question of food deficits—or the problem of feeding the world. It is said that over a third of the world's population of three billion people is undernourished. Consider the rate of world population increase—more than forty-five million people per year. The world's population has approximately tripled in the last 110 years. In other terms, it has been estimated that of the total number of human beings born since the beginning of the Christian Era, and who survived to the age of five years, one-half of this total population is alive today. So there doesn't seem to be room for dissension from the argument that the problem of feeding the world today, and in the future, is of vital concern. Even in the United States, with our current overproduction of farm products, the population is increasing at the rate of 1.7 per cent per year. This means our population, and presumably our consumption, will double in less than 44 years. At the same time we are currently losing a million acres, or 1,600 sq. mi. per year, to urban expansion and associated highway construction, airports, reservoirs, etc. While not all of this area is farm land, something over half, say, 800 sq. mi. per year, represents agriculturally useful land that is being diverted to nonagricultural uses.

Returning to the area of plant breeding, we might briefly review what has happened since the rediscovery of Mendel's laws in 1900 put plant breeding on a scientific basis. This is not to belittle the progress made by plant breeders, or plant selectors, prior to

[1]Senior Geneticist, Hawaiian Sugar Planters' Association Experiment Station.

1900. Progress made by prehistoric man in domesticating crop plants from their wild relatives makes the total crop improvement in historic times seem insignificant. To illustrate, consider the tremendous progress made in prehistoric times in the domestication of the small grains, maize, and sugar cane. In the latter two cases the wild relatives are so different from the domesticated forms that we are not even sure by what route domestication took place. Certainly, modern plant breeders would find it very difficult to create *Zea mays* and *Saccharum officinarum* from the wild species available today.

Since the advent of Mendelism, the examples of crop improvement in terms of yield, quality, disease resistance, and agronomic suitability are many. Perhaps the classic example is maize, where the adoption of hybrid corn not only increased per acre production by about 20 per cent over adapted open-pollinated varieties, but also reduced man-hour requirements per acre through improvements in resistance to lodging and stalk-rot, in ear placement and plant type, and in adaptation to mechanized agriculture. Grain sorghum is another spectacular example. When first introduced into the United States about a hundred years ago, this tropical grass was confined to the warmer parts of the South and Southwest. The originally introduced forms grew taller than a man's head and had to be harvested by hand. During the past forty years earlier and shorter (dwarf) strains were developed with the help of new germplasm from temperate areas of Asia, so that today sorghum is grown successfully as far north as South Dakota and stands only 3–4 feet high at harvest. The latter characteristic has been extremely important in the success of sorghum as a crop plant in the United States because it has permitted harvest by combine. Comparable improvements have been made in small grains, vegetable and fruit crops, and, in fact, in almost every plant cultivated by man.

Before going any further, let me dispel any impressions that crop improvement can be attributed solely to the plant breeders. Such is certainly not the case. Modern crop improvement has resulted from the close cooperation of people in many related disciplines—agronomists, pathologists, entomologists, nematologists, plant physiologists, and agricultural engineers, to name a few. In many cases substantial improvements have come from a single discipline, but more frequently they have come from interdisciplinary cooperation. In general, the plant breeders provide populations of seedlings, or lines, which include as high a proportion as possible of genetically desirable forms. Selection is then based on requirements set by the environment, by the other disciplines, and by the over-all economics of crop production. However, plant breeding is basic to almost all crop improvement programs merely because the plant breeder provides the plants.

If we can assume, then, that plant breeding, in cooperation with other disciplines, has made progress during the past half-century (and I'm sure there is little room for argument in this statement), what then does the future hold? The problems can logically be divided into two major areas: first, those concerned with maintaining present production levels and, second, those concerned with achieving a break-through to new and higher levels.

Offhand, the first problem, that of maintaining present yield levels, would seem to be out of the realm of the plant breeder's concern, but not so. Having produced an acceptable high-yielding variety, the plant breeder must continue to work to keep production high because of the constantly changing environment. The changing environment has many aspects: economic, agronomic, and biologic, to mention a few. Increasing economic pressures dictate constantly changing farming methods and these, in turn, dictate new and specific requirements for crop plants. Here we might mention the necessity to improve quality and to create plant types better adapted to more efficient kinds of mechanization. The agronomic environment also changes. Urban and industrial requirements for land dictate the shifting of farm areas to different environments and to less productive soils, or at least different soils, and this often requires new varieties. Depletion of soil nutrients due to long-continued cropping, loss of topsoil or degradation of soil structure due to increased mechanization, may also dictate new varietal requirements. These changing environmental factors present new challenges to the plant breeder even if he is just to retain present yield levels, but perhaps the most important aspect of the changing environment is biological.

The biological environment is, to a large extent, influenced by the genotype of the crop plant. The problem arises from the fact that there is a myriad of organisms—viruses, bacteria, fungi, nematodes, insects—which are parasitic on crop plants. These organisms have a great deal of genetic variability within their various species and, under the selection pressure exerted by the host crop plant, more virulent strains are bound to emerge as predominant. Several examples will serve to illustrate the problem.

In oats, in the 1930's and 1940's great progress was made in breeding for resistance to crown, leaf and stem rust, and smut. Among each of these species of pathogens are various physiologic races to which resistance was obtained from a number of parents and combined into several resistant varieties. As it turned out, most of these new resistant varieties had a common ancestor, the Victoria variety of oats, which contributed needed genes for resistance to specific rust races. Shortly after the varieties derived from Victoria had virtually taken over the midwest oat acreages in the late 1940's, a previously unknown *Helminthosporium* appeared and caused almost catastrophic losses. Unrecognized by breeders and pathologists, the Victoria derivatives carried a gene for susceptibility to the new *Helminthosporium.* This gene was closely linked to one of the desirable genes for resistance to crown rust. The new disease, called "Victoria blight," was unknown until susceptible hosts were widespread and exerted extreme selective pressure on a rare organism.

In our work with sugar cane, we are only beginning to appreciate the significance, and the potency, of the genetic variation in the pathogens. We are particularly concerned with the complex of pathogens in the soil. With sugar cane we plant a genetically uniform host plant over thousands of acres and its roots are active in the soil for 6–10 years without benefit of crop rotation or fallow. We thus create a near-ideal situation for the selection and multiplication of a rare specific pathogen capable of attacking the particular variety. The pathogen may be rare, or it may be nonexistent, when the variety is first planted. In the latter case it may appear through mutation, or through genetic recombination and segregation, and be selected by the host. The result is that the host loses vitality and lower yields result.

The genetic mobility of the pathogen complex under the influence of the host plant has serious implications for the plant breeder. Keeping abreast of this dynamic pathogen complex and maintaining yields at present levels will require concerted effort on the part of the plant breeders. While this type of problem has been widely recognized among those working on small grains, potatoes, citrus, and bananas, the implications with respect to other crops are widespread.

Let us now switch briefly to the other, and perhaps more romantic, goal of the plant breeder. I refer to the possibility of increasing yields into a new order of magnitude. How, or where, can we expect major break-throughs from the yield levels currently realized? Parenthetically I might say that there are some people who have expressed the opinion that the plant breeders have gone about as far as they can go and now will be hard put merely to hold their own.

The bases for any breeding and selection program are threefold: first, the genes available to the breeder; second, his ability to manipulate them into favorable combinations; and, finally, his ability to recognize and select superior new genetically stable forms. Fortunately, for the plant breeder, there are unexploited areas in all three of these aspects of a breeding program.

A new awareness of the importance of genetic diversity is becoming more prevalent among plant breeders. For example, corn breeders, long content to work within the limited genetic diversity available in the corn belt, are now looking to the West Indies, Central and South America for new breeding materials. Wheat breeders are exploring intergeneric hybridization and exchanging unadapted varieties on a larger scale than ever before in the hope of uncovering superior new gene combinations. Even the peanut breeders are exploring for wild relatives which might carry desirable genes.

I say "*even* the peanut breeders" because this is a crop where radiation-induced genetic variability has been reported to be of some potential value in breeding improved varieties. Another example comes from Sweden, where stiff-strawed barleys have been developed from radiation-induced mutants. However, difficulties in stabilizing this character in combination with other necessary traits have precluded the commercial adoption of varieties with this stiff-strawed character.

In recent years there has developed a great enthusiasm for the possibilities of inducing desirable mutations in crop plants through irradiation with gamma rays, X-rays, and neutrons. This enthusiasm has been attributable, in large part, to the millions of dollars of research grants available from the Atomic Energy Commission. Radiation-induced genetic variability may find useful application in crops with limited available natural variability, and in creating unusual horticultural forms where novelty is an important objective. In general, though, I believe that the usefulness of this approach has been greatly oversold as a panacea for plant breeders. The utilization of existing genetic variability found in nature, with classical techniques of breeding and selection, seems to be a much sounder approach. This is especially true in most of the underdeveloped areas of the world where the United States has installed nuclear reactors and gamma ray facilities, in part as a reputed tool for plant breeders, under the "atoms for peace" plan.

In the area of manipulation of genetic variability, i.e., the creation of hybrids and segregating populations, and the understanding of the mechanisms of heredity, the geneticists and cytogeneticists continue to make significant progress. As genetic mechanisms, including gene action and interaction, are better understood, the plant breeders can capitalize on the advances. In this connection, radiation-induced chromosomal translocations may permit gene recombinations involving nonhomologous chromosomes in wide hybrids and thus lead to significant break-throughs.

The outstanding example of this technique comes from the wheat breeders where the object was to incorporate a desirable gene for leaf rust resistance from the related genus *Aegilops umbellulata.* The gene in question was closely linked with undesirable genes for plant type. Selection in hybrids and backcrosses to common wheat was unsuccessful in breaking the linkage. Selections fell into two categories: those with the desired gene for resistance and undesirable plant type and those with desirable plant type but lacking the gene for resistance. A monosomic derivative of the intergeneric hybrid which had one *Aegilops* chromosome, containing the desired gene, and 42 *Triticum* chromosomes was irradiated. In one progeny plant, an intercalary translocation occurred where it was found that the gene for rust resistance had been inserted in a normal wheat chromosome while the rest of the *Aegilops* chromosome, with its undesirable genes, had been lost.

In addition, the statistical geneticists, armed with electronic computers, are helping define the most efficient breeding schemes in terms of maximizing genetic progress. An interesting recent development is the use of an *Arabadopsis* species as a laboratory plant to study breeding and selection methods. This tiny self-pollinated plant can be cultured in test tubes under controlled environments (temperature, light, nutrient media) by applying techniques similar to those used in the classic genetic studies with *Drosophila melanogaster, Neurospora crassa,* and *Escherischia coli.*

With regard to improving selection techniques, again the statistical geneticists are making significant progress through study of the interactions between genotypes and environments, the efficiency of selection criteria, and many related subjects. However, in using this approach the statistical geneticists have had to make certain simplifying assumptions in setting up their genetic models. In many ways these assumptions have fallen short of reality when related to actual genetic complexities in nature. With the adoption of highly complex statistical designs, and with the increased computational capabilities of new electronic computers, fewer unrealistic assumptions are necessary and the results are becoming more meaningful.

Several weeks ago I had the privilege of participating in a symposium on statistical genetics and plant breeding sponsored by the National Academy of Sciences in Raleigh, North Carolina. The sessions were very productive and much excellent work was reported, but there seemed to be a hope among some of the plant breeders present that an infallible system of selection might be formalized with the aid of statistical techniques. At present, this possibility seems to me to be very remote. The statisticians can provide powerful tools for the plant breeders, but to make selections a plant breeder must have an intimate, first-hand familiarity with his plants in the field. He must, as far as possible, understand the manifold effects of the environment and genotype-environment interactions in order to make intelligent decisions. We are a long way from being able to standardize and categorize the many plant characters used in selection to the extent necessary to turn decision-making over to a computer.

We have seen that temporary agricultural surpluses in the United States should not be used as an argument to reduce activities in the field of plant breeding. With widespread undernourishment prevalent in the world today and with the present rates of population growth, the problem of producing foodstuffs, and the agricultural products for industry, will become increasingly acute. In the United States, population growth and associated reduction of present farm areas due to urban development dictate a need for greater efficiency in the use of crop acres. Changing environments—economic, agronomic, and, especially, biologic—will require continuing varietal replacements. Plant breeders are necessary and vital members of the teams of scientists needed to insure the future well-being of our civilization. Armed with a better understanding of genetics and related disciplines, the plant breeders are confident that significant advances can, and will, be made for the benefit of mankind.

ANNUAL REPORT 1960-61

The thirty-sixth year of the Academy ended with a total membership of 845. There were four Council meetings during the year at which the chairmen of the special and standing committees were in attendance. We record with regret the death of seven members during the past year: Dr. C. E. K. Mees, Mr. R. E. Doty, Mr. H. S. Iwata, Mr. F. W. Walek, Mr. E. Coleman, Mr. C. K. Humphries, and Dean A. R. Keller.

The Secretary wishes to extend the thanks of the Academy to Mrs. Shizuno Ebisuzaki for her unstinting efforts in assisting him with his duties.

Donald P. Gowing, Secretary

FINANCES

Balance on hand April 30, 1960			
Bank of Hawaii (4/27/60)		$ 2,475.07	
Cash not deposited		11.00	
First Federal Savings & Loan		596.15	
		3,082.22	
Less checks outstanding		100.00	$ 2,981.37
Receipts			
Dues		1,396.00	
AAAS Grant		43.26	
Annual Dinner, 1960, 81 reservations		263.65	
Dividends, First Federal Savings & Loan		24.08	
National Science Foundation Grants			
G12407, Teachers' Science Seminars		1,370.00	
G12446, Hawaiian Science Clubs' Service		19,650.00	22,746.99
			$25,728.36
Disbursements			
Annual Dinner, 1960, 79 reservations		264.65	
HAS-Hawaii Division		22.25	
Mailing Expenses		377.15	
NSF Grants			
Teachers' Science Seminars		2,793.09	
Hawaiian Science Clubs' Service—to University of Hawaii		19,650.00	
Printing—Proceedings, 1959/60		639.57	
Supplies		219.76	
Miscellaneous			
AAAS Grant—Donald Chipp	$ 43.26		
P. O. box rental	9.00		
Refreshments	19.28		
Science Education Fund	200.00		
Student Science Seminars (to be refunded)	60.00		
Third Annual Science Fair banquet tickets (refund)	91.00	422.54	24,389.01
Balance March 31, 1961			$ 1,339.35

Balance on hand March 31, 1961		
Bank of Hawaii	$ 749.12	
First Federal Savings & Loan	620.23	
	1,369.35	
Less checks outstanding	30.00	$ 1,339.35

Status of Dues Payments:

	April 1960	March 1961
Advance	$163.00	$161.00
Arrears	300.00	296.00
Applications		20.00
Complimentary Memberships		17

Audited and found correct April 10, 1961.

(s) Chester A. Wismer
(s) Beatrice H. Krauss

TEACHERS' SCIENCE SEMINARS

(Administered by Hawaiian Academy of Science)
National Science Foundation Grant—G8432

Amount of grant	$ 4,160.00	
Expended prior to 4/30/60	2,051.87	
Balance 4/30/60		$ 2,108.13
Disbursements		
Travel and per diem	1,547.57	
Refund to NSF	560.56	2,108.13
Balance February 28, 1961		0000
National Science Foundation Grant—G12407		
Amount of grant, June 7, 1960		$ 1,370.00
Disbursements		
Honoraria and per diem	555.00	
Travel	129.96	684.96
Balance March 31, 1961		$ 685.04

HAWAIIAN SCIENCE CLUBS' SERVICE
(Administered by the University of Hawaii)
National Science Foundation Grant—G8871

Amount of grant	$22,000.00	
Expended prior to 4/30/60	12,777.40	
Balance 4/30/60		$ 9,222.60
Disbursements		
Communications	$ 213.26	
Equipment	449.91	
Printing	59.00	

Repairs, maintenance, etc.	783.73	
Rentals	14.69	
Salaries & wages	1,622.01	
Shipping and freight charges	2.13	
Supplies	974.37	
Travel	1,317.35	
Miscellaneous (indirect cost allowance)	1,730.21	
Refund to NSF	2,055.94	$ 9,222.60
Balance September 16, 1960		0000

National Science Foundation Grant—G12446

Amount of grant, June 7, 1960		$19,650.00
Disbursements		
Communications	308.97	
Equipment	165.55	
Rentals	150.67	
Repairs, maintenance, etc.	1,419.03	
Salaries & Wages	5,031.59	
Shipping and freight charges	230.89	
Supplies	1,158.16	
Travel	1,262.75	
Miscellaneous (indirect cost allowance)	1,459.14	11,186.75
Balance February 28, 1961		$ 8,463.25

MUSEUMS IN MINIATURE
(Administered by the Bishop Museum)

National Science Foundation Grant—G8494

Amount of grant	$ 3,500.00	
Expended prior to 4/30/60	100.00	
Balance 4/30/60		$ 3,400.00
Disbursements		
Equipment	298.47	
Salaries, Wages & Honoraria	1,975.84	
Supplies	75.46	2,349.77
Balance March 31, 1961		$ 1,050.23

SCIENCE EDUCATION FUND
(Administered by Cooke Trust Co., Ltd.)

Balance April 30, 1960		$11,337.60
Receipts		
American Chemical Society	$ 100.00	
F. C. Atherton Trust	250.00	
Juliette M. Atherton Trust	1,500.00	
Bank of Hawaii	100.00	
S. N. & Mary Castle Foundation	1,000.00	
Charles M. & Anna C. Cooke Trust	500.00	
First National Bank	100.00	
Frear Eleemosynary Trust	250.00	
Hawaiian Academy of Science	200.00	
H. C. & D.	100.00	
Hawaiian Electric Co., Ltd.	200.00	
HSPA Experiment Station	1,195.53	
Hawaiian Telephone	200.00	
McInerny Foundation	1,000.00	
Pineapple Research Institute	1,195.53	
Watumull Foundation	100.00	
West Honolulu Rotary	100.00	
Alexander Young	100.00	
von Hamm Young	100.00	
Miscellaneous Contributions	581.25	8,872.31
		$20,209.91
Disbursements		
Printing & Publicity	115.60	
Science Fairs		
Third Annual Science Fair	4,395.01	
Fourth Annual Science Fair	500.00	
Student Science Seminars	823.04	
Supplies	222.48	
Miscellaneous	206.06	6,262.19
Balance March 30, 1961		$13,947.72

THIRD ANNUAL SCIENCE FAIR
(Administered by Cooke Trust Co., Ltd.)

Balance April 30, 1960	(Debit)	$ 4,076.07
Receipts		
Banquet Tickets	$ 91.00	
Science Education Fund	4,385.01	
Travel refunds	610.00	
Miscellaneous	60.00	$ 5,146.01
Disbursements		
Insurance	17.50	
Supplies & Incidentals	18.96	
Travel & Transportation	808.00	
Miscellaneous	225.48	$ 1,069.94
Balance July 26, 1960		0000

FOURTH ANNUAL SCIENCE FAIR
(Administered by Cooke Trust Co., Ltd.)

Receipts		
Banquet Tickets	$ 435.15	
Science Education Fund	500.00	$ 935.15
Disbursements		
Awards	177.83	
Insurance	75.00	
Supplies & Incidentals	50.34	
Publicity & Posters	25.00	
Science Service Entry Fee	100.00	
Travel & Transportation	10.81	
Miscellaneous	42.67	481.65
Balance March 31, 1961		$ 453.50

Eleanor S. Anderson, Treasurer

MEMBERSHIP

This year 41 applicants were elected to membership. Eight science teachers who were, and 25 teachers who were not already members were offered honorary membership because of their successful guidance of students who won awards at the Hawaiian Science Fair.

The membership roll now shows 845 names, of which 38 have achieved life-time membership status.

Albert J. Bernatowicz, Chairman

AAAS FELLOWS

The individuals nominated for Fellowship in the AAAS were: Edward J. Britten, A. H. Cornelison, Dan A. Davis, John Digman, Gerald G. Dull, John A. Easley, Jr., H. Wayne Hilton, Alison Kay, Curtis A. Manchester, John C. Marr, James C. Moomaw, Loren F. Steiner, Sterling Wortman.

The names of the nominees were submitted to Dr. Dael Wolfle, Executive Director of the AAAS, in April, 1961.

Doak C. Cox, Chairman

PROGRAM

The thirty-sixth Annual Meeting of the Academy was held in two sessions, the first on November 9-10, 1960, and the second on April 20-22, 1961. A symposium on "The Origin of the Hawaiian Islands—the Land, Plants and Animals" by seven members of the Academy, and six professional papers were presented at the first session. An invitational paper on "Natural Products from Hawaiian Plants" by Paul J. Scheuer, two scientific papers written by high school students and eight professional papers were presented in the final session. At the Annual Banquet, which was held at the Hawaiian Village Hotel, the retiring president gave his address.

Three special sessions were held—one on October 25, 1960, to hear J. B. Harrar, Vice-President of the Rockefeller Foundation, speak on "American Science Abroad"; the second on February 9, 1961, to hear Dr. R. T. Overman, Oak Ridge Institute for Nuclear Studies, speak on "Modern Concepts in Nuclear Science"; and the third on February 23 to hear A. J. Eames, Professor Emeritus of the Department of Botany at Cornell University, speak on "Changes in Theories of Evolutionary Relationships Among Flowering Plants in Recent Decades." A joint session was held with the Geophysical Society of Hawaii on February 28 to hear "Volcanoes in Japan," by Dr. Hisashi Kuno, Geological Institute, University of Tokyo.

Gerald G. Dull, Chairman

CONSERVATION COUNCIL FOR HAWAII

The Conservation Council for Hawaii, now in its eleventh year, continues to bring many public and private organizations, as well as individuals, interested in conservation together to share their knowledge and coordinate their efforts.

Council officers for 1961 are: C. E. Pemberton, President; L. J. Watson, Vice-President; H. R. Welder, Jr., Secretary; and Agnes Conrad, Treasurer. Work of the Council is organized through five committees, chaired this year by Robert Nelson for Land Conservation; Robert Chuck for Water Conservation; Charles Lamoureux, Flora Conservation; William Smythe, Fauna Conservation; and Colin Lennox, Sites Conservation.

Having produced two issues in 1960, the Council will continue publishing a Bulletin on an intermittent experimental basis to keep the conservation community abreast of developments this year.

The Water Committee was most active in 1960 and culminated its work with a lecture at the Annual Meeting of the Council, February 10, 1961, by Dr. L. S. Lau of the University on "The Effect of Sea Water Intrusion on the Fresh Water Lens" explaining his theoretical and model studies on Oahu's basal water table made for the Board of Water Supply.

R. H. Cox, Representative

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The questionnaire concerning information and activities of the membership was sent out. About one-third of the questionnaires have been returned, and the results are now ready for tabulation.

Eleanor S. Anderson, Chairman

INTER-SOCIETY SCIENCE EDUCATION COUNCIL

The Inter-Society Science Education Council, during its third year, not only expanded its activities on Oahu and the Neighbor Islands, but improved the quality of services offered.

Organization. Three organizations were added to those already associated with the Academy in ISSEC. The societies now included in the membership, their presiding officers, and their representatives on the ISSEC Council are as follows:

American Association of University Women, Honolulu Branch—Florence Hodgson, Leonora Bilger; American Chemical Society, Hawaiian Section—Charles E. Mumaw, L. J. Rhodes, John H. Payne (alternate); American Society of Agronomy, Hawaii Chapter—E. J. Britten, Goro Uehara; American Statistical Association, Hawaii Chapter—Keith Wallace, Otto Orenstein, Richard Takasaki (alternate); Anthropological Society of Hawaii—Samuel Elbert, Robert Bowen, H. Ivan Rainwater (alternate); Engineering Association of Hawaii—Robert Britten, Doak C. Cox; Geophysical Society of Hawaii—Saul Price, Walter Steiger, Thomas S. Austin (alternate); Hawaii Dietetic Association—Nobuko Shiraki, Boletha Frojen; Hawaii Medical Association—T. H. Richert, Nils P. Larsen, Clarence E. Fronk (alternate); Hawaii Psychological Association—David Crowell, A. Leonard Diamond, Edgar Vinacke (alternate); Hawaii State Dental Association—F. A. Sandberg, Manuel C. Kau, Ralph Akamine (alternate); Hawaiian Astronomical Society—Robert G. Jack; Hawaiian Botanical Society—E. J. Britten, Charles Lamoureux; Hawaiian Entomological Society—J. H. Beardsley, Dale Habeck; Institute of Food Technologists, Hawaii Section—Ralph M. Heinicke, Ray Mori; Society of Naval Architects & Marine Engineers, Hawaii Section—Alvin T. Hansen, Guy Slaughter; Society of the Sigma Xi, Hawaii Chapter—Donald C. Matthews, George C. Chu.

Meetings. ISSEC meetings were held whenever the need for them arose to hear progress reports of committee chairmen and budget requests, to formulate general policies and to initiate new projects.

Activities. The services which ISSEC has been able to offer the young people of the community were received with such enthusiasm by them, their parents and teachers that it is most gratifying and very humbling. This has been possible only through the concerted effort of members of the scientific community, scientific institutions, organizations and business firms which have given so freely of their time, money, and materials. The brief account below gives no real idea of the tremendous amount of work done, nor does it credit many of the people who gave so generously of their time.

1. Science Fair

An estimated 15,000 people viewed the 129 Science Fair exhibits at the Dome, Hawaiian Village, during the Fourth Annual Hawaiian Science Fair, March 24-26. These exhibits were selected from more than 5,000 projects as reviewed by some 90 judges in public and private school fairs throughout the state. Twenty exhibits each were selected by the Hawaii and Maui County Fairs from school fairs held on those islands; 15 exhibits from Kauai and 74 from Oahu came directly from school fairs. Scientific reports, an innovation this year, were used to check the accuracy of on-site judging. This system also encourages students to learn the techniques of concise and logical scientific reporting. At the Awards Banquet, 78 awards were presented in recognition of 43 exhibits. These were in addition to 31 Grand Pacific Life Science Awards given to the most meritorious project in each high school. More than 300 persons in attendance at the banquet enjoyed a talk by President Laurence Snyder of the University of Hawaii, entitled "Framing Sensible Questions of Nature." Top awards went to Ronald Sakimura, University High School (Sugar Award, presented by the Hawaiian Sugar Planters' Association), Cynthia Rolfes, Kailua High School (Pineapple Award, presented by Pineapple Research Institute), Dale Yamamoto, Hilo High School (IRE Award, presented by the Institute of Radio Engineers, Hawaii Chapter), and Randall Ho and Frederick Mark, Washington Intermediate School (Clayton J. Chamberlain Memorial Award).

The two finalists, Cynthia Rolfes and Ronald Sakimura, took their projects to the National Science Fair, held in Kansas City, May 9-12. They were accompanied by Mrs. H. Ivan Rainwater, Chairman of the Exhibits Committee, and Dr. Gerald G. Dull, Associate Director of this year's Fair and Director of the Fifth Annual Hawaiian Science Fair, to be held early in 1962. They also accompanied Mrs. Rainwater to Washington, D.C., where she attended the National Science Foundation Conference of Directors of State Academies of Science Educational Programs. In Beltsville and Bethesda they had the opportunity to consult with scientists working in their fields of interest.

2. Science Library Resources

Three sets of the Traveling High School Science Library were circulated this year. One set went to schools on Hawaii where they had not been previously. One set circulated among four large public schools on Oahu and one set went to Oahu parochial schools. By the end of this year nearly all public and parochial schools will have had them although several non-Catholic schools have not.

This year Hawaii received two sets of Traveling Elementary School Science Libraries of 160 books each which are being used only in well-established centralized school libraries, preferably where special science programs are in progress. Eighty books were left at each school for one semester and then exchanged.

The *Science Book List for Children* (1,105 titles) was published by the American Association for the Advancement of Science and the National Science Foundation this year. ISSEC financed the purchase of 200 copies of this list for all elementary schools.

3. Teachers' Science Seminars

This series is intended to keep science teachers and others informed of current developments in a variety of scientific disciplines and to provide useful classroom materials.

The program of seminars, with subjects ranging from anthropology through zoology, on Oahu (rural and Honolulu) and the Neighbor Islands was carried out through the help of a National Science Foundation grant. Through the use of local scientists, careful scheduling of travel on grant funds, and use of speakers traveling on other funds who volunteered their time and services for the series, extra seminars were offered on the islands of Hawaii, Maui, and Kauai. In all, 46 seminars were given, or two more than the schedule of 44 called for in the grant.

Teachers' response to the seminar series has been overwhelmingly favorable. Many letters of appreciation were received and helpful suggestions offered as well as requests for specific topics or speakers. These were met a high percentage of the time. Attendance depended primarily on the teacher population in the area and on the publicity effectiveness for the program.

Cooperation was given to student groups by offering the services of most of the scientists for talks to Student Science Seminars and Science Clubs wherever convenient. The State Department of Public Instruction offered a 1/4 B credit to teachers attending five or more seminars in a series.

4. Counseling and Scholarships

Activities of this committee included (1) acquiring speakers for "Career Day" at McKinley High School and (2) developing a list of counselors to be circulated by ISSEC to local high school counselors.

5. Science Clubs Service

The program of the Hawaiian Science Clubs Service, supported by a grant from the National Science Foundation, was concentrated in the following areas.

a. Arranging field trips for science clubs. This service is the most popular of the program. On Oahu, about fifty trips were provided with fewer on Neighbor Islands.

b. Providing guest speakers for science clubs. Talks and presentations were given by 20 speakers, to more than 45 schools. Usage was about equal on Oahu and the other islands.
c. Distribution of science literature to all secondary schools. More than 125 science project ideas, club demonstrations, industrial brochures and science leaflets from many sources were distributed.
d. Circulating science films and filmstrips, either borrowed or purchased, to both science clubs and schools. About 50 loans were made each month, with each loan being viewed by 15 to 1,500 students.
e. Conducting workshops for science club advisors and science teachers. The workshops were attended by an average of 100 teachers. Their purpose is to provide science teachers and science club advisors with practical, useful information on types of projects possible and methods to use. The three summer workshops and the most recent, held in connection with the Fourth Hawaiian Science Fair, were all enthusiastically received. A great deal of credit goes to the scientists who put so much effort into the preparation for these programs.
f. Arranging science camps and cruises. New to this program this year was the arrangement of an Hawaiian Science Navy Cruise, a science-oriented two-day cruise for outstanding boys from each of the science clubs. The first 20 boys went from March 27-28, 1961; the remainder (about 40) will go this summer. A "Science Camp" is planned for the last weekend in April, 1961. About 150 students will attend two days of lectures and demonstrations by 30 scientists.
g. Assisting with the Teachers' Science Seminar Series. Frequent use was made of the Science Clubs Service communication with schools and scientists.
h. Conducting a loan program of surplus electronic material. A supply of military surplus electronic material was obtained and is available on a loan basis for science clubs.
i. Produced a weekly science television program from October, 1959 to February, 1961. The weekly science TV show was seen in 4,500 homes, and gained some notice among mainland education TV stations. The show, named *Science in Hawaii,* was suspended temporarily when a reduction of activities became mandatory.

The Science Clubs Service has been immensely successful. More schools have science clubs now than ever before in Hawaii. One major contribution was quite unexpected. Teachers seem a little prouder to be teachers. Recognition of the importance of their work has brought about an improvement in science teaching through the indirect route of improving morale among the teachers themselves.

6. Student Science Seminars

The Student Science Seminars program was designed to offer a select group of students of exceptionally high ability, instruction in scientific concepts, methods and applications, more advanced, rigorous and individualized than can at present be offered under the regular high school curriculum. The organization and development of content for the seminar sessions was determined by the participating students in cooperation with the director of the project. Twenty-six meetings were held on Oahu and 15 meetings on Maui. The average attendance at meetings was about 22 out of 25 on Oahu and 25 out of 27 on Maui. The director of the program has made arrangements to hold seminars on Hawaii and Kauai during the coming school year.

7. Museums in Miniature

The first increment of the Museum in Miniature project, financed by a grant from the National Science Foundation and administered jointly by the Academy and Bishop Museum, was completed during the year. This project involved the planning and construction of exhibits emphasizing the local application of general scientific principles. The exhibits were first shown to the public at the Open House at Bishop Museum in February, before being sent out for use in the schools. Invaluable help was given by members of the Museum staff and by persons in the local scientific community.

8. Teachers' Coordination and Science Talent Search

In addition to being responsible for the dissemination of information to all Oahu schools regarding the various activities of ISSEC, this committee also assumed the responsibility of conducting the Science Talent Search for Westinghouse Science Awards. Twelve students, eight from Oahu, three from Maui and one from Kauai, submitted personal data, took the Scientific Aptitude Tests in December, 1960, and wrote on "My Scientific Projects." Though none of these students won national honors, it is felt that they benefited from the experience. The papers were returned to Hawaii, where they were judged for state recognition. Three awards, consisting of Handbooks of Chemistry and Physics by Chemical Rubber Company, were given to David Crozier of Roosevelt High School, and to Martha Masaki and Carolyn M. Dote, of McKinley High School.

9. Elementary Science Texts

In 1955, the Roman Catholic Diocese of Honolulu initiated the publication of a series of supplementary science texts designed to guide elementary school children in the study of plants and animals of Hawaii and other local phenomena not usually covered in school texts of the temperate zone. The title of the series is EXPLORING NATURE IN HAWAII.

Books I, II, and III, published in 1955, 1956, and 1958 respectively, are directed to children in primary grades. They emphasize observation and identification of approximately fifty of the most common plants and animals of Hawaii plus a few fundamental science concepts. Book IV, published in 1959, introduces the study of plants by family groups, the maintenance of tropical aquaria and terraria and suggestions for student projects suitable at this level. Books V and VI are in process, with publication expected in August, 1961. Book I is under revision to include more color plates and the ISSEC approval on the title page.

Books VII and VIII, with revisions of Book II and possibly Book III, are planned for 1962. Teachers' Manuals accompany each text.

ISSEC agreed to endorse the books officially early in 1959, and a statement of this fact was placed on the title page of the next volume published. Members of the Academy contributed their aid and criticisms of the manuscripts.

In 1959, the texts were included in the list of books about Hawaii recommended for children by the Hawaii Library Association. In 1960, the DPI placed the series on the list of approved texts for use in the public schools. Distribution of these supplementary texts is spreading through the schools, not only in Hawaii, but also on the mainland, New Zealand, the Philippines, the Marshall Islands, and Central America.

10. Public Relations and Community Participation

Community support was generally very good. Publicity releases to all media totaled about 150. This included newspaper coverage of local and county fairs as well as the state fair. Radio and television coverage was helpful in promoting attendance at the fair. Other science education activities throughout the year were given excellent press coverage. The brochure explaining ISSEC activities was revised and circulated throughout the community and a start was made toward national publicity of ISSEC activities. There is a need for much more publicity, both locally and nationally, for the very important role ISSEC is playing in science education in Hawaii. Many people are not aware that these activities place our Academy among the top states in the nation in the promotion of science education. Though many academies of science offer science education programs to augment those of the schools, the scope and depth of the ISSEC program is probably unique.

By action of the Council of the Hawaiian Academy of Science, the office of Public Relations was given a position on the Council in order to serve more adequately the needs of the Academy.

11. Allied Activities

Of interest to ISSEC and the Academy, though not one of its own programs, is the Hawaii Junior Science Apprenticeship program sponsored by the University of Hawaii with the assistance of a National Science Foundation grant. Research organizations participating are: Bishop Museum, Hawaiian Sugar Planters' Association, Honolulu Biological Laboratory of the U. S. Fish and Wildlife Service, and Pineapple Research Institute, in addition to the University. Sixty-five students, chosen on the basis of scholastic standing, vocational aptitudes, interests, previous achievements, and personality, will devote seven weeks during the summer to study and work with scientists on pre-selected problems and preparation of reports.

The enthusiasm with which members of ISSEC have approached not only the projects which were their own concern, but also accepted additional responsibilities, has been most gratifying. Members of the scientific community, by their willingness to give every form of assistance, have made greater accomplishments possible. The coming year should see the completion of such projects as Museum in Miniature, though others will continue. Our emphasis in the past has been placed entirely on the training of future scientists. This was justified logically on the basis of the Academy's interest. The time has come when the Academy should look to the development of future citizens who, though they may not be potential scientists themselves, will have a greater understanding of what science is, what it can and cannot do, and what it needs.

ISSEC Council
Dorothy T. Rainwater, Chairman
H. Wayne Hilton, Vice-Chairman
Patricia Golden, Secretary
Dwight H. Lowrey, Treasurer

ISSEC COMMITTEES

Budget
John H. Payne, Experiment Station, HSPA
Community Participation
C. E. Nolan, Hawaiian Electric Company
Student Science Seminars
Albert B. Carr, University of Hawaii
Michael Hazama, Office of District Superintendent, DPI (Maui)
Elementary Science Texts
Sister Mary St. Lawrence, Catholic School Department
Museum in Miniature
Wilfrid Greenwell, Punahou School
Science Teacher Coordination
Edwin Y. H. Chinn, Office of District Superintendent, DPI
Public Relations
Robert E. Coleman, U.S.D.A., Crops Research Division
Science Library Resources
Carolyn Crawford, Department of Public Instruction
Teachers' Science Seminar Series
James C. Moomaw, University of Hawaii
Counseling and Scholarships
Arthur H. Lange, Pineapple Research Institute
Science Clubs
Donald C. McGuire, University of Hawaii
Donald Li, University of Hawaii
Science Fair
Director, J. B. Smith, University of Hawaii
Associate Director, Gerald G. Dull, Pineapple Research Institute
Secretary, Setsuko Nakata, Bishop Museum
Treasurer, Dwight H. Lowrey
Awards, Charles Lamoureux, University of Hawaii
Exhibits, Dorothy T. Rainwater, Bishop Museum
Sites and Props, Howard McAllister, University of Hawaii
Judging, Jules Fine, U.S.D.A., Agricultural Research Service
Hospitality, Frances Davis, University of Hawaii
Public Relations, Robert E. Coleman, U.S.D.A., Crops Research Division

NOMINATIONS

The Nominating Committee nominates the following as candidates for office for the 1961–62 Academy year:

President Elect:	Dr. Leonard D. Tuthill, Dr. A. J. Bernatowicz
Secretary:	Dr. Donald P. Gowing
Treasurer:	Mrs. Eleanor Anderson
Councilor:	Dr. Samuel Allison, Dr. G. G. Dull

President for 1961–62 will be Dr. Alexander Spoehr. Dr. John N. Warner will be a councilor, and Mr. William M. Bush will continue as a councilor.

R. L. Cushing, Chairman

OFFICERS

1960–1961

John N. Warner	President
Alexander Spoehr	President-Elect
Donald P. Gowing	Secretary
Eleanor S. Anderson	Treasurer
William M. Bush	Councilor (2 years)
Gordon A. Macdonald	Councilor (1 year)
Vernon E. Brock	Councilor (ex officio)

1961–1962

Alexander Spoehr	President
Leonard Tuthill	President-Elect
Donald P. Gowing	Secretary
Eleanor S. Anderson	Treasurer
Samuel D. Allison	Councilor (2 years)
William M. Bush	Councilor (1 year)
John N. Warner	Councilor (ex officio)

HAWAII DIVISION

The following officers were elected for the year 1961–62:

Dr. James Mitchell, Chairman
Dr. Kaoru Noda, Secretary-Treasurer
Mrs. Ruth Wong, East Hawaii Representative
Mr. Mark Sutherland, West Hawaii Representative
Dr. Chester Wentworth, Council Representative
Membership Committee: Violet Hansen, Chairman
Matthew Chow
Richard Penhallow
Harold R. Warner

There were 15 new members elected in 1960–61, bringing the total membership to 88.

The Hawaii Division conducted and co-sponsored a series of lectures in Hilo and Kona which served as Science Seminar for the teachers on Hawaii. Speakers and topics were:

Mr. Harold Krivoy: The Measurement and Use of Tilting of the Earth at Kilauea.
Mr. Michio Takata: Recent Developments in Fisheries Management.
Dr. Earl Linsley: You Are a Space Traveller.
Dr. T. Murashige: Plant Tissue Culture.
Dr. A. Abbott: Geothermal Steam for Power.
Dr. Wayne Ault: Volcanic Gases from Kilauea.
Dr. Jerry Eaton: Mechanics of Hawaiian Eruptions.
Mr. William Mileski: Introduction to Space Vehicles.
Dr. David Crowell: Behavioral Studies in the Neonatal Period.

The Hawaii Division joined the Department of Public Instruction and other community organizations and individuals in sponsoring a Hawaii County Science Fair with over a hundred exhibits. Twenty-six winners were sent to Honolulu. Dr. Kaoru Noda was the Academy representative on the joint committee organizing this activity.

Expenditures for 1960–61 were $27.51 for postage and office supplies. Income from membership dues was $22.25, and about $10.00 additional was donated, bringing the bank balance to $37.02. The budget for 1961–62 is $50.00.

Chester K. Wentworth, Chairman

The 36th
ANNUAL MEETING 1960-61

Program

SPECIAL SESSION I

October 25, 1960, University of Hawaii, Honolulu
J. G. Harrar: American Science Abroad

FIRST SESSION

November 9, 1960, Experiment Station, HSPA, Honolulu

1. Warner Wilson: Correlates of Avowed Happiness.
2. Gilbert Sax and Albert Carr: An Empirical Evaluation of the Spiral-Omnibus Form of Item Arrangement.
3. Donald L. Plucknett: Concentration of Aluminum in Various Plant Parts of *Rhodomyrtus tomentosa.*
4. Chan Street: Bellamy Drift Indicator.
5. Robert H. Riffenburgh: On Estimation Errors in Distribution Extremes.
6. Harry L. Arnold, Jr., and Frank H. Haramoto: Skin Eruption Caused By *Pyemotes boylei* Krczal Following Fumigation of Dwelling for Termites.

November 10, 1960, Experiment Station, HSPA, Honolulu

A Symposium

The Origin of the Hawaiian Islands—The Land, Plants, and Animals.

7. Agatin Abbott: Formation of the Islands.
8. Vernon E. Brock: Ocean Currents.
9. Alison Kay: Shellfish.
10. William A. Gosline: Marine Vertebrates.
11. Maxwell S. Doty: Establishment of a Primary Community.
12. James Moomaw: Origin of Land Plants.
13. Ryoji Namba: Origin of Terrestrial Animals.

SPECIAL SESSION II

February 9, 1961, Experiment Station, HSPA, Honolulu
Ralph T. Overman: Modern Concepts in Nuclear Science.

SPECIAL SESSION III

February 23, 1961, Experiment Station, HSPA, Honolulu
Arthur J. Eames: Changes in Theories of Evolutionary Relationships Among Flowering Plants in Recent Decades.

SPECIAL SESSION IV

Sponsored jointly with the Geophysical Society of Hawaii.
February 28, University of Hawaii, Honolulu
Hisashi Kuno: Volcanoes in Japan.

FINAL SESSION

April 20, 1961, Experiment Station, HSPA, Honolulu

1. Paul Scheuer: Natural Products from Hawaiian Plants.
2. Robert H. Riffenburgh: A Sociometric Identification of Hawaiian Stereotypes on the Basis of Multiple Measurements.
3. John M. Digman: Dimensions of Childhood Personality Emerging from Teachers' Judgments.
4. Alan Rixon and G. Donald Sherman: Calcium Aluminum Relationships Resulting from Liming Soils of Hamakua Coast.
5. Robert G. Rigler: Radioiodine Therapy of Hyperthyroidism.

April 21, 1961, Experiment Station, HSPA, Honolulu

6. Cynthia Rolfes: Can the Dog Tick Act as Intermediate Host to Heartworm?
7. Ronald Sakimura: Nematode-Trapping Fungi.
8. E. H. Bryan, Jr.: The Pacific Scientific Information Center.
9. Ruth Sherman and Arthur A. Dole: Determinants of the Choice of a Science Program by Sixth Grade Boys.
10. Carey D. Miller and Nao S. Wenkham: Effect of Diet on Blood Pressure of Rats.
11. Robert A. Nordyke: Individual Kidney Function Testing with Radioactive Tracers.

April 22, 1961, Hawaiian Village Hotel, Honolulu
Banquet
Introduction of New Officers
Presidential Address
John N. Warner: Plant Breeding Today.

Abstracts

FIRST SESSION

1. Correlates of Avowed Happiness

The avowed happiness of 329 college students was measured with a questionnaire and correlated with a large number of other variables. Among the positive correlates were: energy, health, social adjustment, family adjustment, success in dating, estimated happiness of parents, and conservatism in attitudes toward sex and religion. The reported discrepancy between need for achievement and actual achievement, sensitivity, and a desire for a high grade average were negative correlates. Rank in high school class, college board scores, college grades, spending money, family income, occupation and education of parents, and need for achievement did not prove to be significant correlates. The data suggest that, in the case of the population in question, social and family adjustment and the adoption of a realistic and moderate attitude toward achievement are important determinants of happiness, whereas intellectual ability, material circumstances, and actual level of achievement seem unimportant.

WARNER WILSON
University of Hawaii
Honolulu, Hawaii

2. An Empirical Evaluation of the Spiral-Omnibus Form of Item Arrangement

At least two ways exist in which items may be presented to an examinee. Traditionally, all of the items measuring the same subject matter, such as mathematics, were grouped together to form separate subtests. However, in the spiral-omnibus form of organization, different types of items (such as mathematics, vocabulary, etc.) are intermixed and are placed in increasing order of difficulty. It was believed that an analysis of the spiral-omnibus and the subtest form of item arrangements would not only help fill a gap in the theory of measurement, but would also contribute to an understanding of response sets if subjects respond differentially on two forms of the same test where one form is in spiral-omnibus arrangement and the other is in a subtest organization.

Three hundred thirty-five freshmen in an introductory course in education at the University of Hawaii were given forms A and B of the Henmon-Nelson Tests of Mental Ability. These tests are arranged in spiral-omnibus form and contain vocabulary, mathematics, and spatial relationship items. Forms A and B had both been equated so that a student obtaining a given score on one form would obtain a similar score on the other form. On one form of the Henmon-Nelson Tests items were cut and reorganized into separate subtests and placed in increasing order of difficulty; on the other form the items were presented in the original spiral-omnibus form.

To reduce practice effects, approximately half of the group took the spiral-omnibus form first, followed by the subtest form, whereas the procedure was reversed for the other half of the group. The directions and time limits were the same for both groups.

An analysis of the results indicated that students attempted significantly more items on the spiral-omnibus form than they did on the subtest form.

Students also attained significantly higher scores on the spiral-omnibus form. The differences in the number correct were greater than one could explain by differences in the number attempted.

No statistically significant differences were found between the two forms on Kuder-Richardson Formula 20 reliabilities or on validity coefficients found by correlating test scores with grade-point averages.

In summary, evidence as to the presence of a response set was indicated, inasmuch as students attempted significantly more items and obtained significantly higher scores on the spiral-omnibus than on the subtest form of item arrangement. At least on the mathematics items, students tended to eliminate a significantly larger number of items at the end of the subtest form than they did on the spiral-omnibus form. No differences in reliability or in validity could be found.

GILBERT SAX
ALBERT CARR
University of Hawaii
Honolulu, Hawaii

3. Concentration of Aluminum in Various Plant Parts of *Rhodomyrtus tomentosa*

Rhodomyrtus tomentosa was introduced on Kauai about 50 years ago and since that time has become dominant on and around Kilohana Crater. Since field observations indicate an association of *Rhodomyrtus* with the bauxitic soils of Kauai, it was decided to study the relationship of *Rhodomyrtus* and soil aluminum.

One phase of the study was designed to test aluminum uptake by *Rhodomyrtus* from soils of bauxitic areas. Preliminary field samplings of leaves from various soils were made with two samples taken from each plant, old leaves and young leaves. Young leaves were sampled as the second pair of new leaves of the shoot, while old leaves were sampled as the fourth to sixth pair of leaves of the shoot. Analysis of these leaves indicated that old leaves contain higher concentrations of aluminum than young leaves. Average concentration for old leaves was 132 ppm, while the average concentration for young leaves was 33 ppm. There was no difference statistically between areas sampled.

A pot experiment was established using five soils with six replications. Three months after *Rhodomyrtus* seedlings were planted the seedlings were harvested and aluminum analysis was run on the roots, stems, and leaves. The concentration gradient of plant parts was as follows: roots>stems>leaves. The differences in concentration between plant parts were found to be highly significant statistically, although there was no statistical difference between concentrations of plant parts from different soils. Average values for two representative soils were as follows: Hanamaulu soil series: roots, 1951 ppm, stems, 879 ppm, leaves, 435 ppm; Kapaa soil series: roots, 1501 ppm, stems, 674 ppm, leaves, 289 ppm.

Since the concentration gradient in *Rhodomyrtus* plant parts follows the relationship roots>stems> leaves, it is suggested that aluminum precipitates in plant tissues and is relatively immobile in the plant. It seems possible that aluminum could precipitate as aluminum phosphate, which could explain some of the problems of phosphate nutrition in tropical soils.

In view of the concentration differences in plant parts of *Rhodomyrtus* it is suggested that the tissue sampled as a basis for aluminum accumulation is of the greatest importance. Conventionally, a plant with 1000 ppm or more of aluminum is considered an aluminum accumulator. By this standard, *Rhodomyrtus* would not be an accumulator if aluminum is measured in leaves; however, if root measurements are used, it would be an accumulator. Since leaf samples are most often used, perhaps aluminum accumulation should be based on leaf concentration.

DONALD L. PLUCKNETT
University of Hawaii
Honolulu, Hawaii

4. Bellamy Drift Indicator

This device makes a continuous recording of data from which the cross-wind component affecting a plane in flight may be determined. Its function depends on the pressure changes to be found wherever there are geostropic winds. The term "geostropic wind" actually applies to all winds. The motion of air in the atmosphere blows along the isobars and the strength of the wind is a function of the pressure gradient. If this gradient can be determined, then the cross-wind component may be calculated.

A plane in normal flight flies at a constant-pressure altitude; that is, it always maintains an altitude so that the atmospheric pressure is constant. Thus, as it moves into regions of higher or lower pressure it ascends or descends to follow this plane of constant pressure. By determining the change in altitude thus produced, the change in pressure may be determined. From an equation developed by Dr. John C. Bellamy, the lateral drift may be calculated if the differences between the pressure and absolute altitude are known for two different points in a flight.

The instrument under discussion measures the absolute altitude with a radar altimeter and the pressure altitude with a very sensitive pressure transducer. The resulting "D" value is then continuously recorded on a small portable recorder that can sit on the navigator's table. The precision of measurement is to the order of 10 feet up to an altitude of 40,000 feet.

The data so recorded will show the presence of "shear" winds that would otherwise go unnoticed by the spot-check method. In addition, it gives a continuous detailed check on the pressure pattern over the oceans that are now known only in their broad patterns. Another advantage of this instrument is that by observing the pattern recorded, it is possible to find and hold the jet streams at high altitude and thus shorten the flight time to the most efficient pattern.

CHAN STREET
Street Laboratory of Applied Physics
Honolulu, Hawaii

5. On Estimation Errors in Distribution Extremes

In many cases data are observed which are approximately normally distributed in the region about the mean, but which become impossible rather than highly improbable when quite deviant from the mean. If the probabilities at the end points of the closed interval defining the possibility range are nonzero, truncation is appropriate, and the theory is well known. However, if the probabilities approach zero as a limit at the end points, truncation is inappropriate. This paper presents a transformation to a quasi-normal probability function with finite range. Such a transformed function will usually be an approximation to the population function, but an approximation better than the original normal approximation. However, sometimes it will be an exact distribution, and an example of this case is given.

Some uses for the quasi-normal transformation follow: Where the transformation is appropriate, the power functions of tests associated with the distributions will be markedly altered. By the same reasoning, the two types of errors are affected in making tests of hypotheses, with resulting alteration in sample size required or alternatively in significance level. When there are desired estimates of probabilities associated with values of the independent variable in the vicinity of the ends of the range, a very large improvement in the accuracy of the estimate follows the transformation.

Under the assumption of the variate x standard-normally distributed, the theory for the transformation to x is a subset of $[-c,c]$, c a constant, and $\lim_{x \to -c^+} f(x) = 0$ and $\lim_{x \to c^-} f(x) = 0$, is worked out for the cases: the variance known, the variance unknown. In the first case, the transformed probability function and its mean and variance are obtained. $E(x) = 0$ and $E(x^2)$ is given as a function depending on the incomplete gamma distribution. It is shown that $E(x^2) < 1$, the variance of the normal prior to the transformation, and $E(x^2)$ is tabulated for 38 values of c. Similarly, when the variance is unknown, Student's *t*-distribution is assumed and the transformation is effected. The functional form of x is rather intractable mathematically, but not too restrictive conditions covering most applications are specified under which a simplification may be made.

Tests of hypotheses on the mean and variance are set up for both cases.

An example is given in which the transformed function is the exact distribution related to the schooling strategy of fish. An example is also given in which the probabilities of a type I error and a type II error in a *t*-test are evaluated more accurately, the application being a comparison of the mean percentage present of an erythrocyte antigen in sardines in two geographical regions. It is pointed out that in quality control the transformation, if appropriate, permits the probability of accepting a defective item to be estimated more precisely and hence improves the control system.

ROBERT H. RIFFENBURGH
Honolulu Biological Laboratory
Honolulu, Hawaii

6. SKIN ERUPTION CAUSED BY *Pyemotes boylei* KRCZAL FOLLOWING FUMIGATION OF DWELLING FOR TERMITES

A family was observed, all the members of which were afflicted with a generalized intensely itchy eruption apparently due to insect bites. The persistence of these suggested mites as the cause, but no source was apparent. The home had been fumigated about 2 weeks before to kill termites. It was learned through the fumigating company that they had found that the grain mite *Pyemotes boylei* Krczal might leave its haunts on the coleopterous larvae in the beans on any of various trees (in this instance, a large monkeypod tree) and live on the bodies of dead termites in fumigated houses. This phenomenon is described in some detail. Spraying the home with a miticide stopped the eruption promptly.

HARRY L. ARNOLD, JR.
FRANK H. HARAMOTO
Straub Clinic
Honolulu, Hawaii

THE ORIGIN OF THE HAWAIIAN ISLANDS—THE LAND, PLANTS, AND ANIMALS

A Symposium

No abstracts available.

FINAL SESSION

1. NATURAL PRODUCTS FROM HAWAIIAN PLANTS

The major emphasis of our research program has been placed on the isolation and determination of molecular structure of alkaloids from endemic Hawaiian plants. Alkaloids are an attractive class of chemical constituents since most of them are physiologically active and they can be isolated without resort to a bioassay. Plant species may be selected for study on several grounds: they may belong to a family which has never been studied chemically; they may be botanically related to plants which have produced interesting substances elsewhere; or they may have found application in folk medicine.

Hawaii has over 1,200 endemic plant species. Only one of these, *Erythrina sandwicensis,* had been studied chemically when the present research was initiated in 1954. We began a systematic survey of the Hawaiian flora for alkaloids. To date, 180 species have been tested of which 42 have been shown to contain alkaloids.

Five new alkaloids have been isolated from four species in Apocynaceae. The structures of two of these, sandwicine and holeinine, have been completely elucidated. Holeinine, which was isolated from *Ochrosia sandwicensis,* represents the first example of a quaternary ammonium base to have been found in Apocynaceae. The crude alkaloid mixture from *O. sandwicensis* has hypotensive activity. The structures of two new alkaloids from two endemic species of Rutaceae have been determined. One of these, 6-methoxydictamnine, which was isolated from the bark of *Platydesma campanulata,* is one of two "missing" dimethoxyfuroquinoline alkaloids.

Part of our research effort has been devoted to a study of nonalkaloidal constituents. We have investigated the essential oil of *Pelea anisata* (Rutaceae), which was shown to contain anethole as its major constituent; the bitter principle of *Tacca Leontopetaloides* (Taccaceae), which is a complex anhydride of composition $C_{18}H_{26}O_7$; a minor constituent of *Piper methysticum* (Piperaceae); and the bark of *Eugenia malaccensis* (Myrtaceae), which has been reported to have been used as an antidote against fish poisoning.

One of our investigations has dealt with the volatile constituents of an economic plant, *Passiflora edulis* (Passifloraceae). We have established that 95 per cent by weight of the volatile oil consists of only four compounds, all of them unbranched aliphatic esters. One of these, n-hexyl caproate, was isolated for the first time from a natural source.

It is a pleasure to acknowledge the collaboration of the following graduate students and postdoctoral fellows: M. Y. Chang, D. N. Hiu, L. P. Horigan, J. T. Horigan, W. R. Hudgins, L. A. Madamba, J. T. H. Metzger, C. E. Swanholm, and F. Werny, as well as financial assistance by the following agencies: University of Hawaii Research Committee, Research Corporation of New York, National Institutes of Health, National Science Foundation, Eli Lilly and Co., Smith, Kline, and French Laboratories, Abbott Laboratories, Mead Johnson and Co., and the Western Regional Laboratory through a grant to Professor G. D. Sherman.

PAUL J. SCHEUER
University of Hawaii
Honolulu, Hawaii

2. A Sociometric Identification of Hawaiian Stereotypes on the Basis of Multiple Measurements

The problem is to characterize groups by summaries (mean vectors and dispersion matrices) of sets of measurements of some sociological event for each member of each of a set of groups and thence to compare and establish "distances" among the groups on the basis of these summaries. "Distances" are measured by Mahalanobis' D^2 statistic. Topics investigated are: the establishment of presence or absence of significant distances, simultaneous confidence intervals, diagrammatic representation, reduction of variables, and identification of sociological factors involved. An example is given of racial stereotyping in Hawaii. The sample consisted of 266 students from University of Hawaii elementary sociology classes. A forced ranking on a 1-to-5 basis was required on 7 questions involving (1) study effort, (2) wealth, (3) sex, (4) imagination, (5) happiness, (6) political opportunity, and (7) responsibility, where the choice to rank groups were Chinese, Filipino, Haole, Hawaiian, and Japanese. These choices were presented in randomized order for each question. Only Chinese, Japanese, and Haole appeared in numbers adequate for statistical inference, but male and female differences appeared, so the seven judging groups were male and female of these three ethnic groups, plus a pooling of all students.

Some of the great many inferences made from the study follow.

1. Females are much more sensitive to stereotyped differences than are males for all groups.
2. Japanese females are the most sensitive of all.
3. Haole males are the most accepting (i.e. least sensitive to differences) of all.
4. Any group will agree to another group's being more desirable on some characteristic or other, but place themselves second; no one is willing to take worse than second place.
5. Each of the Chinese, Japanese, and Haole groups saw themselves as different from the other two, but saw little difference between the other two.
6. For the pooled set of groups, the Chinese and Japanese were thought to be more alike than any other pair.
7. Filipinos were almost universally ranked in the least desirable position.
8. Females of all groups exhibited a tendency to regard their own group as more desirable than did the males of that group.
8. Comments 1, 2, 3, and 8 and several other cues offer a suggestion (but not a conclusion) that University of Hawaii females are more self-important and class-conscious than males.
10. Highly correlated were questions 1 with 6, 1 with 7, 2 with 6, 5 with 7 (negatively), and 6 with 7.

ROBERT H. RIFFENBURGH
University of Hawaii
Honolulu, Hawaii

3. The Principal Dimensions of Childhood Personality as Inferred from Teachers' Judgments

A total of 102 first- and second-grade children, all enrolled in grades I and II at the University of Hawaii Laboratory Schools, were judged by their teachers with respect to 38 characteristics, using the method of successive categories as the scaling procedure. Sex was added as a dichotomized variable, and all variables were intercorrelated.

A factor analysis of the resulting matrix indicated the presence of 11 factors. These were identified as: Superego Strength, Aggressive Hostility, Cheerful Extroversion, Aesthetic Sensitivity, Intelligence, Status Concern, Social Confidence, Neuroticism, Sex, Parental Attitude, and one unidentified minor factor.

Considerable correspondence with the results of similar studies at the adult level was noted, suggesting that the phenomenon of personality undergoes its principal elaboration during the very early childhood years.

JOHN M. DIGMAN
University of Hawaii
Honolulu, Hawaii

4. Calcium Aluminum Relationships Resulting from Liming Soils of the Hamakua Coast, Hawaii

Soils of the Hamakua and Hilo coasts on the island of Hawaii are derived principally from volcanic ash. In a humid climate this material has altered rapidly with a heavy loss of bases and silica. Highly amorphous soils having a considerable aluminum content have been produced. These soils are highly acidic. Sugar cane is grown on these soils and the possibility of aluminum toxicity is considered. Thus, any modifications of the forms of this element in these soils is thought to be of importance.

A series of replicated applied lime experimental plots are being conducted on soils of the Hilo, Akaka, and Kaumoali series. Lime in the form of crushed coral stone was used. Rates of 4,000, 11,000, and 22,000 pounds lime per acre were applied to the Hilo series, Hilo Plantation, and to the Akaka series, Hakalau Plantation. Rates of 4,000, 19,000, and 34,000 pounds lime per acre were applied to the Akaka series, Pepeekeo Plantation. Rates of 12,000, 30,000, and 46,000 pounds lime per acre were applied to the Kaumoali series of Paauhau Plantation. Soil samples were taken approximately 5 months after the plots were established.

Soil pH and exchangeable calcium values were obtained. Ammonium acetate, barium chloride solution buffered to pH 4.8, was used to extract aluminum. Ammonium aurine tricarboxyllate was used in the colorimetric determination of aluminum. The soils were kept in firmly tied polyethylene bags to retain field moisture, and for each sample a moisture factor was determined.

Applications of crushed coral stone resulted in increased exchangeable calcium accompanied by decreased extractable aluminum. This situation was consistent for the four experimental areas. The soil pH values increased with each addition of crushed coral stone. There were no examples where the soil reaction had attained the neutral value of pH 7.

Linear relations btween exchangeable calcium and extractable aluminum for the four investigated areas have been established. Exchangeable calcium and extractable aluminum values are represented by X and Y, respectively. For the Hilo series the equation was $Y = -0.253X + 10.25$. For the Akaka series, Hakalau Plantation, the equation was $Y = -0.368X + 15.17$ and for Pepeekeo Plantation it was $Y = -0.223X + 15.72$. For the Kaumoali series the equation was $Y = -0.267X + 21.46$.

A highly significant negative correlation between exchangeable calcium and extractable aluminum has been obtained for soils belonging to the Hilo, Akaka, and Kaumoali series on the island of Hawaii.

ALAN RIXON
G. DONALD SHERMAN
University of Hawaii
Honolulu, Hawaii

5. Radioiodine Therapy of Hyperthyroidism

Hyperthyroidism, or increased activity of the thyroid gland, produces signs and symptoms of nervousness, tremor, weight loss, intolerance to heat, exophthalmos, gastrointestinal symptoms, muscular weakness, rapid pulse, cardiac arrhythmias, heart failure, and even death if uncontrolled.

Iodine is stored in the thyroid gland and incorporated into thyroid hormone. The avidity of the thyroid for iodine is roughly proportional to its activity and the concentration of a radioactive iodine tracer or therapeutic dose enables accurate diagnosis and treatment.

While hyperthyroidism may be temporarily controlled by stable iodine or antithyroid drugs, cure is best accomplished by surgical resection of part of the gland or intensive selective irradiation by I^{131}.

In a study of all cases of hyperthyroidism treated by radioiodine at the Straub Clinic over a 4-year period, the following results and conclusions have been reached:

1. The results of this series parallel and compare favorably with other published series.

2. At the time of this writing, 61 of 63 patients treated, or 97 per cent, are clinically well from a thyroid standpoint with two patients exhibiting persistence of disease which will require re-treatment. Five patients are taking thyroid extract. A completely euthyroid state was achieved in 56 patients, or 89 per cent.

3. Five of our patients, or 8 per cent, became permanently hypothyroid and 11 patients, or 17.5 per cent, required an additional therapeutic dose. Radioiodine therapy causes permanent hypothyroidism in about 9 per cent of patients treated for unknown reasons.

4. The higher incidence of hyperthyroidism among patients of Japanese and Chinese ancestry in our series above the general population may be significant and needs further study.

5. Hyperthyroidism can be controlled with reliance, economy, and safety and without pain by radioiodine.

R. G. RIGLER
Straub Clinic
Honolulu, Hawaii

6. Can the Dog Tick Act as Intermediate Host to Heartworm?

The heartworm, *Dirofilaria immitis*, is a white, viviparous nematode which attains a length, in the adult stage, of 6–12 inches. It inhabits the right ventricle and pulmonary artery of the dog host's heart, and produces young called microfilariae which migrate to the peripheral blood vessels to facilitate ingestion by an intermediate host in which three stages of the life cycle occur. Several species of mosquitoes have been established as suitable intermediate hosts to *D. immitis* but evidence is lacking of any extensive investigations of other blood-sucking arthropods such as fleas or ticks. The latter was of particular interest to me because I possessed a dog diseased with heartworm that was also heavily infested with the brown dog tick, *Rhipicephalus sanguineus.* Although ticks are not equipped with wings and could not therefore transmit *D. immitis* widely as do the mosquitoes, it seemed possible that they could be responsible for the constant reinfestation of the dog upon which they were feeding.

In order to establish whether or not the brown dog tick could act as an intermediate host to heartworm, the following procedures were utilized: 1. Blood samples were taken from the dog and upon examination were found to contain a large number of microfilariae, indicating a heavy infestation of the animal with *D. immitis.* 2. Ticks were removed from the dog and the examination of smears of their bloodmeal indicated that microfilariae had been ingested. 3. The same ticks were dissected to determine whether or not the microfilariae had migrated to other organ areas as they would in a suitable intermediate host. None were observed, indicating that they had either been digested, autolyzed, or overlooked. 4. The remains of the dissected ticks were run through the Baermann apparatus to insure against oversight. Water samples from this apparatus did not contain microfilariae, strengthening the idea that they had been digested or autolyzed. 5. Interval blood samplings from the tick were examined to determine how long the ingested microfilariae remained in the tick. After 1 hour, none was observed.

On the basis of this evidence, I would conclude that the brown dog tick does not act as an intermediate host to heartworm.

CYNTHIA ROLFES
Kailua High School
Kailua, Hawaii

7. Nematode-Trapping Fungi

The nematode-trapping fungi are part of the general group of predacious fungi which kill and consume microscopic animals. Since Zoph in 1888 first recognized *Arthrobotrys oligospora* as a trapping fungus of nematode, a few more species were described, but it was not until 1935–37 that Drechsler described and redescribed 20 to 25 species of the fungi, bringing this interesting microorganism into the spotlight. Locally, the late Dr. Linford, in 1936–1937, observed numerous local species of the fungi and carried out some experiments on utilization for biological control. Twenty years later, Dr. Klemmer worked on the predacious activity in relation to pineapple trash decomposition.

The objective of my project was collection and partial identification of the nematode-trapping fungi, present in Hawaiian soil. This was necessary for a thorough understanding of the organisms in order to continue more complex experimentation in the future.

The first method used was a simple sprinkling of a few grams of soil on water agar (2 per cent) plates and incubating for a short period. Since this method was found unsatisfactory, another method developed by Dr. Klemmer was used. In this method a soil-agar suspension strip was placed on corn meal agar adjusted to 10 per cent nutrients to keep down more vigorous growth. Free-living nematodes obtained by Baermann apparatus were inoculated and the plates were incubated at 25–26°C. In all 250 to 275 aliquots were made out of 80 different soil and root samples during the past 5 months. The species recognized were *Stylopage hadra* Drechs., *Arthrobotrys musiformis* Drechs., *A. oligospora* Fres., *A. dactyloides* Drechs., *Dactylella asthenopaga* Drechs., *D. ellipsospora* Grove, and *Dactylaria psychrophila* Drechs. Of these seven, *S. hadra, D. asthenopaga,* and *D. psychrophila* were unrecorded locally.

Individual conidia of the various trappers were picked off and transferred to nutrient agar (corn meal agar 10 per cent, modified malt agar 10 per cent, agars adjusted to pH 4–5, beef agar, and water agar 2 per cent) plates and slants, and broth of similar nutrients. In this way five isolates were obtained. A sixth species, *S. hadra,* being an obligate parasite, was not isolated successfully.

RONALD SAKIMURA
University High School
Honolulu, Hawaii

8. The Pacific Scientific Information Center

A clearinghouse for information about the geography, natural and social sciences of the oceanic Pacific islands has been established at Bishop Museum, made possible by a grant from the National Science Foundation. Its first undertaking has been to try to learn "who knows what" about these subjects regarding Polynesia, Micronesia, Melanesia, New Guinea, and closely related areas; to begin to abstract the bibliography; to accumulate and file notes, maps, and air photographs of the area; and to investigate ways and means for reproducing graphic materials. Most of all, the Center seeks the cooperation of all persons intersted in the Pacific area, believing that the objectives can be attained best through their cooperative efforts. Its information is being timed to serve the Tenth Pacific Science Congress and to seek the assistance of its delegates.

E. H. BRYAN, JR.
Bishop Museum
Honolulu, Hawaii

9. Determinants of the Choice of a Science Program by Sixth Grade Males

Twenty-three per cent of all sixth grade males (1,322 pupils) enrolled in public schools in Hawaii, were surveyed on a permissive basis to discover what interests, values, and external influences they would report as determinants of their choice of one of five secondary school study programs. This paper was concerned with identifying distinctive determinants of the choice of the college preparatory science program. A secondary purpose of the study was to determine whether certain personal and socioeconomic attributes were related to the reported determinants of science program choice.

The population was separated into two groups, differing in school district. A "local" group consisted of 574 males drawn from schools located in urban Honolulu and the neighbor islands. Fifty per cent of these boys were of Japanese parentage; 9 per cent were of Caucasian background. Thirty per cent, the largest single percentage, reported they were sons of skilled workers.

A "military" district group included 748 males enrolled in schools in rural Oahu. Approximately 53 per cent were sons of civilian or uniformed military personnel, as contrasted with 10 per cent of the "local" group. Forty-two per cent were of Caucasian parentage; 19 of Japanese. Other ethnic groups were represented by comparatively equal proportions in both districts.

Within the local group, 153 boys who indicated a preference for a college preparatory science secondary school study program were compared with all boys. Two hundred sixty-three boys within the military group who elected science from among the five possible secondary study programs were similarly separated for comparison.

Significantly more sons of Japanese ancestry in the local group planned to elect a science program, and significantly fewer of Filipino ancestry in both groups. Other personal and socioeconomic attributes measured were not associated with science program choice.

In both the military and local groups the boys who planned on a college preparatory science program differed significantly from their peers in that they: (1) were strongly interested in science; (2) were little interested in art and music; and (3) attributed the greatest value to obtaining satisfaction from their field of study.

The scientifically inclined boy from the military district was more likely to be sure of his plans and less likely to think of himself as changing than the scientifically inclined boy from the local district.

Significant correlations were found between the military and local scientific groups on interests (rho = +.89) and external influences (rho = +.83), suggesting that these determinants are largely independent of socioeconomic and ethnic defferences for the sixth grade male in Hawaii.

The rank order correlation between the two scientific groups on values determining their study choice was smaller (rho = +.63) although significantly positive. It was concluded that teachers, counselors, and scientists should be sensitive to these distinguishing determinants in discussing science as a specialization with young boys.

RUTH SHERMAN
ARTHUR A. DOLE
University of Hawaii
Honolulu, Hawaii

10. Effect of Diet on Blood Pressure of Rats

There is the impression among laymen, borne out by Department of Health statistics, that cancer of the stomach is more prevalent in men of Japanese ancestry than those of other ethnic groups in Hawaii. Because some people had questioned if diet might be a factor, 28 rats of two strains were first used in 1956 for a pilot experiment. After about a year, the rats showed no ulcers or tumors, but those of one strain fed the Japanese diet showed evidence of hypertension and enlarged kidneys. Histological examination of the kidneys of several indicated arteriolosclerosis. Later when a Photoelectric-tensiometer became available for the determination of blood pressure in small animals, it was decided to continue the experiment and study the problem of blood pressure instead of possible tumor formation. Forty rats of both sexes from seven litters of the susceptible strain were divided into two groups of litter mates; one was fed the stock diet and one the Japanese diet. When there was an extra rat from a litter, we put it in the group for the Japanese diet and ended with 24 rats on the Japanese diet and 15 rats on the stock diet. For the Japanese diet the proportions of foods given daily for a medium-sized rat were as follows: rice 40 gm.; fish, raw or cooked, 10 gm.; cooked fresh vegetable 7 gm.; salt-pickled vegetable 5 gm.; shoyu 4 gm.; miso or aburage 2 gm.; tofu, Saturdays only, 10 gm.; "synthetic sake" (10–20 per cent alcohol solution, sweetened) 5 ml. A variety of cooked vegetables were used, but only two salt-pickled vegetables were given alternately, green mustard cabbage and takuwan (salt-pickled turnip). Undiluted evaporated milk was given for 5 weeks, starting with 1 ml. daily and increasing to 2 ml. daily. At the 11th week, the "synthetic sake" was given starting with 5 ml. of a 10 per cent solution of alcohol with a little added sugar and increasing to 10 cc. containing 20 per cent alcohol by the 21st week. The young rats placed on this diet at 3 weeks of age rather quickly adjusted to it, grew well, and accumulated large stores of fat. The stock diet was a semi-natural one composed largely of whole wheat flour and skim milk powder, with smaller amounts of cornmeal, white flour, brown rice flour, soybean flour, and a small amount of cotton seed oil. To this mixture, small quantities of yeast, salt mixture, and cod liver oil were added, as this diet is used for the breeding colony. After approximately 42 weeks on the diets, the mean systolic blood pressure of 190 for the 24 rats on the Japanese diets, both males and females, was in striking contrast to the value of 118 for the rats on the stock diet. Some aspects of the problem that should be investigated were suggested.

CAREY D. MILLER
NAO S. WENKAM
Hawaii Agricultural Experiment Station
Honolulu, Hawaii

11. Individual Kidney Function Testing with Radioactive Tracers

In the clinical practice of medicine, it is often important to determine the function and excretion of each kidney separately. Although examination of the urine and blood tells us much about the combined function, it tells us nothing about the proportion provided by each side.

The value of obtaining this information is illustrated by the problem of high blood pressure. The most common curable cause of high blood pressure is a decreased arterial blood flow to one kidney. Such a decrease stimulates release of the hormone "angiotensin" which produces spasm of the arterioles and consequent hypertension. Removal of the offending lesion often eliminates the high blood pressure. However, since fewer than 5 per cent of persons with elevated blood pressure have a unilateral kidney lesion as its cause, a simple screening technique would be useful to separate out this group of curable individuals.

Heretofore three approaches to the evaluation of separate kidneys have been used: the X-ray pyelogram, which demonstrates excretory passage structure but is relatively insensitive to functional differences; the X-ray aortogram, which localizes lesions in major arteries but is an involved hospital procedure; and the "Howard test," which provides a comparison of function but may injure the patient and is time-consuming and technically difficult.

A new approach using radioactive tracers gives us information on each kidney more simply and more sensitively than the previous techniques. The procedure is as follows: A substance which is extractable from the blood by the kidneys is tagged with a gamma-emitting radioisotope (sodium iodohippurate tagged with I^{131}). After the intravenous administration of this trace material, scintillation detectors placed externally to the body over the kidney areas graphically record the rate of each kidney uptake and excretion individually. This allows comparison of the function and the excretion of each kidney. It therefore provides a rapid screening technique for kidney-caused high blood pressure as well as for diagnosing obstruction of the ureter. In addition, it may be used for serially following many kinds of kidney disease.

Since the radiation involved in the test is low (0.05 rads to the bladder wall, much less elsewhere in the body), it can be used in the pregnant state with greater safety than other X-ray procedures.

The simplicity, sensitivity, and safety of the renogram thus make it useful for rapid screening of unilateral urinary tract disease.

ROBERT A. NORDYKE
Straub Clinic
Honolulu, Hawaii

CONSTITUTIONAL AMENDMENT

HAWAIIAN ACADEMY OF SCIENCE

ADOPTED MAY 26, 1960

Amend ARTICLE X (REGIONAL DIVISIONS), Section 5, to read as follows:

"A Regional Division may receive a portion of the Annual Academy dues paid by its members, the amount to be set annually by the Council."

NECROLOGY

HARRY SHIGEO IWATA

Harry Shigeo Iwata died in Honolulu on January 14, 1961, following a heart attack.

He was born in Hiroshima, Japan, on March 20, 1907, and was brought to Hawaii by his parents as an infant. His only formal education was in the public schools on Kauai.

When not yet 17, on January 15, 1924, he joined the staff of the Sugar Technology Department of the Experiment Station of the Hawaiian Sugar Planters' Association as a laboratory assistant. For many years he was assigned to assist the team of technologists in annual inspections of the sugar factories in the islands. In this work he made wide and lasting friendships in the sugar industry. He became familiar with all phases of cane sugar factory operation and became particularly expert in the practice of sugar boiling.

In the thirties Mr. Iwata began assisting in the research program on molasses exhaustibility and sugar crystallization and continued in this activity until his death. He made substantial contributions to these studies which are well known throughout the sugar world. His name appears as a contributor to many publications reporting the results of the work.

Mr. Iwata was a painstaking experimentalist and an extraordinary technician. What he lacked in formal education he made up in continuous study. He kept careful and complete records and his final results left no area doubtful.

CHARLES EDWARD KENNETH MEES

On August 15, 1960, the Academy lost one of its distinguished members in the death of Dr. C. E. K. Mees. He was born in Wellingborough, England, on May 22, 1882. He received his B.S. degree from the University of London in 1903, and his Doctorate in Science in 1906. His major contributions to science were in the theory on photography. From 1912 to 1934 he was the Director of Research with the Eastman Kodak Company, and was Vice President in charge of research from 1934 until his retirement.

He was also Chairman of the Board of Distillation Products Incorporation, an Eastman subsidiary. In this connection, it may be noted that he was instrumental in initiating the series of "Kodak Reports On:—" advertisements which are so widely and avidly read on their appearance in various scientific journals.

Because of his accomplishments in research on the photographic process and in particular because of his activities in the field of color photography, Dr. Mees received many honors during his lifetime. He was a member of many national and international scientific societies and was a Fellow of the Royal Society of London.

He had been living in Honolulu for several years and had addressed several local scientific societies in the community on a number of subjects. Dr. Mees was a most interesting speaker, with a wealth of experience on which he drew freely in capturing both the attention and imagination of his audiences.

Dr. Mees' technical accomplishments will be the subject of many of the obituaries of societies privileged to count him as a member. The Academy membership will feel his passing as a personal loss no less important than his passing from the scientific scene.

RALPH E. DOTY

Ralph E. Doty died on July 3, 1960, at his home in San Anselmo, California.

Mr. Doty was born in Hastings, Nebraska, December 3, 1891. Upon his graduation from the University of California in 1915 he joined the Experiment Station, HSPA, as assistant agriculturist. He retired as associate agronomist at the end of 1956 after 36 years of dedicated service.

During World War I, Mr. Doty served as an officer in the U. S. Army, retiring at the end of the war with the rank of captain.

In 1923 in collaboration with Dr. Harold L. Lyon, Mr. Doty initiated for the Pineapple Canners' Association a program of research in the culture and breeding of pineapples which eventually led to the establishment of the Pineapple Experiment Station.

Mr. Doty's interests in sugar cane agriculture covered a wide field, including diseases, varieties, fertilization, and rodent control. His outstanding contributions in the latter field led to many requests for his advice from other regions, including Okinawa and Mexico, where he helped to initiate effective rat control measures. Upon his retirement he was retained as a consultant for the University of Vera Cruz in Mexico.

Mr. Doty will long be remembered, not only for his valued contributions, but also for his friendly and helpful nature which endeared him to his fellow workers.

ARTHUR RIPONT KELLER

Arthur R. Keller, Dean Emeritus of the College of Applied Science of the University of Hawaii, was born in Buffalo, New York, on July 28, 1882. He graduated from Cornell University with the degree of Civil Engineer in 1903, and later received an M.S. in Civil Engineering from Harvard and an M.S. from the Massachusetts Institute of Technology. He married Lora Keegan in 1908.

He worked as an engineer in New York, Alabama, and Washington, D. C., before coming to Hawaii in 1909 as Professor of Civil Engineering in the College of Agriculture and Mechanic Arts. He was a Captain in the United States Army during World War I.

In 1921, Arthur Keller became the first Dean of the College of Applied Science at the University of Hawaii and retained that position until his retirement from the University in 1947. Concurrently, he was

Vice President from 1932 to 1941, Acting President in 1941–1942, and Vice President again from 1943 to 1947. He taught both engineering and mathematics, laid out roads and utilities, designed many of the earlier University buildings, and not infrequently supervised their construction.

Arthur Keller lived his career of a University professor and administrator with wisdom, foresight, energy, and encouragement to those around him. To this work he added bounteous community service. He was a member of the Territorial Board of Health from 1911 to 1915 and 1943 to 1947, and was its Acting President in 1912. He was a member of the City Planning Commission and the Public Utilities Commission, a secretary of the Hawaii Housing Authority, executive secretary of the Territorial Retirement and Pension Committee, and a Director of Queen's Hospital. He left his mark on the University of Hawaii, the city of Honolulu, and the state of Hawaii. In Queen's Hospital, to which he had contributed a full measure of time and devoted service, he died on April 8, 1961.

For him Keller Road was named and Keller Hall dedicated, and in the minds of his many students, who over the past 50 years have studied at the University to which he devoted his life, his memory is enshrined.

CONTRIBUTORS

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American Society of Agronomy, Hawaii Chapter
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Hinrichsen, Erik C.

* Member, American Association for the Advancement of Science
† Fellow, American Association for the Advancement of Science
‡ Member, Hawaii Division, Hawaiian Academy of Science

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‡Kaneko, Yoshiyuki
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Contents

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

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THE FUTURE OF ANTHROPOLOGICAL STUDIES IN THE PACIFIC

Alexander Spoehr[1]

I

On this annual occasion, it is customary for the retiring president of the Academy to report on and to review a branch of science coming within his purview and related to the Academy's purpose of furthering scientific research in Hawaii and the Pacific. I am accordingly taking this opportunity to express some personal views as to the future of anthropological studies in the Pacific area, as well as to Hawaii's most promising role in the prosecution of such studies.

Two introductory points are necessary to set what follows in perspective. The first point concerns the Pacific area in relation to scientific research. The second point deals with the nature of anthropology as a discipline.

In Hawaii we are quite properly concerned with the Pacific area, and though each of us may conceive the territorial limits of this area in somewhat different ways, we are all conscious of the fact that we live in one of the most distinctive major regions of the earth. Among us, it is also common to hear the phrase "Pacific science." This coupling of the word "science" with that of a major world region is understandable. However, the phrase "Pacific science" also carries a danger in the intellectual provincialism which it may impose.

Any importance the Pacific area has in scientific research is as a field of observation, the results of whose study can be incorporated in the general framework of knowledge. This point is perhaps too obvious to labor, but it is particularly relevant to anthropology. The very diversity of human history, of human races, and of cultures has made it necessary for anthropologists to specialize regionally in order to control the necessary factual material. I well remember as a graduate student listening with some skepticism to an eminent teacher propose that the time had come when archæologists should more consciously realize that the principal objective of archæology was to contribute to an integrated world history of man. In those days this statement seemed a little far-fetched, when the prehistoric relations of many large parts of the earth were unknown, and when the established time perspective of human history was so inadequate. Yet in something over two decades progress in archæology has been so considerable that the outlines of a world picture of early man are beginning to emerge with some clarity to form the prehistoric underpinning of documentary history. In this scheme, the Pacific is important to the degree that it contributes to a planetary rather than to a local body of knowledge.

The second point deals with the nature of anthropology. Its somewhat pretentious name is apt to be misleading. "Anthropology cannot claim, as history can claim, to be a single method applicable to all subject matters, nor can it claim, like philosophy, a logical place in any sphere of knowledge. It pursues a diversity of approaches toward the understanding of a diversity of phenomena having to do, in one way or another, with man." This diversity is apparent both in the roots from which anthropology has grown and in the subfields into which its practitioners divide themselves.

Of these subfields physical anthropology is primarily a part of human biology. Archæology in its written product is a form of history. Linguistics, as practiced by anthropologists, is both comparative and historical, though mainly dealing with unwritten languages, or those which were unwritten before being reduced to writing in recent times. Ethnology and social anthropology are allied to history, psychology, comparative sociology, end ecological aspects of biology. This diversity is further emphasized by the fact that anthropologists exhibit a disposition to venture into borderline areas in the biological and social sciences, wherever their problems may lead them. As a result, anthropology tends to be an aggregation of interests rather than a highly systematic body of knowledge.

Certain common characteristics, however, pervade these subfields and help hold the subject together. First, anthropology is essentially empirical, and demands field work and the careful collection of data at first hand by skilled observers. Such conclusions as anthropologists derive from these data are drawn not from *a priori* premises but from reality as they are able to perceive it. Anthropology tends therefore to be nondeductive.

Second, anthropology is broadly comparative in the treatment of its subject matter. This concern is not

[1]Chancellor, East-West Center.

a high regard for the exotic and different, but a conscious attempt to construct a comparative study of man in all places and at all times.

II

It may also be useful for the purpose of this paper to note four chapters in the historical background of contemporary anthropological research in the Pacific. For convenience, these chapters may be labeled the Age of Exploration, the Concept of a Changing Universe, the Recognition of the Diversity of Human Culture, and the Emergence of the Professional Anthropologist.

The hero of the first chapter is Captain James Cook. Although the burst of exploration which emanated from western Europe led other daring seafarers to venture into the Pacific before him, it was Captain Cook who marked a turning point in the exploration of the Pacific. The reason is that his quest was essentially for accurate knowledge rather than for gold or conquest of foreign lands. In addition to his service as a cartographer, he and the men who sailed with him provided documentation of the peoples they met, of how they lived, and of details of their behavior. In three remarkable voyages (1769–80) Captain Cook ushered in the age of scientific exploration of the Pacific.

The second chapter is notable for the acceptance of a profound change in the manner in which scholars regarded the universe in which they lived and the intellectual framework according to which knowledge of nature and man was to be ordered. Two men, Charles Darwin and Alfred Wallace, working in opposite sides of the Pacific, became foremost protagonists for this new point of view. Darwin's famous voyage on the Beagle (1831–36) carried him around South America to the Galapagos Islands. Wallace at the other end of the Pacific worked in the Malay Archipelago from 1854 to 1862. Together they crystallized the concept of evolution and furthered the wide realization that the universe is not static, but that all of nature, including man, is undergoing a constant process of change. This great intellectual advance remains a major stimulus to all those, including anthropologists, who seek the regularities governing the processes of change in the natural world.

The third chapter I have called the Recognition of the Diversity of Human Culture. For a comparative study of man to emerge, it was first necessary to procure accurate depiction of the peoples of the world to demonstrate the diversity of men, of their languages, and of their cultures. Out of this diversity common classes of phenomena could be described, and an attempt made to bring order into this diversity. Yet useful description required extended periods of residence among alien peoples. In this the observant missionary had a great advantage, for he was among the first to spend long periods living in foreign societies. The noteworthy Pacific missionary accounts of Ellis, Turner, Williams, and, above all, Codington provided grist for the mill of those scholars who in the latter half of the 19th century laid the foundations of anthropology as a discipline.

These founders of anthropology were by and large not often field men. The turning point for the Pacific came in 1898 with the Cambridge University Expedition to the Torres Straits. Organized by Haddon, a zoologist, the other members of the expedition consisted of Seligman, a medical doctor and primarily a pathologist; Rivers, Myers, and McDougall, all psychologists; Ray, a philologist; and Wilkin, a history student. Not long after the Torres Straits expedition came that of the Hamburg Museum expedition, led by Thilenius, which laid the groundwork of Micronesian ethnography. These expeditions, and the subsequent careers of their participants, contributed directly to the fourth chapter—the emergence of the professional anthropologist—a man no longer only a library scholar, but a trained field observer as well. During the last fifty years several scores of such anthropologists have worked in the Pacific. The growth of anthropology reflects their research.

III

Over the last decade, anthropological studies in the Pacific area have exhibited a characteristic of the field as a whole—that of increasing specialization. This is a natural development in a discipline which has attained maturity and academic acceptance. Related to this increasing specialization has been the sharper definition of problems and the refinement of analytical techniques. One has only to review the growth of the Pacific Science Congresses to discern this trend. A few examples are appropriate.

It is my impression that of the subfields of cultural anthropology, linguistics is most nearly approaching the characteristics of a science. It has a precise system of notation; has made very distinct progress in uncovering the structural principles inherent in the morphology of the many languages of the world through the application of rigorous comparative analysis; is developing sophisticated statistical techniques for handling large bodies of data in comparative work; and has registered substantial progress in the study of regularities in linguistic change through time. The study of the Malayo-Polynesian language family is a case in point. Work accomplished or in progress has clarified the structural principles of Malayo-Polynesian; is beginning to show more precisely the degrees of relationship of the hundreds of languages composing this family; and at least for Polynesia has given a clear indication of the pattern of differentiation of Polynesian languages through time. It is interesting to note that the lexico-statistical work now being undertaken on the Malayo-Polynesian languages would have been impossible in the pre-computer era.

Physical anthropology has always had a major interest in human paleontology in relation to the problems of biological evolution. Regional interest in this area of work tends to focus on locations of the most exciting finds. For the last few years Africa has tended to occupy the center of the stage. Except for Indonesia and China, the Pacific has had little competition to offer. What has also developed in physical anthropology, however, is a strong interest in population genetics. Here the Pacific islands offer many attractions. Even allowing for recent admixture, the islands present a fascinating series of breeding isolates, suitable for comparative genetic work. Apart from the mapping of Pacific island blood groups, primarily through Australian efforts, interest has also been centered on the genetic factors involved in certain diseases with a dramatically high incidence. The two principle examples of these are *Kuru* in New Guinea and multiple lateral sclerosis in the Marianas. It is probable, however, that a closer inspection of Pacific island populations will reveal a series of singular genetic characteristics of a nonpathogenic nature but of real significance in furthering understanding of the problems of human genetics.

In archæology, perhaps the most important development has been the fact that Oceanic studies are now catching up with the rest of the world. In particular, Polynesian prehistory for too long lay in the realm of speculation. It is most gratifying to see the application of sophisticated archæological techniques in excavations recently completed or underway in Hawaii, the Society Islands, the Marquesas, Easter Island, Samoa, and New Zealand. This is a true emergence from the Stone Age.

Finally, a brief word should be said as to ethnology and social anthropology. Here specialization has led to a series of rather sharply defined field studies all of which have importance, whether they be in the area of comparative legal institutions, social organization, religion, mythology, culture and personality, human ecology, or others. My personal interest has been primarily in the social structure of village communities. These continue to play a major role in the lives of the peoples of the Pacific islands through to Southeast Asia. With certain notable exceptions, there has been until recently a lack of studies in sufficient depth to permit comparative analysis. Whether in the Philippines, Formosa, Thailand, or the Pacific Islands, the increase in the number of competent village studies has now reached the point where fruitful comparison of these largely kin-based rural societies can be made.

IV

It can be anticipated that specialization in Pacific anthropological studies will continue, and that such studies will also continue to benefit the discipline as a whole. Yet one is led to speculate as to whether there are not general focal points of interest specially appropriate to research in the Pacific area on one hand, and to the needs of anthropology on the other. This consideration leads me to pose the following questions:

How can anthropology develop more fruitful ties with biology, one of the strongest roots from which anthropology has grown? I am not thinking here so much of physical anthropology, which will certainly remain a branch of human biology. Physical anthropology is actually attempting to relate itself more clearly to cultural anthropology, as for instance in determining the social and cultural factors operative in selection. What concerns me is that archæologists, and particularly ethnologists, should investigate more fully the nature of the adaptation of human societies to their natural environments and the ecological factors operative in specific situations.

The second question is how can anthropologists deal more precisely with cultural change, not only as a sequence of connected events occurring through time, but as exhibiting regularities of a more general nature? In commenting on this question, as well as on the first, I shall divide my remarks into two categories applicable to field research in the Pacific area: the study of culture history, and the study of contemporary change.

In developing the culture history of the Pacific area, archæologists must perforce play a major role. They are now attempting to discover the time and space framework of man's movement into, and settlement of, the Pacific islands. This time and space framework must then be linked to Malaysia and to Asia. The critical period for this linkage on the Asian side is from 8,000 B.C. to the beginning of the Christian era, a period for which there are pitifully few existing data. This time span encompasses the domestication of the major Indo-Pacific cultivated plants, as well as of rice, and the beginning of contacts and eventually trade routes by sea from north China and Japan through Malaysia and southeast Asia to India, and from there to the Near East.

As this fascinating prehistoric story unfolds, the data of archæology, ethnology, and linguistics will assuredly be combined in the final product. Yet I am concerned that investigation proceed with due recognition that many of the problems demand the viewing of man as a part of a biotic assemblage, consisting of man, his cultivated plants, weeds, and associated animal organisms. Furthermore, the story involves the adaptation of human communities to a multiplicity of natural environments through a complex set of ecosystems. In this realm the archæologist must develop closer ties with modern biology if he is to achieve his goal.

When one turns to the contemporary scene, one is struck with the fact that the social and cultural changes occurring in the Pacific area since World War II are probably greater than in any other period of comparable extent in the last several hundred years. I am led to wonder whether anthropologists are fully cognizant of the outstanding features of this change. One is certainly urbanization. Yet at a recent South Pacific Commission technical conference on urbanization problems, where the conference was composed of participants from several disciplines, it rapidly became apparent that the subject could be apprehended only against the background of an annual population growth rate in the Pacific islands of up to 4.5 per cent. Human demography through the accident of history is considered a part of sociology, whereas the study of animal and plant populations falls in biology. Yet it is evident that the study of populations is basic to both the social sciences and to biology. We have not yet in current anthropological field studies of contemporary change in the Pacific given full recognition to the pressures of population growth.

V

A final comment concerns the most fruitful means for the prosecution of anthropological studies in the Pacific area, and Hawaii's role in such research.

With a few exceptions, anthropological field work is a rather solitary business. This is particularly true of ethnology and linguistics, less so of archæology and physical anthropology. Yet there are certainly two definite trends in the Pacific: the first is the productivity of programed research involving a number of investigators. The second is growing international cooperation.

Although in the future there will always be plenty of room for the individual investigator working on his own problem, the trend since World War II is certainly toward fairly ambitious field programs. As examples, the Coordinated Investigation of Micronesian Anthropology, sponsored by the Pacific Science Board of the National Academy of Sciences; the Tri-Institutional Pacific Program of Yale University, the University of Hawaii, and the Bishop Museum; the Philippine Studies Program initiated by the University of Chicago, the Chicago Natural History Museum, and the Newberry Library are only a few examples. The plain fact of the matter is that the Pacific area is so vast, and the problems are so extensive, that programed research is the logical answer for the attaining of definitive results. This is not necessarily, however, "team research." It is rather the concentration of manpower within the framework of definite problems, often involving institutional collaboration.

The second trend is growing international cooperation. Here the Pacific Science Association, and the Congresses it has sponsored, has played a unique role. As a result of the Tenth Pacific Science Congress, the National Science Foundation has provided support for a program of archæological research in Polynesia sponsored by the Bishop Museum, in collaboration with three New Zealand institutions: Auckland University, and the Canterbury and Otago Museums. This example is indicative of the future—programed research and international cooperation.

How does Hawaii take full advantage of the research opportunities in the study of man in the Pacific? We have two advantages. The first is a favorable geographic location. The second is that anthropological research in Hawaii has been most successful where it has cultivated institutional relationships. This type of cooperation requires experience. In anthropology there is a backlog of such experience, extending back for over forty years.

Hawaii has also two disadvantages. One is simply the unfortunate limitation of professional manpower and financial resources. The second is the ever-present danger of provincialism, whereby our island isolation can warp our point of view. Yet I do not regard these disadvantages as in any way unsurmountable. If we are willing to commit ourselves to major rather than to minor problems, and willing to find those effective mechanisms of institutional cooperation in an international milieu, I believe we can not only participate in getting some major jobs done, but can build a position of strength and respect for the Hawaii of the future.

ANNUAL REPORT 1961-62

HAWAIIAN ACADEMY OF SCIENCE

SECRETARY

The thirty-seventh year of the Academy ended with a total membership of 793. There were five Council meetings during the year at which the chairmen of the special and standing committees were in attendance.

We record, with regret, death of the following members during the year: J. Ballard Atherton, J. F. G. Stokes, Edward Y. Hosaka, Miss L. M. Larrabee.

The Secretary wishes to extend the thanks of the Academy to Mrs. Shizuno Ebisuzaki and Miss Patricia Bacon for assisting him with his duties.

Donald P. Gowing, Secretary

MEMBERSHIP

This year 68 applicants were elected to membership. Of the 793 members presently on the rolls, 48 are life members, since they have met the constitutional requirements for that status. This is an increase of 10 during the year.

Sidney C. Hsiao, Chairman

PROGRAM

The fall meeting of the Academy was held November 8-9, 1961, at Agee Hall, HSPA. The first evening was devoted to a symposium on the genetics of plants and animals with Dr. J. B. Smith moderating and presenting the human genetics topic. Dr. John N. Warner covered sugar cane breeding, Dr. Estel Cobb the breeding of farm animals, and Dr. Donald McGuire discussed horticultural plant genetics, especially the USDA program on introduction and conservation of plant germ plasm. The symposium was well received by the audience; it was scientific without being too technical and interesting to a general audience without being patronizing.

The second evening was devoted to eight contributed papers. No particular selection was necessary since all papers appeared worth including and no additional papers were at hand at the time of the deadline. Four papers subsequently were received, and letters were sent to the authors requesting that they resubmit for the spring meeting.

Dates of April 25-26, 1962, were selected for the spring session of the Academy. Dr. G. G. Dull was chairman of the program committee for this period. On April 25, Dr. Roland Force and Dr. Robert Hiatt gave invitational papers, and on April 26 papers were contributed from the membership. The Hawaiian Junior Academy of Science also met on the afternoon of April 25, and the membership was invited to attend.

The presidential address by Dr. Alexander Spoehr was delivered at the Annual Banquet, April 28, at the Queen's Surf.

H. Wayne Hilton, Chairman

NOMINATIONS

The Nominations Committee takes pleasure in proposing the following slate of nominees for the Academy's 1962-63 year:

For President-Elect: Dr. Donald P. Gowing
Dr. John J. Naughton
For Secretary: Dr. Roman Romanowski
Dr. Robert F. Fox
For Treasurer: Mrs. Eleanor Anderson
For Councilor: Mr. William Bush

President in 1962-63 will be Dr. Leonard D. Tuthill. Dr. Alexander Spoehr will be Councilor ex officio, and Dr. Samuel D. Allison will continue as Councilor.

John N. Warner, Chairman

AAAS REPRESENTATION

The Academy did not find it possible to obtain representation at the AAAS Annual Meeting in Denver. Some AAAS Council business, however, has been conducted by correspondence.

As an affiliate of the AAAS, the Academy is authorized to nominate each year one boy and one girl for honorary junior membership in the AAAS. The 1962 memberships were awarded to the Science Fair finalists, Lana Jong of Hilo High School and Richard Onouye of Waipahu High School.

Funds also are available from the AAAS for the support of student projects. This year one small grant from this source was made, to Sammy Shive of Waianae High School.

Doak C. Cox, Representative

AAAS FELLOWS

The following members of the Hawaiian Academy of Science and AAAS have been nominated as Fellows by the Fellowship Committee: Estel Cobb, Richard H. Cox, Aaron L. Diamond, Alan Kohn, Philip C. Loh, Charles Mumaw, Larry W. Quate. The nominees' names were submitted to Dr. Dael Wolfle, Executive Officer, AAAS, on April 9, 1962.

Your committee would also like to recommend that HAS conduct a membership drive for AAAS since there are many members of the HAS who, if members of the AAAS, would be excellent candidates for Fellowship.

The members of the committee were Leonard Tuthill, Alison Kay, Ralph Heinicke, Beatrice Krauss, and John Warner.

Wallace G. Sanford, Chairman

INDEX

Biographical and other pertinent data have been gathered from members. This information will be coded and placed on IBM cards. When completed, these cards will permit rapid selection and listing of members in respect to a number of categories: e.g., scientific specialty, foreign language proficiency, memberships, etc. Some conceivable uses are: answering inquiries relative to number of members in various specialties, rapid listing of groups for meetings with visitors, and up-to-date maintenance of membership information.

John M. Digman, Chairman

PUBLIC RELATIONS

The activities of the Public Relations Committee have been largely associated with the Science Fair. Such activities have included newspaper coverage of local Science Fairs, and newspaper, radio, and TV coverage of the Fifth Annual Hawaiian Science Fair. This type of coverage has been effective in publicizing science activities in Hawaii. In addition, two TV programs, featuring local Science Fair winners, were telecast in conjunction with the Science Clubs Service. The Honolulu Advertiser co-sponsored the Fifth Hawaiian Science Fair and proved very helpful in reporting articles, printing posters and programs, and in providing technical assistance.

A clipping service was subscribed to for the four months of major Science Fair activity to determine the effectiveness of publicity in local papers. The ISSEC brochure was revised to correspond with current activities of the organization and also to correct any changes in officers or committee chairmen.

Robert D. Wiemer, Chairman

CONSERVATION COUNCIL IN HAWAII

The Conservation Council for Hawaii conducts most of its business through its committees, on Land, Water, Flora, Fauna, and Sites Conservation. The Annual Meeting of the Council, at which the reports of these committees were received and at which their resolutions were considered, was held February 16, 1962. The program also included a talk by Dr. Charles H. Lamoureux, Assistant Professor of Botany at the University of Hawaii, entitled "Leeward Islands of Hawaii."

A revision of the constitution of the Council is being considered, with the object of broadening the scope of activities of the Council to fill needs seen by other groups interested in conservation and related areas. The unification of the aims of the Coordinating Committee for Conservation, and of the subcommittee of the Honolulu Chamber of Commerce on State Parks and Recreation, with those of the Conservation Council for Hawaii, is seen as an opportunity for an active program toward these aims within the framework of the Council. Consolidation of the views of the several interested groups is expected to lend strength to the cause of Conservation in Hawaii.

Michio Tanaka, Representative

FINANCIAL REPORT
1961-62

Balance on hand March 31, 1961			
Bank of Hawaii		$ 749.12	
First Federal Savings & Loan Assoc.		620.23	
		1,369.35	
Less checks outstanding		30.00	$ 1,339.35
Receipts:			
Dues		1,418.00	
AAAS grants		200.80	
Dividends, First Federal Savings & Loan		25.83	
Miscellaneous			
Annual Dinner, 1961, 56 reservations	$ 210.00		
Refund on 60/61 Proceedings	8.20		
Refund of advance to 1960/61 Student Science Seminar	60.00		
Reprints	86.00	364.20	
National Science Foundation Grants			
G17046, Hawaiian Science Clubs Service	18,460.00		
G17101, Teachers Science Seminar	2,900.00		
G17248, Students Science Seminar	4,220.00		
Travel refund	83.13		
G8494, Museums in Miniature refund from Bishop Museum of unexpended balance	215.88	25,879.01	27,887.84
			$29,227.19

Disbursements:

AAAS grants			
R. N. Bowen	50.00		
W. K. Kikuchi	50.00		
John Kunisaki	50.00		
Ruth Hew Len	24.00		
Stella Morimoto	12.70		
Sammy Shive	14.10	200.80	
HAS—Hawaii Division, 73 members @ 50¢		36.50	
Mailing expenses		322.64	
Printing		668.78	
Supplies		166.44	
Miscellaneous			
Decorations, refreshments, and incidentals	18.88		
P.O. box rental	9.00		
AAAS Academy Conference donation to operational fund	17.00		
Annual Dinner, 1961	202.72	247.60	
National Science Foundation Grants			
G17046, Hawaiian Science Clubs Service—to University of Hawaii	$18,460.00		
G17248, Student Science Seminar			
Salaries $1,400.00			
Cler. Asst. & Inc. 105.00			
Travel & per diem 2,413.40	3,918.40		
G12407, Teachers Science Seminar (60/61 grant)			
Travel & per diem 526.60			
Refund of balance to NSF 158.44	685.04		
G17101, Teachers Science Seminar (61/62 grant)			
Workshop	465.00		
G8494, Museums in Miniature			
Refund of balance to NSF	215.88	$23,744.32	$25,387.08
Balance March 31, 1962			$ 3,840.11

Balance on hand March 31, 1962		
Bank of Hawaii	$ 4,060.00	
First Federal Savings & Loan Assoc.	646.06	
	4,706.06	
Less checks outstanding	865.95	$ 3,840.11

Status of Dues Payments:

	March 1961	March 1962
Advance	$161.00	$157.00
Arrears	296.00	180.00

Complimentary Memberships 27

HAWAIIAN SCIENCE CLUBS' SERVICE
(Administered by the University of Hawaii)
National Science Foundation Grant,
G12446 (60/61 grant)

Amount of grant		$19,650.00
Expended prior to Feb. 28, 1961		11,186.75
Balance Feb. 28, 1961		8,463.25
Disbursements:		
Communications	$ 279.88	
Equipment	656.08	
Rentals	135.78	
Salaries and wages	5,026.54	
Shipping and freight charges	53.81	
Supplies	2,651.32	
Miscellaneous, including indirect cost allowance	1,936.03	10,739.44
Total expended		$21,926.19

National Science Foundation Grant, G17046

Amount of grant		$18,460.00
Disbursements:		
Communications	282.34	
Equipment	1,484.52	
Printing and binding	227.19	
Salaries and wages	6,006.31	
Shipping and freight charges	156.48	
Supplies	339.45	
Travel	1,867.41	
Miscellaneous, including film rentals	1,995.74	
Allowance for indirect costs	1,853.91	
	14,213.35	
Accounts payable	1,308.19	15,521.54
Balance March 31, 1962		$ 2,938.46

MUSEUMS IN MINIATURE

(Administered by Bishop Museum)
National Science Foundation Grant, G8494

Amount of grant		$ 3,500.00
Expended prior to March 31, 1961		2,449.77
Balance March 31, 1961		1,050.23
Disbursements:		
Salaries and wages	$ 712.15	
Shipping charges	82.69	
Supplies	39.51	834.35
Balance February 13, 1962		$ 215.88
Refunded to NSF		$ 215.88

SCIENCE EDUCATION FUND

(Administered by Cooke Trust Co., Ltd.)

Balance March 31, 1961			$13,947.72
Receipts:			
F. C. Atherton Trust	$ 500.00		
Juliette M. Atherton Turst	1,500.00		
S. N. & Mary Castle Foundation	1,000.00		
Charles M. & Anna C. Cooke Trust	500.00		
First National Bank	100.00		
Frear Eleemosynary Trust	250.00		
H. C. & D.	100.00		
Hawaiian Electric Co., Ltd.	200.00		
HSPA Experiment Station	1,293.95		
Hawaiian Telephone	200.00		
McInerny Foundation	1,000.00		
Pineapple Research Institute	1,293.95		
Rotary Club of Honolulu	100.00		
Watumull Foundation	100.00		
G. N. Wilcox Trust	500.00	$ 8,637.90	
Miscellaneous Contributions		590.00	
Miscellaneous (refund)		39.62	9,267.52
			$23,215.24

Disbursements:			
Awards		89.19	
Film rental		980.00	
Furniture		72.96	
Printing & publications		110.60	
Scholarship		50.00	
Science Fairs			
Fourth Annual	5,656.44		
Fifth Annual	500.00	6,156.44	
Student Science Seminars		210.00	
Supplies & incidentals		278.28	
Transportation		1,092.84	
Miscellaneous		55.66	9,095.97
Balance March 31, 1962			$14,119.27

FOURTH ANNUAL SCIENCE FAIR

(Administered by Cooke Trust Co., Ltd.)

Balance March 31, 1961		$ 453.50
Receipts:		
Banquet tickets	$ 7.30	
Science Education Fund	5,656.44	
Star-Bulletin	75.00	
Travel refunds	787.14	6,525.88
		6,979.38
Disbursements:		
Food & catering	170.44	
Hawaiian Village Hotel	1,822.96	
Insurance	23.60	
Programs	326.28	
Publicity	89.39	
Supplies & incidentals	48.13	
Travel and transportation expenses	4,458.53	
Miscellaneous	40.05	6,979.38
Balance March 31, 1962		00000

FIFTH ANNUAL SCIENCE FAIR

Receipts:		
Bus fares	$ 24.50	
Science Education Fund	500.00	$ 524.50
Disbursements:		
Awards	161.54	
Science Service Entry Fee	100.00	
Supplies & incidentals	118.74	
Travel and transportation expenses	112.20	
Miscellaneous	67.98	560.46
Balance March 31, 1962	Debit	$ 35.96

Respectfully submitted,
Eleanor S. Anderson
Treasurer

INTER-SOCIETY SCIENCE EDUCATION COUNCIL ANNUAL REPORT 1961-62

Organization. The societies now included in the membership, their presiding officers and their representatives on ISSEC are as follows:

American Association of University Women, Honolulu Branch: Florence Hodgson, Leonora Bilger; American Chemical Society, Hawaiian Section: Charles E. Mumaw, L. J. Rhodes, John H. Payne (alternate); American Society of Agronomy, Hawaii Chapter: E. J. Britten, Goro Uehara; American Society of Mechanical Engineers, Hawaii Section: Colin J. Fryer, Fred Cordes; American Statistical Association, Hawaii Chapter: Keith Wallace, Otto Orenstein, Richard Takasaki (alternate); Anthropological Society of Hawaii: Joan Steffens, H. Ivan Rainwater; Engineering Association of Hawaii: Robert Britten, Doak C. Cox; Geophysical Society of Hawaii: Saul Price, Walter Steiger, Thomas S. Austin (alternate); Hawaii Dietetic Association: Carey D. Miller, Mabel Walker; Hawaii Medical Association: T. H. Richert, Nils P. Larsen, Clarence E. Fronk (alternate); Hawaii Psychological Association: A. Leonard Diamond, Joseph C. Finney; Hawaii State Dental Association: F. A. Sandberg, Manuel C. Kau, Ralph Akamine (alternate); Hawaiian Academy of Science: Alexander Spoehr, Dorothy T. Rainwater, H. Wayne Hilton (alternate); Hawaiian Astronomical Society: Michael J. Morrow; Hawaiian Botanical Society: Charles Lamoureux, Hayle Buchanan; Hawaiian Entomological Society: H. Ivan Rainwater, Henry A. Bess; Institute of Food Technologists, Hawaii Section: Ralph M. Heinicke, Leroy Miller; Society of Naval Architects & Marine Engineers, Hawaii Section: Nathan Sonenshein, Alvin T. Hansen; Society of the Sigma Xi, Hawaii Chapter: E. J. Anderson, Gerald G. Dull.

Activities. ISSEC, formed four years ago by the Council of the Hawaiian Academy of Science to strengthen science education has adhered firmly to that purpose. The sincerity of the efforts of all those working on the various committees can best be appreciated by those who work with them and by the students who benefit directly. Response of teachers, students, and their parents was most gratifying.

The following report gives no real indication of the many hours freely given through a desire on the part of Hawaii's scientific community to perform a useful service.

1. Science Fair

An estimated 25,000 people viewed the 112 projects at the Hilton Hawaiian Village Dome during the Fifth Hawaiian Science Fair which was held March 23-25. This increased attendance is attributed to the cooperation of the Honolulu Advertiser which served as Press Sponsor. This was the first year that the Honolulu Advertiser acted in this capacity. The Science Fair Committee found the arrangement highly satisfactory. The projects were selected from more than 5,000 entrants in public and private school fairs which were reviewed by more than 120 judges. Twenty projects from Hawaii and 16 from Maui were selected from their county science fairs. Ten projects from Kauai and 66 from Oahu came directly from school fairs. The awards program was changed with the institution of $25.00, $10.00, and $5.00 "Wish Awards." Most of the affiliated societies followed the "wish award" program in presenting their awards.

At the Awards Banquet, 67 awards were presented, 32 of which were Wish Awards presented by the Science Fair. Another innovation this year was the withholding of announcement of awards until the banquet. One big consideration in instituting this plan is that the winning projects are not marked for special attention until the last day of the Fair, therefore, all projects receive equal notice from science fair viewers. Thirty-two Grand Pacific Life Science Awards were presented for the most meritorious projects in each high school.

As guest speaker at the Awards Banquet, Governor William F. Quinn presented an address on the interdependence of science and our community. Major awards were to Lana Yong, Hilo High School (Sugar Award, presented by Hawaiian Sugar Planters' Association); Richard Onouye, Waipahu High School (Pineapple Award, presented by the Pineapple Research Institute of Hawaii); Robert Roman, Hilo High School (IRE $50.00 Wish Award, presented by the Institute of Radio Engineers, Hawaii Chapter); and Ida Jo Rheuark, Kailua Intermediate School (Clayton J. Chamberlin Memorial Award).

The two finalists, Lana Yong and Richard Onouye, took their projects to the National Science Fair-International, held in Seattle May 2-5, in connection with the Century 21 Exposition. They were accompanied by Mrs. H. Ivan Rainwater, Chairman of the Exhibits Committee and Dr. Robert E. Coleman, Associate Director of this year's Fair and Director of the Sixth Hawaiian Science Fair. Dr. Donald H. Smith, of the Pineapple Research Institute, will be Associate Director of the Sixth Hawaiian Science Fair.

Ronald Sakimura, one of the top award winners in last year's Science Fair, represented about one million young American science fair entrants when he went to the Fifth Japan Student Science Fair held in Tokyo in November, 1961.

Credit should be given here for the invaluable services rendered by members of the Kaimuki High School Science Club in staffing the Hawaiian Science Fair office and in operating the projectors used for showing science films during the Fair.

2. Student Science Seminars

The Student Science Seminar program operated for the first time under a grant from the National Science Foundation and was therefore able to extend its services to all the islands. Twenty-six seminars were held on Oahu, 20 on Hawaii, 17 on Maui, and 16 on Kauai. Attendance at these meetings was approximately 90 per cent of the thirty juniors and seniors who were members on each island.

ISSEC was represented this year by Dr. Albert B. Carr, Director of this series, who attended the meeting of the National Science Foundation Conference of Directors of State Academies of Science Educational Programs in Washington, D. C., on April 2.

3. Teachers' Science Seminars

The number of informational seminars was sharply reduced by the needs of the new Director for orientation to the aims and mechanics of the program. The major effort was the co-sponsorship of the Teachers' Workshop associated with the Science Fair.

A seminar program is underway on Hawaii at both Hilo and Kona with a Geophysical theme. It will extend into July and August for the Kona schools. Spring programs are imminent on the other islands. This program receives support from the National Science Foundation.

4. Hawaiian Science Clubs Service

The Hawaiian Science Clubs Service continued its active program which is supported by the National Science Foundation. The number of science clubs increased on most of the islands, with the largest increase on Oahu.

Approximately 13,500 pieces of scientific literature were distributed to the 77 schools on the mailing list. Almost 700 bookings were made for films and filmstrips available through the film loan program. In order to meet the demand, it was necessary to supplement these films with additional ones purchased with funds from the University of Hawaii and ISSEC. Thirty field trips were arranged for science clubs. Because of a cut in funds, it was possible to finance only one field trip for each science club this year. Field trips are one of the most popular services of this program.

Arrangements were made for speakers at 28 schools. HSCS worked closely with the Science Fair Committee in arranging for talks on the Science Fair. The weekly Science in Hawaii TV program made effective use of science films as well as live shows. The series was well received by students in spite of a relatively poor viewing hour.

Two hundred and twenty students attended the science clubs camp held at Camp Erdman January 26-28. There was a fairly even distribution of boys and girls and high school and intermediate school students Slightly more than half were from Honolulu schools, while the rest were from the rural areas. Plans for next year call for separate camps for the high school and intermediate grades.

HSCS held its Summer Science Teachers' Workshop in cooperation with the Pacific Missile Range, Hickam Air Force Base, and the Standard Oil Refinery on August 4 and 5. Sixty-three teachers participated in the program which included guided tours of the Pacific Missile Range at Kaneohe, the flight simulator and the Nose Cone Recovery Center at Hickam Air Force Base, and the Standard Oil Refinery.

The Third Annual Science Teachers' Workshop in conjunction with the Fifth Hawaiian Science Fair was held on March 24. Science teachers received information in the fields of electronic computers, virology, bacteriology, anthropology, radio, and radar. About 120 teachers attended.

It is the recommendation of HSCS that the possibility of merging some of the functions of HSCS, the Teachers' Science Seminars, and the Student Science Seminars be explored in order to bring about a more efficient utilization of available resources and speakers.

5. Elementary Science Texts

The elementary science text series, *Exploring Nature in Hawaii,* continued to grow. Books V and VI, with teachers' manuals, came off the press. The revised edition of Book I was published to replace the first edition of 10,000 copies which had sold out. Books VII and VIII plus a revised edition of Book II were to be ready for distribution by September, 1962. Credit is given here to The Pineapple Growers Association, the Contractors of Hawaii, and the Hawaii Sugar Planters' Association who financed the colored center pictorial inserts in Books V, VI, and VII respectively featuring pineapple, geology, and sugar in Hawaii. Support was being sought for an anthropology center insert for Book VIII.

6. Hawaiian Junior Academy of Science

The Hawaiian Junior Academy of Science was designed to further the cause of science education in Hawaii junior and senior high schools by providing an annual program of scientific atmosphere and stimulation for capable students. It is comparable to similar scientific meetings of adult scientists. Its purpose is to supplement other efforts of ISSEC and the Hawaiian Academy of Science in the encouragement of able students of science by providing another avenue of stimulation and expression. The first meeting was held April 25, 1962, in Agee Hall. It is hoped that this program can be enlarged next year to include the Neighbor Islands.

7. Teacher Coordination and Science Talent Search

The principal function of this committee was to distribute information to all Oahu schools regarding the activities of ISSEC. The committee was also responsible for conducting the Science Talent Search for Westinghouse Science Awards.

8. Community Participation

The response of the community in support of ISSEC activities was excellent. A total of $6,605.00 was received in monetary contributions. In addition, services, materials, and supplies were given willingly to assist the work of this Council. Without the magnificent and wholehearted support of our community and the dedication of scientists who have given so freely of their time and effort, ISSEC could not exist.

9. Budget Committee.

The Budget Committee approved the budget for 1961-62 as follows:

Fifth Hawaiian Science Fair	$5,300.00
Junior Academy of Science	150.00
Student Science Seminars	150.00
Hawaiian Science Clubs Service	980.00
Public Relations	100.00
Community Participation	25.00
Contingency	300.00
Total	$7,005.00

As of March 1, 1962, the Treasurer reported a current balance of $15,649.27 in the account at Cooke Trust Company, Ltd.

The Budget Committee recommended that an ISSEC Committee be designated to study possible contributions toward strengthening teaching of mathematics at the elementary level. Wilfred A. Greenwell was appointed Chairman of this committee.

10. Public Relations

The activities of the Public Relations Committee were largely associated with the Science Fair. These activities included newspaper coverage of local Science Fairs, and newspaper, radio, and TV coverage of the Fifth Hawaiian Science Fair. Two TV programs, featuring local Science Fair winners, were telecast in conjunction with the Hawaiian Science Clubs Service. The ISSEC brochure was revised for circulation throughout the community for solicitation of contributions.

The Honolulu Advertiser served as Press Sponsor for the Fifth Hawaiian Science Fair. This association proved very effective in stimulating interest in Science Fair activities.

Allied Activities. ISSEC was the recipient of a Certificate of Achievement in the 1960-61 "Action in Education" awards program sponsored by Better Homes and Gardens magazine in cooperation with the National Education Association and the National School Boards Association.

The Science Theatre, held in connection with the 10th Pacific Science Congress, was conducted through the cooperation of ISSEC and the Kaimuki High School Science Club members who operated the projectors.

The *Classroom Science Bulletin,* published by the Jersey City State College, devoted its January issue to education in Hawaii. The work of ISSEC was featured.

The chairman of ISSEC was notified of her appointment to serve a three-year term as a member of the National Science Fair International Council, the governing body of that organization.

ISSEC Officers

Chairman: Dorothy T. Rainwater, Bishop Museum
Vice-Chairman: H. Wayne Hilton, HSPA, Experiment Station
Secretary: Laura Lofgren, Bishop Museum
Treasurer: Dwight H. Lowrey, Cooke Trust Company

COMMITTEES

Budget: John H. Payne, HSPA, Expt. Sta.
Community Participation: L. D. Baver, HSPA, Expt. Sta.
Student Science Seminars: Director: Albert B. Carr, University of Hawaii, Kauai: Barton Nagata, Department of Education, Maui: Michael Hazama, Department of Education, Hawaii: Allan Kondo, Hilo High School.
Elementary Science Texts: Sister Mary St. Lawrence, Catholic School Department
Science Teacher Coordination: Edwin Y. H. Chinn, Office of District Supt. Dept. of Education
Public Relations: Robert Wiemer, HSPA, Expt. Sta.
Science Library Resources: Carolyn Crawford, Department of Education
Science Fair: Director, Gerald G. Dull, Pineapple Research Institute; Associate Director, Robert E. Coleman, USDA and HSPA, Expt. Sta.; Secretary, Setsuko Nakata, Bishop Museum; Treasurer, Dwight H. Lowrey, Cooke Trust Company; Awards, John W. Hylin, University of Hawaii; Exhibits, Dorothy T. Rainwater, Bishop Museum; Sites and Props, Roy T. Tribble, Pineapple Research Institute; Hospitality, Leonora Bilger, Prof. Emeritus, University of Hawaii; Public Relations, Robert Wiemer, USDA and HSPA, Expt. Sta.
Teachers' Science Seminars: Paul Ekern, Pineapple Research Institute
Counseling and Scholarships: Arthur Dole, University of Hawaii
Science Clubs Service: Director, Wallace Sanford, Pineapple Research Institute; Associate Director, Donald Li

CONTRIBUTORS TO ISSEC 1961-62

Aloha Motors
American Association for the Advancement of Science
American Association of University Women, Honolulu Branch
American Chemical Society, Hawaii Section

American Society of Agricultural Engineers
American Society of Agronomy, Hawaii Chapter
American Society of Mechanical Engineers, Hawaii Section
American Factors, Ltd.
American Statistical Association, Hawaii Chapter
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Hawaii Dietetic Association
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Hawaii State Dental Association
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Hawaiian Astronomical Society
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Hawaiian Electric Company, Ltd.
Hawaiian Entomological Society
Hawaiian Sugar Planters' Association
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Hawaiian Village Hotel
The Honolulu Advertiser
Honolulu Construction & Draying Company, Ltd.
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Honolulu Roofing Company
Honolulu Rotary Club
Honolulu Star-Bulletin, Ltd.
Institute of Food Technologists, Hawaii Section
Institute of Radio Engineers, Hawaii Chapter
Kaimuki High School Science Club
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Society of the Sigma Xi, Hawaii Chapter
Thomas Tanaka
Edwin Tani
United States Army
United States Navy
Waterhouse Photo Company, Inc.
Watumull Foundation
G. N. Wilcox Trust

The 37th ANNUAL MEETING 1961-62

Program

FIRST SESSION

November 8, 1961, Agee Auditorium, HSPA, Honolulu

A Symposium

Plants and Animals of the Future

1. Jimmie B. Smith, Moderator: The Importance of Genetic Variability.
2. John N. Warner: New Genetic Material for Sugar Cane Breeding in Hawaii.
3. Donald C. McGuire: Introduction of New Plants and Preservation of Existing Species.
4. Estel H. Cobb: Improving Livestock Breeds.
5. Jimmie B. Smith: Human Genetics.

November 9, 1961, Agee Auditorium, HSPA, Honolulu

6. Constance E. Hartt: Tracing Sugar in the Cane Plant.
7. John F. Mink: The Transition Zone in the Ground Water Lens of Southern Oahu.
8. Gerald M. Meredith and Connie G. W. Wong: Some Personality Correlates of Religious Attitudes.
9. Donald P. Gowing and Arthur H. Lange: Modification of Flower Colors by Chlorine-Substituted Fatty Acids.
10. J. Linsley Gressitt: Insects of Antarctic Regions.
11. Toshio Murashige: Studies on the Gibberellin Suppression of Shoot Formation in Cultured Tobacco Cells.
12. Anthony F. Chunn and Arthur H. Dole: Why East-West Center Students Come to Hawaii.
13. Charles H. Lamoureux: Vegetation of Laysan.

FINAL SESSION

April 25, 1962, Agee Auditorium, HSPA, Honolulu

Meeting of the Hawaiian Junior Academy of Science

1. Charleen Aina: The Use of Autolysed Yeast as a Protection Against Radiation.
2. Priscilla Chow: Modulo 7.
3. Lana Yong: The Viability of *Stellantchasmus falcatus*.

Hawaiian Academy of Science

1. Robert W. Hiatt: Biomedical Sciences in the Pacific Area.
2. Roland W. Force: The Ghost Dance Religion and Receptivity: A Study of Homeostatic Imbalance in the Acculturation Process.

April 26, 1962, Agee Auditorium, HSPA, Honolulu

3. W. Edgar Vinacke: Some Recent Experiments on Coalitions in Triads.
4. Daniel W. Tuttle, Jr. and William McIntire: The "University of Hawaii Poll"—An Experience Report.
5. Harry F. Clements and Minoru Awada: Flowering of Sugar Cane.
6. C. P. Zones and John F. Mink: Pyrite Mineralization in the Dike Complex of the Koolau Series.
7. E. Alison Kay: Hawaiian Bivalved Gastropods.
8. Ralph B. Cloward: A New Approach to the Diagnosis and Treatment of Painful Lesions of the Cervical Spine.
9. John J. Naughton and O. A. Schaeffer: Some Preliminary Age Determinations on Hawaiian Lavas.
10. Claire Ball: The Inheritance of Hemoglobin H.

April 28, 1962, Queen's Surf, Honolulu

Banquet
Introduction of New Officers
Presidential Address

Alexander Spoehr: The Future of Anthropology in the Pacific.

Abstracts

FIRST SESSION

1. Introduction to Symposium on Plants and Animals of the Future — The Importance of Genetic Variability

Heritable variability is as essential to genetics as cardinal numbers are to arithmetic. Yet it need not be thought that geneticists invented variability; rather it was in the analysis of existing variability that the principles of inheritance were determined. These principles include the idea that a diversity of forms of genes, residing one at a time at a given locus on a chromosome, have arisen by the mutational processes. The separation of allelic types during gamete formation, followed by random association in gametic fusion, provide for a second order, or segregational, variation. Intra- and inter-chromosomal recombination add a further order of permutation, and the net effect of all these processes is to provide a continuing source of variation upon which artificial or natural selective forces may operate.

In the absence of selective forces, or random loss of alleles in the fortuitous reproduction of small populations (drift), a given population is remarkably stable in genetic content. Relative proportions of various allelic forms reach an equilibrium as described by the Hardy-Weinberg Law. Newly incorporated mutant alleles will not increase in frequency, or decrease, unless their effect on the phenotype is one of altered fitness. Thus, although a newly arisen mutant may "spread" or become more widely scattered in the process of random mating, it will not increase in frequency necessarily. Obviously, various natural selective forces have operated on variability in the past, including even man himself, resulting in the diversity of form and function seen today in the biological world.

Modern man, who can at the same time be conscious of the above forces and have the technological skill to manipulate them, seeks to alter the pool of variability to fit his needs, as in the highly important programs of plant and animal breeding. At the same time he is beginning to consider what he may do about himself, whether to be the subject of the random forces of nature as now seriously disrupted by his own doing, or to take his own biological future in hand. Whatever he attempts in the genetic alteration of his own or other species, variation is a requisite, as will be elaborated by the speakers to follow.

JIMMIE B. SMITH
University of Hawaii

2. New Genetic Materials for Sugarcane Breeding in Hawaii

Interspecific hybridization in sugarcane is almost as old as sugarcane breeding itself. Spectacular advances, in terms of improved varieties, have been made in every sugarcane breeding program following the transition from intra-specific hybridization within *Saccharum officinarum* to interspecific crosses involving *S. officinarum, S. barberi, S. spontaneum,* and/or *S. robustum.*

S. officinarum includes the original sweet chewing canes which were cultivated as a subsistence crop by the natives of the southwest Pacific area and which were the canes used to establish the sugarcane industries of the world. Until recent years, varieties of *S. officinarum* and their hybrids have been used commercially.

Hybridization of *S. officinarum* with the primitive cultivated species *S. barberi,* and with the wild species *S. spontaneum* and *S. robustum,* has resulted in more vigorous, disease resistant varieties with improved agronomic habit and higher yield.

Exploration to find new sources of sugarcane germ plasm has been extensive but the job of genetic evaluation is a tedious one and much remains to be done. Hawaii has a regular program of introducing and evaluating new breeding canes, both wild and hybrid. All of our commercial varieties of today have both wild species and foreign hybrids in their pedigrees.

JOHN N. WARNER
HSPA Experiment Station

3. Introduction of New Plants and Preservation of Existing Species

Since early colonial days, the American federal government has received plant materials from all over the globe. From the early voluntary efforts of travelers and government officials, a formal program slowly emerged. At first, seed was distributed directly to farmers. This development may have hindered plant introduction work, for seed distribution became a major effort, its political merit perhaps being greater than its scientific worth.

A Section of Seed and Plant Introduction of the USDA was established in 1898, and the collection of thousands of types of plants began in earnest. A major weakness of the effort became apparent in the handling of materials. Seed was sent to interested specialists, who discarded any items which did not carry the desired genetic characteristic. It has since been learned that in some plants genetic resistance to disease exists before the disease becomes known. We therefore should conserve all plant materials, anticipating a time when they must be tested against a disease presently unknown or unimportant. Adaptive characteristics and commercially valuable qualities about which we now know nothing, may be revealed in a context of a new area of cultivation or new market requirements, but only if the germ plasm remains available.

Plant introduction thus has two vitally important aspects: The discovery and importation of the material, and the conservation and evaluation of the material, which of course includes periodic increase of seed.

The probable loss of irreplaceable germ plasm has been of increasing concern to plant scientists. Vast areas are now being closed to plant exploration. Hence, it was with profound gratitude that Federal and State workers set up four regional plant introduction projects soon after the Research and Marketing Act of 1946 provided support.

Each regional project controls a Regional Plant Introduction Station, staffed by a coordinator, an horticulturist, a pathologist, and secretarial and field assistants. Overall management is the responsibility of the Regional Technical Committees, made up of one member from each State in the region. The Station is usually provided space and facilities by a major experiment station of the region. In the West, this is at Washington State University, Pullman. States provide supporting research through contributing projects. Of the eleven states in the western region, all have conducted research or domestic exploration, or otherwise been intimately associated with the work of W-6.

The western regional project grows for increase or evaluation over 3,000 accessions each year, mostly at Pullman. Each year Pullman receives over 1,000 new accessions, and distributes over 3,000 packets of seed to researchers. Researchers return their evaluation reports for the central file.

Loss of seed is much less likely since the establishment in 1958 of the National Seed Storage Laboratory, Fort Collins, Colorado. This laboratory is the only one of its kind in the free world. Its construction resulted from congressional support of the requests of interested agencies at all levels in the country. It has facilities for long-time storage of thousands of types of seed, as well as research on seed physiology.

The changing domestic agricultural situation has altered the plant introduction program. There is a greater sense of urgency in foreign plant explorations, but support funds which have not increased with increasing need and cost have made more careful and effective planning mandatory before expeditions begin. More attention to domestic exploration has already yielded results, and further trips into our own mountains and deserts are planned. Greater attention is being given at all levels to crops which might replace those currently in surplus production. We are seeking genes for agronomic qualities in a number of industrial crops, and are working closely with regional crop utilization laboratories in their evaluation.

The program has been of immense value to American economy over the years. All the bread wheats, soybeans, rice, many tree crops, and source materials for originating or improving nearly all crops in our agriculture, have been brought in from other areas of the world. Person-to-person contacts provide a second major source of new plants. By continuing, even expanding these programs, we are accumulating the building material for continued improvement of our crop plants.

DONALD C. MCGUIRE
University of Hawaii

4. Improving Animals for the Future

Genetic variation is the basic raw material with which the animal breeder works. Unfortunately, most of the traits with which the animal breeder is concerned are influenced in varying degrees by environment and they are affected by many genes. In addition, many traits are involved in describing an economically valuable animal that can efficiently produce a product with high consumer acceptance.

Some of the main changes in animal breeding practices over the last several years are the following: Much more effort to measure the merit of individuals objectively as in cow testing, trapnesting, performance testing, and the use of testing stations; wider and more systematic use of progeny test and sib tests; use of artificial insemination of dairy cattle to intensify the selection of bulls; more effort to standardize the environment under which the individual merit is determined; and the use of specific mating systems such as inbreeding and crossbreeding. The emphasis of the show ring, breed trade marks, and traits of little or no economic value have been de-emphasized but still receive too much emphasis.

The main changes in animal breeding which can be expected in the near future are for more emphasis to be placed on the merit of the individuals as evaluated under controlled conditions, a re-evaluation of the economic values of all traits with more emphasis being placed on those of maximum economic importance, development and improvement of techniques for measuring carcass merit on the live animal to permit direct selection for these traits, the development of banks for the storage of superior germ plasm (both semen and ova), the development of a successful method of sex determination, and the development of better techniques for evaluating genetic superiority. Breeding of animals for specific environments will receive more emphasis in the years to come. Maximum use of outbreeding, or crossbreeding as it is more commonly called, will be used to take advantage of hybrid vigor. The farm animals of the future will be the result of planned evolution.

ESTEL COBB
University of Hawaii

5. Human Genetics

An anthropological assessment of modern man is that he is a member of one of several races within a single species. He has been the object of mutational and selective forces which have left their imprints in recognized adaptations; other racial differences may be credited to random change in corporate genetic content (drift), or to antiquated effects of selection no longer identifiable as such in modern environments. Biologically, his genetic information is coded in packets which are arranged in linear order on 23 kinds of chromosomes, with each chromosome being represented twice in somatic cells, once in gametes. The arrangement is such that if only one diallelic gene existed per chromosome pair, there could be produced 8,338,608 kinds of gametes! The actual existence of more like 100,000 genes (or loci), permutated in gametic fusion, make an infinite number of genetic types possible. Except, then, for identical twins, it can be safely said that no two humans were ever alike or ever will be!

That man actually is genetically highly heterogeneous is attested by measuring his genetic load of harmful alleles. Fully one to two per cent of human births are genetically defective, though usually born to normal parents. Estimates are that each human possesses 8-10 harmful alleles and that a new one may be produced as often as one in every two gametes. Random mating assures a continuous distribution throughout human populations.

Certain modern human forces are thought to impinge upon this naturally occurring variability. These include: (a) break-down of racial and other isolates, (b) increase in mutation rate, (c) relaxation of natural selection, and (d) establishment of dysgenic selective differentials.

Gene flow between racial groups is increasing, though far from representing a major breakdown in isolation. Genetic exchange between Negroid/Caucasoid groups in the US has been a significant factor in the alteration of the genetic composition of both groups, though accomplished mostly illegitimately. Legitimate exchange, as in Hawaii, has easily noted effects on the races involved. The consequences of these exchanges are: (1) loss of special combinations of genes, though not the genes themselves, (2) decrease in combined frequency of unilaterally contributed harmful genes, and (3) decrease in probability of further drift.

Mutation is inescapable and has always been a fellow-traveler with man. To insist that mutations are always bad would be to insist that man today is not a success, and yet he is here. However, any mutation within a finely adjusted genetic framework would, not surprisingly, be harmful, and most are. Further mutational gain invariably is at the expense of genetic death. Geneticists are agreed that radiation hazards increase the frequency of mutations that already naturally occur in lower frequency. Genetic deaths bear a constant relationship to mutation rate, where natural selection is allowed to operate in an unrestricted manner. However, since most mutations are recessive, a considerable load may be carried in the heterozygous state.

Man's ability to order his environment to fit his genes, rather than be the subject of the reverse process of natural selection by which he has arrived, is a modern innovation. The consequence is that genotypes formerly considered "unfit" are now "fit" in an artificial environment, such as has become possible through medical research. Diabetes, for example, endows a person with normal reproductive capacity (genetic "fitness") in an insulin environment. Prior to 1927, nature took its course; since 1927 man has taken his course, and diabetes incidence in Denmark has increased from 12/10,000 to 43/10,000 as of 1950. Natural selection no longer counterbalances mutation. Also, it may be wondered whether differential fertility, as associated with intelligence and occasioned by certain sociological forces, may not be working revenge on the creators of these same sociological forces.

New evidence suggests that natural systems tend to preserve heterozygosity involving harmful recessives. This arises when the heterozygote is more fit (or heterotic) than either homozygote. An example might be where a_1a_1 had a fitness of 0.8, a_1a_2 of 1.0, and a_2a_2 of 0.2, and which would result in 32 per cent of the population being heterozygous. A continuous polymorphism is effected, balanced by selection for the heterozygote in spite of the low fitness of the recessive. An astounding example of this has been noted in the incidence of sickle cell trait among American Negroes as compared to certain African Negro tribes. Sickle cell trait, the heterozygous form of a serious hemoglobin recessive anomaly, occurs in only about one per cent of American Negroes but among 40 per cent of the Baamba population in Africa, apparently owing to the fact that the heterozygotes are highly resistant to malaria as compared to the homozygous "normal" counterparts. Evidence is increasing that such polymorphic systems are common in the human and have been shown to be routine in wild populations of Drosophila.

As twentieth century man contemplates his future, he is possessed of considerable knowledge pertinent to the direction of his own biological destiny. He recognizes the massive heterozygosity or variability available to him and realizes the impossibility of achieving much homozygosity in any case, owing to the inherent difficulties of selection against recessives in a randomly mating population. Unlike the plant and animal breeder, he will probably keep his variability widely dispersed in walking gene pools, ever increasing in size, and not resort to artificial and narrow gene collections (varieties) which must be subject to constant directed revision or substitution from storage. Taking his cue from nature, he will probably recognize the need and compulsion to maintain a variable population, but commensurate with genetic hygiene practices, will seek to protect the genetic material from undue mutational damage and unwise selection gradients. If man fails to appreciate his genetic heritage for what it is worth, and parallel to his appreciation of culture or learned behavior, he may well deserve what his posterity will probably get!

JIMMIE B. SMITH
University of Hawaii

6. Tracing Sugar in the Cane Plant

To put sugar in the bag, the first step is to put it in the stalk.

Radioactive sucrose made by photosynthesis with $C_{14}0_2$ in the blade of the sugar cane plant, is quickly mobilized into the veins and proceeds primarily downward. The sugar follows the veins to the midrib in the blade and moves down the sheath veins into the stalk, going chiefly to the center. In 10 minutes sugar has already moved 25 cm. below the fed part. Sugar made on one side of the blade remains chiefly on that side as it moves down the sheath into the stem. Some feed into the midrib but very little, if any, moves to the opposite side or to the apex.

The nearer the front of movement the higher the per cent of counts soluble in alcohol. Sucrose is shown by paper chromatography to be the main compound translocated.

Upon reaching the stalk, sucrose first turns downward and moves down several joints before any turns upward. Sucrose moves at rates generally ranging from 1-2 cm. per minute, reaches the roots and up into the suckers. A large per cent of the newly formed radioactive sucrose is stored in the millable cane, both of the fed primary stalk and the suckers.

Blade 5 sent half its counts to the stalk in 90 minutes, blade 8 only 21 per cent and blade 12 a small amount. Blades 5-8 sent some counts up, but not blade 12. These data illustrate the fact that a leaf in exporting sucrose to the stalk must compete with the leaves above it. Blade 6 exports a larger per cent of counts if blades 1-5 are removed, illustrating the importance of competing streams.

A detached blade fed C_{14} above the middle, translocates sugar down the veins at rates of same order of magnitude as an attached blade. This translocation is inhibited 90-98 per cent by darkness. Supplying a sink, e.g. growing lalas or suckers, increases the rate down the stalk. Thus translocation forces include a light-dependent push from the leaf and a pull from below.

Leaves export 90-98 per cent of labelled photosynthate in 24 hours under normal conditions. Rates and amounts of translocation are affected by nutrition, moisture, temperature of air and roots, light and other factors.

The C_{14} method can be used to determine whether a plant is storing its sugar in maximum amount.

CONSTANCE E. HARTT
HSPA Experiment Station

7. The Transition Zone in the Basal Water Lens of Southern Oahu

The existence of a transition zone in the basal water lens of southern Oahu has been recognized ever since the Ghyben-Herzberg principle was first elucidated for the Hawaiian situation in the early part of the century. Descriptions of this zone were mainly speculative, however, until recent years when the results of model tests were matched with field observations.

Laboratory and theoretical studies indicate that a transition zone forms when the interface between two miscible fluids (fresh and salt water) is displaced, and that the concentration distribution across this zone approximately matches the error function distribution. Data obtained from three wells drilled through the basal water lens of southern Oahu show that the field situation corresponds closely with laboratory tests. The concentration-depth curves for these wells are nearly symmetrically sigmoidal, and the depths to the 50 per cent relative concentration points approximate the depths to the interface based on Ghyben-Herzberg considerations.

The chief causes leading to the formation of a transition zone in Southern Oahu are tidal action, nonuniform recharge, and pumping stresses. Consequently the zone is thickest near the coast and progressively contracts inland. The data thus far obtained show that the zone is thinnest in the Beretania area of Honolulu, and thickest in the Pearl Harbor region.

JOHN F. MINK
Board of Water Supply

8. Some Personality Correlates of Religious Attitudes

In his provocative book *The Individual and His Religion,* the psychologist Gordon W. Allport defines the "religious sentiment" as a "disposition, built up through experience, to respond favorably, and in certain habitual ways, to conceptual objects and principles that the individual regards as of ultimate importance in his own life, and as having to do with what he regards as permanent or central in the nature of things." What are the roots of religious sentiments? Allport finds the "origins" in the individual's bodily needs, his temperament and mental capacity, his interests and values, his pursuit of rational explanation, and his response to the surrounding culture.

The purpose of the present study was to investigate the relationship between a number of selected personality and attitudinal variables with two clusters of religious attitudes, one dealing with attitudes toward the efficacy of religion and the church, and the other dealing with attitudes toward God, evolution, and birth control.

Subjects included 165 females and 117 males enrolled in the introductory psychology course at the University of Hawaii. The sample was predominantly youthful, single, lower-division in academic standing, and diverse with respect to ethnic and religious background. On the basis of religious affiliation and church participation differences, the sex groups were treated independently. Personality and attitudes were measured through the use of standardized pencil-and-paper tests. Religious attitudes were measured by two objective experimental scales: Thurstone's *Attitude Toward The Church Scale* and the Ferguson *Religionism Scale.*

The results of the male and female subjects were treated separately. The raw scores on the two religious attitude scales along with 37 personality and attitude measures were interrelated with one another through the aid of the IBM 650 computer. The Pearson product-moment coefficient of correlation was computed between each pair of variables, yielding a 39-order matrix of r-values for each sex group. An attempt was made to statistically ferret out through the tool of multiple correlation analysis those variables that tended to be the "best" predictors of each religious attitude cluster.

The results of this analysis indicated that the "best" predictors of male attitudes toward religion and the church were tendency toward conservatism, high super-ego strength, strong endurance need, and conventionality. The "best" predictors of female attitudes toward religion and the church were tendency toward conservatism, suppression of sexual need, high super-ego strength, and low academic performance. The "best" predictors of male attitudes toward God, evolution, and birth control were tendency toward conservatism, suppression of sexual need, high super-ego strength, and low academic performance. Finally, the "best" predictors of female attitudes toward God, evolution, and birth control were tendency toward conservatism, low achievement need, warmth and sociability, and low academic performance.

The results of the present study support the conception that religious attitudes and sentiments are rooted within the total personality system and are interrelated with other sub-systems. Since the present study was only cross-sectional in time, an intensive longitudinal study is imperative to shed light on both the problem of early "origins" as well as the problem of developmental sequence of religious beliefs and their interaction over time with other ongoing personality structures.

GERALD M. MEREDITH
CONNIE G. W. WONG
University of Hawaii

9. MODIFICATION OF FLOWER COLORS BY CHLORINE-SUBSTITUTED FATTY ACIDS

Several of the chloroalkylcarboxylic acids (trichloroacetic acid, 2,2-dichloropropionic acid, 2,3-dichloroisobutyric acid, and 2,3,3'-trichloroisobutyric acid) change the red color of a number of flowers to shades of orange or yellow. These compounds show biological activity on plants in several other ways. Some are selectively herbicidal for grasses (together with other analogues of the series), at least one is a gametocide on the cotton plant, and several interfere with the pantothenate synthesizing enzyme in several plants.

Our results showed morphological effects on the flowers in addition to the changes in flower colors; the number of petals of double hibiscus blossoms were reduced, for instance. It was felt that a report of these results would be of interest to individuals working on objective methods of characterization of flower colors, or working on the biosynthesis of flower pigments. It may be that these various effects may be related or connected through metabolic pathways whose existence is not yet established.

DONALD P. GOWING
ARTHUR H. LANGE
Pineapple Research Institute

10. INSECTS OF ANTARCTIC REGIONS

Insects (including mites, ticks) prove to be the dominant terrestrial animals of the Antarctic continent, and also of sub-Antarctic islands. Of course, insects may be said to be the dominant animals of the world, as far as numbers of known species are concerned, even including the marine environment. But in Antarctica the marine fauna is rich and the terrestrial fauna is very limited. It is made up almost entirely of insects and mites, as far as we know now, and as far as many-celled animals are concerned. There are no true terrestrial vertebrates, land mollusks, earthworms, land crustaceans, centipedes, millipedes, and perhaps no flatworms. The only ones besides insects, mites, and ticks are a few roundworms, rotifers, and tardigrades.

At present we know about 13 mites (mostly free-living), 2 ticks, 10 Collembola (spring-tails; free-living), 17 Mallophaga (lice on birds); 5 Anoplura (sucking lice on seals), and 2 flies (free-living midges): thus nearly 50 species, with probably a few more to be recorded.

Probably insects will prove to be the southernmost occurring animals. Mites and springtails have already been found at 83° 55′ S. Lat. which is nearly as far south as ocean water is known to occur—beneath the Ross Ice Shelf, 300 m. (1000′) thick, so it may be some time before we know what animals occur beneath the ice at the south end of the shelf, 800 km. (500 miles) from its edge.

Although in summer prevailing air temperatures are rarely higher than freezing in many of the areas where insects occur, the particular niches are slightly warmer during part of the summer, permitting activity. The ectoparasites, of course, benefit from the body warmth of their hosts (birds, seals) and are protected from the uniformly slightly sub-freezing temperature of the sea water, or lower temperature of the air. The free-living insects occur where there is exposed rock or soil. They are dependent upon the presence of plants: algæ, lichens, mosses, except in the northernmost part, where there are also liverworts and grasses. The microenvironment is warmed above freezing by the absorption of solar energy by the exposed rocks or soil. Moisture is also necessary, so insects occur only fairly near melting snow, as the air of Antarctica is quite arid. Areas like the floors of some of the dry valleys are true deserts, but insects occur below the ends of glaciers, where there is melting water from contact of the ice with rock on warm days. Mites and springtails generally occur on undersides of loose rocks, or in moss and lichens. When weather is warm, they crawl about on the surface of rocks and plants. On cool days they may be aroused by breathing on the undersides of rocks where they are resting. In winter they probably burrow as deep as the soil or cracks in the rocks will allow. In more southerly areas they probably are exposed to temperatures as low as —60° C. There is some evidence that they undergo some growth during periods below freezing.

Part of Bishop Museum's object in working on insects in Antarctica is the study of natural dispersal. Trapping has been done on ships, on land, and from airplanes. Data being obtained correlate with that of similar trapping in the tropical Pacific, and strongly indicate air dispersal as the means of colonization in Antarctica, as well as on oceanic islands.

J. LINSLEY GRESSITT
Bishop Museum

11. Studies on the Gibberellin Suppression of Shoot Formation in Cultured Tobacco Cells

Gibberellic acid (GA_3) in concentrations 50, 100, 500, 1000, and 5000 gammas per liter markedly depressed shoot formation in tobacco cell cultures. The suppression was not due to toxicity since fresh and dry weights were not correspondingly reduced. The following additions or concentration variations of other chemicals were unable to reverse the suppression: Indole-3-acetic acid, 0.5, 1, 2, and 4 mg/1; kinetin, 1, 2, 4, and 8 mg/1; L-tyrosine increased from 300 to 500 mg/1; sucrose increased from 2 to 4 and 6 per cent; NaFeEDTA increased from 50 to 100 and 150 mg/1; KH_2PO_4 increased from 137.5 to 275 and 412.5 mg/1; casein hydrolysate, 1 g/1; adenine, 25, 50, 100, and 200 mg/1; and chlorocholine chloride, 0.2, 2, 20, and 200 mg/1.

TOSHIO MURASHIGE
University of Hawaii

12. Why East-West Center Students Come to Hawaii

Forty per cent of all graduate East-West Center students in residence as of the spring semester 1961 were surveyed to identify reasons, interests, values, and influences which motivated them to come to an American university; to compare men and women; and to compare East-West students with University of Hawaii undergraduates. The population, representing seven different countries, was composed of 20 men with a mean age of 28 years, and 12 women, mean age of 26 years. Dole's 79 item modification of Iffert's *Reasons for going to College* was adapted for this study.

Both the East-West men and women rated the following as among the three most important reasons: "Find out more about certain fields of knowledge"; "Scholarships"; and "See America and get to know her people."

For this sample, the decision to come to an American university was relatively independent of sex affiliation. When the means within each of four arbitrary determinant item groupings were placed in rank order, the hierarchies for the East-West male group were highly similar to the hierarchies for the female group. This is in contrast to American student groups where interests of the sexes have tended to be unlike.

The East-West men and women were only moderately similar to the 1960 University of Hawaii freshmen. However, the East-West Center students were in general and as a group rather highly similar in their response hierarchies to the University of Hawaii 1960 seniors.

On item-by-item comparison with the American undergraduates, the East-West Center students were substantially less degree-oriented, less influenced by the example of persons they respected, less concerned about becoming a success in life, less interested in occupational exploration and job entry, less motivated to attain an easier life, status, or a mate. They were more attracted to the fellowship of dormitory living and to possible intellectual exploration.

In sum, the East-West Center students seemed less concerned about the extrinsic aspects of education and more concerned with its intrinsic worth.

ANTHONY F. CHUNN
ARTHUR A. DOLE
University of Hawaii

13. Vegetation of Laysan

Laysan, one of the leeward Hawaiian Islands, is a low sand island about 1.5 miles long, 1 mile wide, and 40 feet high. In its center is a large depression containing a salt lake. Despite its small size and relatively uniform environment, Laysan once possessed five endemic birds and five endemic plants.

In 1892 guano digging operations were started. A botanical survey made by Schauinsland in 1896 revealed that 26 species of higher plants grew on the island, 25 of which were native. In 1903 rabbits were introduced to Laysan and increased rapidly. An expedition in 1911 spent three months on Laysan and found only 15 plant species (13 natives). In 1923 the Tanager Expedition was able to find only 8 living species (4 natives). The members of this expedition exterminated the rabbits and planted several kinds of seeds and cuttings.

Studies made in 1959 and 1961 indicate that there are now 23 species (17 natives) of higher plants on Laysan. Most of the island is vegetated and 5 plant associations can be recognized. These are the:

1. *Nama* association. On beaches above high-water mark, extending inland from 10 to 300 meters. Dominated by *Nama sandwicensis* var. *laysanicum* with *Portulaca oleracea, Boerhavia diffusa, Ipomoea pes-caprae,* and *Heliotropium curassavicum.*
2. *Scaevola* association. A band from five to 100 meters wide, inland of the *Nama* association. Also present in scattered patches on lower inner slopes of island, below the *Eragrostis* association. Dominated by *Scaevola taccada* with *Ipomoea pes-caprae, Capparis sandwichiana, Boerhavia diffusa, Tribulus cistoides,* and *Eragrostis variabilis.*
3. *Eragrostis* association. A band from 50 to 500 meters wide on the crest and inner slopes. Dominated by *Eragrostis variabilis* with *Tribulus cistoides, Boerhavia diffusa, Nicotiana tabacum,* and *Fimbristylis cymosa.*
4. *Boerhavia-Tribulus-Ipomoea* association. A band from 10 to 100 meters wide on inner slopes below the *Eragrostis* association. Dominated by *Boerhavia diffusa, Tribulus cistoides,* and *Ipomoea pes-caprae,* with scattered plants of *Eragrostis variabilis, Sicyos* sp., *Pluchea indica,* and *Ipomoea indica.*
5. *Sesuvium-Cyperus-Heliotropium* association. A band from 10 to 100 meters wide above the shore of the lake. Near the lake shore *Sesuvium portulacastrum* and *Cyperus laevigatus* occur in pure stands; further from the shore both species occur together and mixed with *Heliotropium curassavicum.* Scattered plants of *Ipomoea pes-caprae, Tribulus cistoides,* and *Fimbristylis cymosa* are also found here.

CHARLES H. LAMOUREUX
University of Hawaii

FINAL SESSION

1. The Use of Autolysed Yeast as a Protection Against Radiation

With the use of atomic energy and the creation of fallout, many people are becoming more aware of the increasing necessity of finding a protection from the deadly rays of fallout. Using the conclusions and procedures of an experiment conducted at the Yale Medical School, autolysed yeast as prepared by Jaraslow's method was used as a protection against overdoses of X-ray radiation for mice. The hypothesis upon which this purpose was based was formulated by the conclusions of the Yale group which stated that the yeast-injected animals were protected from overdoses of radiation and survived while the unprotected ones were fatally affected. Upon this the purpose of my experiment was formed: to test the possibility of protecting the offspring of an animal exposed to an overdose of radiation, by previous injection of prepared yeast.

The animals, two female white rats, were mated and maintained under healthy conditions. After eight days of presumed mating, one animal was injected intraperitoneally with the yeast extract (1 ml.). Both animals were radiated with three doses of X-ray radiation at 300R., at five minutes for each dose.

For the first week of 29 days of observation, both animals were slow moving, drowsy, and not really responsive to either food or attention. Later both suffered eye irritations, were very temperamental, and lost weight. The injected animal suffered almost the same effects. Both animals did not deliver any known litters.

From these observations nothing much can be concluded. The yeast was not proven to be a protection for the offspring, but neither was it proven not to be a protection, since both animals survived. However, radiation was shown to be a detrimental factor to the eyes. Since nothing conclusive was deduced from the investigation it will be tried again, using new information, animals, and experience.

CHARLEEN AINA
Kamehameha School for Girls

2. Modulo 7

The Modulo system is a finite circular arithmetic which keeps repeating itself. Keeping in mind that Modulo 7, that is, 0, 1, 2, 3, 4, 5, 6, 0, –, is a finite set under the operations of addition, subtraction, multiplication, and division, its answer is never more than 6. Any number factorable by 7 is zero.

In addition, the equation is: $\frac{\text{a no.} + \text{a no.}}{7}$, the remainder $= X$. The equation for subtraction is: $\frac{(7 - \text{subtrahend}) + \text{minuend}}{7}$, the remainder $= X$. The additive method of subtracting—the subtrahend plus the difference equals the minuend—was used to get the subtraction table. $\frac{\text{A no.} \times \text{a no.}}{7}$, the remainder $= X$, is the equation for the multiplication of Modulo 7. When a no. factorable by 7 + the dividend divides evenly into the divisor, the result is the answer in division. The multiplicative method of dividing—the divisor times the quotient equals the dividend—was used to get the table in division. For any of the four equations above, the sum, difference, product, or quotient is the answer if it is less than 7. Then there is no need to divide by 7.

Because Modulo 7 satisfies all the properties for a number field, it is a number field.

PRISCILLA CHOW
2117 Pililani Place

3. The Viability of *Stellantchasmus falcatus*

In Hawaii, a large number of people eat raw fish and have been found to be infested with heterophyids. A knowledge of the viability of the metacercariæ in the muscle tissue of mullet would help determine the likelihood of their infesting in man.

Infested muscle tissue of mullet (*Mugil cephalus*) was exposed to various temperatures to determine the viability of the metacercariæ of *Stellantchasmus falcatus*.

The tissue was also exposed to simulated conditions of man's digestive processes.

Finally, the effects of condiments used in eating raw fish were tested.

It was found that only cooking or freezing the fish well would definitely kill the parasite. Therefore, it would be very likely that those who eat fresh, raw, infested mullet would be infested with heterophyids.

LANA YONG
Hilo High School

The Identification of Some of the Nonsucrose Constituents of Hawaiian Cane Syrup

No abstract available.

ROWENA PEROFF
Kamehameha School for Girls

Research in Bioluminescence

No abstract available.

MARILYNN YEE
Punahou Academy

Inability of CCC, Adenine, and TIBA to Reverse the Suppression of Shoot Formation Caused by Gibberellic Acid in Cultured Tobacco Cells

No abstract available.

ROBERT H. HOLMES
Radford High School

Gastric Digestive Time Studies in the Bullfrog

No abstract available.

RICHARD ONOUYE
Waipahu High School

1. Biomedical Sciences in the Pacific Area

In Hawaii and in other Pacific island areas, as well as in countries bordering the western Pacific Ocean, there are many medical and sociological problems whose solution would be of lasting importance to the peoples of this area, to the United States, and to all humanity. Also, unusual opportunities exist in this vast region to utilize both the human and marine biological resources for investigations into the fundamental mechanisms of life processes. There is a prime opportunity, therefore, for the University of Hawaii to develop and implement an action program for research and education in the biomedical sciences to take fuller advantage of one of its most significant natural geographic assets.

This paper comprises (1) a substantial case for the establishment in Hawaii of a multipurpose biomedical research institute which would serve as a national and international regional center focusing its activities on unsolved medical problems and would utilize untapped biomedical resources of this vast area, (2) a digest of current developments in the biomedical sciences in Hawaii, (3) a plan to associate a school of basic medical sciences with concurrent developments in biomedical research, and (4) a perspective on the significant role which the East-West Center can play in research and education in the biomedical sciences. Correlated with this latter objective will be a suggested mechanism, dependent upon the establishment of a school of basic medical sciences and ultimately a full fledged medical school, whereby Hawaii may play a far more significant role than it has thus far in accomplishing an understanding, in Asian and Pacific countries of American values and attitudes. In this scheme, the University, the East-West Center, and the Hawaiian community will all have leading roles to play.

ROBERT W. HIATT
University of Hawaii

2. The Ghost Dance Religion and Receptivity: A Study of Homeostatic Imbalance in the Acculturation Process

The concept of culture as an integrated, functioning whole is generally accepted by anthropologists today. Some have voiced reservations about the emphasis on the organic nature of culture, stressing that biological entities and cultural entities are not properly analogous. As with other abstract concepts, however, reification often facilitates analysis and understanding. There is today in the social sciences perhaps an overemphasis of so-called model theory, but paradigms of various kinds have long been valued as analytical tools.

Students of cultural change focus their interest on the dynamic aspects of culture. They concern themselves in part with the processes by which cultures change. And they have developed a considerable body of theory not only concerning *how* change is brought about, but also *why* it is brought about—what stimulates change through time. For the past 25 years there has been an increasing interest in cross-cultural change and in acculturation studies. That is, with the ampact made upon each other by alien cultures brought into contact.

Among the many reactions to contact with a dominant, more numerous, or more technologically developed culture are certain patterned responses. Some of these responses are negative reactions to new, externally imposed cultural stimuli. Reactions that involve attempts to sustain or even revive indigenous features of culture and that include resistance to new stimuli are often termed nativistic movements. Such adaptations to impinging cultural changes are often millenarian. The cargo cults of Melanesia provide an Oceanic example of such reactive adaptations that have occurred in relatively recent time. During the 19th century the Indian Shaker church, the Earth Lodge cult, and the Prophet Dance, the Dream Dance, and the Ghost Dance religions, among others, were comparable phenomena in North America.

The Ghost Dance religion of North America was an unsuccessful attempt to re-establish and maintain cultural equilibrium. If we may borrow a term from the physiologist W. B. Cannon, the process of maintaining cultural equilibrium or balance may best be defined as cultural homeostasis. The process involved is that for each disequilibrating external stimulus impinging upon a culture, there is a corresponding self-contained reaction—an internal force or inner tendency, which tends to re-equilibrate the system and re-establish balance.

The Ghost Dance religion was unable to restore the aboriginal cultures which adopted it to their former states of vitality; the magnitude and inertia of the impinging dominant white culture was too great. However, it did effect certain stabilities for a short time which could not otherwise have been achieved except through the medium of some alternative response, such as the Peyote cult.

The concept of cultural homeostasis is only one of many with applicability to the study of group phenomena. Like other models or paradigms it is imperfect because it is conceived in normative terms. Data are seldom if ever normative. One important point to stress is that the constancy of cultural change dictates that the homeostatic process is one of perpetual flux, absolute stability being impossible of achievement in the realm of cultural phenomena. Adjustments and reactions occur in proportion to the omnipresent external stimuli which prompt them. A steady state or state of equipoise is best considered as approximated rather than actually achieved. The incidence and history of the Ghost Dance religion and the receptivity to it by various North American Indian groups demonstrates one variety of contact situation in which the concept of cultural homeostasis may be a useful analytical tool.

ROLAND W. FORCE
Bishop Museum

3. Some Recent Experiments on Coalitions in Triads

This research has been concerned with the behavior associated with various patterns of power-relationships that can occur in small groups. Following a theoretical analysis by Theodore Caplow, the following patterns were established: all members equal in strength; one member all-powerful; internal differences in strength, but no member stronger than the other two in combination. When groups, with these patterns, play a simple competitive game, and coalitions are permitted, several contrasting strategies may be identified.

Rather than the strictly "rational" strategy predicted by the theory of games, the prevailing strategy in the University of Hawaii experiments has been determined by the subjects' perception of their relative strength. In general, this means that the weaker players tend to form alliances in opposition to the apparently stronger member. When a cumulative score is maintained, the two players who are behind in points tend to ally against the one who is ahead.

A highly significant difference between the sexes in style of play has led to the concepts of "exploitative" (male) and "accommodative" (female) strategies. The former is competitive and oriented toward winning. The latter is oriented toward the social situation and seeks to arrive at outcomes satisfactory to all the members. The two sexes have been found to show this difference under four incentive conditions. This difference is augmented in a game designed to enhance feminine interests. Similar differences are associated with motivational characteristics of the players and with cultural background. In mixed-sex triads, where exploitative and accommodative strategies are both present, the female has a distinct advantage.

The size of the group has an effect on the character of play, as revealed in an experiment with tetrads. There is some evidence that the simplest winning coalition tends to supersede the weak-against-strong strategy.

W. EDGAR VINACKE
University of Hawaii

4. The "University of Hawaii Poll"—an Experience Report

During the period June 1959 to December 1961, small groups of supervised University of Hawaii students conducted six public opinion polls of state-wide significance. These polls, three of which were undertaken immediately prior to state elections, sought to measure voter reaction to various political candidatures and issues. Students knocked on an estimated 23,600 doors to obtain, according to rigid requirements, a total of 7,863 sample ballots. These efforts have been popularly entitled the "University of Hawaii Poll."

To minimize biasing and instrumental error, a method best generally described as "pin-point sampling, with modifications," was employed. Precinct polling areas were selected after extensive analysis of the 1956, 1958, and (later) 1959 election returns provided an index of party strength for each precinct and the entire state. Polling areas that coincided with previous state-wide electoral results as to party strength were drawn from diverse state representative districts on Oahu. Areas included both marginal and heavy partisan locales and were checked for candidate idiosyncracies. Characteristics permitted use of a "poll within a poll" technique. Registration data facilitated balancing the size of precinct samples. Sex was used as a control factor.

Ballots, similar to actual ballot forms, were accepted only from voters registered in the polling areas. Respondents were asked to mark ballots *in secret,* to vote as they would if the election were actually taking place, and to deposit ballots in sealed boxes.

Major results of these polls were released shortly after completion. However, data were accumulated which permitted further study re a possible difference in the voting behavior of males and females. Results of Poll No. 3 (July 1959) and Poll No. 6 (November 1961) revealed that a significant difference was apparent in only two of the eight contest situations studied. Both of these involved gubernatorial contests (one actual, the other hypothetical).

The average deviation of poll results from actual election results in the three validating situations was 2.3 percentage points, a figure well within the limits of an advance error estimate of plus or minus 4.0 points. Figures were published for 55 individual candidates. In 12 of these cases, error exceeded the estimate limits; in 21 instances, error was less than one-half of such estimate. Using a more popular measure, the poll winner coincided with the election winner in 23 of the 24 contest situations.

The "secret" aspect of procedure and the fact that pollers were able to identify themselves as University students facilitated public cooperation. Other interesting and valuable field experience was noted.

Complete and careful publication and avoidance of polling for private groups have given the "Poll" a quality of uniqueness among Island polls.

Experience with the "University of Hawaii Poll" has demonstrated (1) the feasibility of student participation in community polls, (2) the utility of "pin-point sampling, with modifications," in Hawaii, and (3) the value of poll data in advancing knowledge of political behavior in Hawaii. Other major conclusions emerge from this research.

DANIEL W. TUTTLE, JR.
WILLIAM MCINTIRE
University of Hawaii

5. Flowering of Sugar Cane

Flowering of sugar cane in Hawaii's commercial fields results in very serious losses of yield, particularly if the blossom occurs during the first year of the crop. In order to solve this problem most simply, it will be necessary through breeding and selection to develop commercial varieties which will not tassel under natural conditions. Techniques then need to be developed to force ordinary nontasseling canes to produce tassels under artificial conditions so that the plant breeder can make the necessary crosses, and thus improve such varieties while maintaining in the hybrids under natural conditions the nontasseling characteristic.

Vijayasaradhy and his associates at Coimbatore, India, continuing the work of Dutt and others have been most successful so far. They have induced their Coimbatore varieties to blossom more or less at will throughout the year merely by extending the natural dark period for some two to four hours nightly.

Chilton *et al.* at Baton Rouge, Louisiana, where fall frosts prevent regular tasseling, and therefore, a dependable breeding program, were successful in producing fertile flowers by exposing plants beginning in spring to an exact replica of the series of shortening day lengths experienced in Hawaii between June 21 and continuing through the early September period.

Coleman of the USDA and Davis, also of the USDA, working in Hawaii, were able to induce 37-1933 to blossom in late June, following exposure for several months to photoperiods of 12½ hours.

The work at the Hawaii Agricultural Experiment Station begun in 1959 has now progressed to the point where easy tasseling canes CO-312 and NCO-310 as well as 37-1933 have been forced into blossom at all periods beginning in October and continuing into May. Furthermore, we have been able to force plants of the reluctant tasseling variety 45-2708 to bolt beginning on April 3, 1962. The likelihood is that these varieties can now be forced to flower throughout the year using the following procedure:

Cane plants started from seed cane planted directly into pots are grown in the open. When of sufficient age, they are transferred from continuous days, or days of 13 hours, 21 minutes in the greenhouse, or from any natural day length out of doors to a condition of darkness extending from 4:00 p.m. daily to 3:35 a.m. At this time, lights are automatically turned on and continued until 8:00 a.m. when the plants are wheeled from the darkroom into the direct sunlight. Further requirements so far determined are a very low soil moisture tension preferably below 0.20 atm., a night temperature near 70° F., a day temperature of about 85° F., and a sunlight of maximum intensity at or in excess of 10-12,000 fc.

HARRY F. CLEMENTS
MINORU AWADA
Hawaii Agricultural
Experiment Station

6. Pyrite Mineralization in the Dike Complex of the Koolau Volcanic Series of Oahu, Hawaii

Previous reports on the geology of Hawaii are not known to mention the occurrence of pyrite, except as a possible constituent of the opaque minerals observed in thin sections. This apparent scarcity of pyrite seems anomalous in view of the volcanic origin of the Hawaiian Islands. Only three pyrite localities in the State, all on the island of Oahu, are known to the writers: (1) Lualualei Valley, in western Oahu, where pyrite has been found in basalt obtained by core drilling; (2) Olomana Peak, in eastern Oahu; and (3) at Puu Pahu, eastern Oahu, where pyrite occurs in the dike complex of the Koolau Volcanic Series of Pliocene (?) age.

Pyrite mineralization at Puu Pahu is associated with a group of closely spaced dikes. The youngest dike in the group is a black, dense, asphanitic basalt, which was intruded after the older dikes had been hydrothermally altered. The pyrite crystallized chiefly in fissure veins at the edges of the black dike and in paper-thin fractures within the dike; it also crystallized in fractures and vesicles in the hydrothermally altered dikes, but in amounts that decrease with distance from the black dike. The pyrite occurs in platy crystalline masses and as separate euhedral crystals up to 0.2 cm. in diameter.

Quartz, calcite, chlorite, and minor amounts of zeolite are associated with the pyrite. The quartz occurs as granular aggregates in veins and in some vesicles, and as drusy coatings in cavities. The chlorite occurs as cavity-filling material in vesicles that are less than 1 mm. in diameter and as a lining in many of the larger vesicles containing quartz.

The chlorite was deposited first; pyrite and quartz were next; and calcite, which fills the interstices between the other minerals, was last. The zeolite probably was contemporaneous with the calcite.

The scarcity of pyrite in outcrops in the dike complex may be more apparent than real and may be due to rapid weathering of the sulfide. The presence, in southeastern Oahu, of gypsum—a possible byproduct of the weathering of pyrite—leads to the speculation that pyrite may be present in quantity.

C. P. ZONES
U. S. Geological Survey
JOHN F. MINK
Board of Water Supply

7. Hawaiian Bivalved Gastropods

One of the distinguishing features of two of the best known classes of the phylum Mollusca is the occurrence of a single shell in the Gastropoda and a bivalved shell in the Lamellibranchia. The discovery by Kawaguti and Baba in 1959 of a gastropod with a bivalved shell was, therefore, of considerable interest. The bivalved gastropod described by Kawaguti and Baba is a sluglike animal which carries two shells dorsally, the left bearing a spiral nucleus, the right appearing as an area of calcification near the aperture of the embryonic shell and developing as a second shell valve. Since Kawaguti and Baba's description of these animals, two additional species have been described from Australia and one species from Baja California. The purpose of this paper is to record three species from the Hawaiian Islands.

One specimen of a bivalved gastropod congeneric with Kawaguti and Baba's *Berthelinia limax* was collected alive on a sample of *Caulerpa racemosa* var. *turbinata* (J. Ag.) Eubank growing around a basalt boulder at the low tide level near Poipu, Kauai, on 25 November, 1961. The animal, approximately 6 mm. in length and 4 mm. in diameter, resembled the alga both in form and color. Bright emerald green, it was ornamented with sparse milk-white spots on the oral tentacles and rhinophores, and by microscopic brown freckles on the head and neck and microscopic white freckles on the dorsal surface of the foot. Although similar to the species already described, the shells are shorter in relation to the height of the valve than are the shells of *B. limax* from Japan, have blunt, rounded anterior and posterior ends rather than the pointed ends of the Australian species, and differ from all described species in the nuclear characters of the left valve. Designation of a specific name will await the collection of additional material.

A small, green bivalved shell described from the Hawaiian Islands in 1862 by Gould, *Julia exquisita,* which has heretofore been known only from valves collected in beachdrift, has also turned out to be a bivalved gastropod. Several living specimens were collected from clumps of a species of the alga *Microdictyon* near Koloa, Kauai, during the months of February and April, 1962. The animals are similar to the other bivalved gastropods which have been described, but differ in color and shape of the shell. *J. exquisita* also differs from the previously described species in its association with *Microdictyon;* the other species appear to be confined to the algal genus *Caulerpa.*

Specimens of a second, but thus far unidentified species of *Julia,* were also collected in the same area as *J. exquisita* in April, 1962; they too were associated with *Microdictyon.* The species differs from *J. exquisita* in its smaller size (2.5 mm. compared with 4 - 6 mm. in *J. exquisita*) and distinctive color pattern on both the animal and shell.

ALISON KAY
University of Hawaii

8. A New Approach to the Diagnosis and Treatment of Painful Lesions of the Cervical Spine (A Motion Picture)

A 25-minute color-sound motion picture produced by a Hollywood surgical motion picture producer, made at Queen's Hospital, Honolulu, 1961, as a teaching film to demonstrate the results of recent research projects in the development of a new modality of diagnosis (Discography), and a new surgical treatment (Anterior Approach).

RALPH B. CLOWARD
388 Young Bldg.
Honolulu, Hawaii

9. Some Preliminary Age Determinations on Hawaiian Lavas

Recent work has shown that the potassium-argon method of age determination can be applied with some confidence to volcanic glasses and to microcrystalline igneous intrusives. We wish to report on some exploratory work on the application of this method to a few samples from the older volcanic rocks of the Hawaiian series.

On the basis of stratigraphy and comparative weathering, the exposed portions of the Hawaiian volcanoes have been dated as extending in age to the late Tertiary (Pliocene). Further it has been postulated that the main bulk of the islands may be the product of major volcanism in the Pacific during Miocene times.

For the determination of the ages of rocks and minerals in this range, 10 million years or less, elaborate precautions have to be applied in the measurement of the very small amounts of radiogenic argon-40 involved. Ultra high vacuum techniques must be used, and the bake-out of all vacuum apparatus is desirable in order to reduce the blank. The major problem, however, is the contamination of the samples by argon-40 from the air. This may completely mask the radiogenic argon-40 in younger rocks. A variety of techniques was tried in an attempt to release this contaminant argon, which presumably was held on the surfaces and microcracks of the constituent rock minerals. Treatment in a high frequency glow discharge of mercury or nitrogen ions was found to reduce the contamination by about 20 per cent. Crushing in vacuum gave indications of being a useful method, but further work and improvement of the procedures are needed. The most effective treatment, which additionally has the virtue of simplicity, was to crush and screen the carefully hand-picked samples under water, and store under vacuum until time for use. Air argon-40 contamination could thus be reduced by about 80 per cent.

As examples of the results of such age determinations, two Waianae samples give 2.8 m.y. (million years) and 5.4 m.y. A Koolau dike glass was dated to be 2.2 m.y. old, while a similar sample of rather poor quality from West Maui gave 5 m.y. It is widely recognized that radiogenic argon can be lost from certain minerals, and that anomalous ages will be found for such materials. An example of this phenomenon is probably shown in the results for a Hawaiian Laupahoehoe Hawaiite and its included mica, where the mica gives an age of 2.8 m.y. and the whole rock records 0.6 m.y. Micas are known to yield the most reliable ages by this method. For the others, it is difficult to judge which may be somewhat in error. In general, however, the ages are in agreement with those postulated on other grounds.

This research was performed under the auspices of the U. S. Atomic Energy Commission.

JOHN J. NAUGHTON
O. A. SCHAEFFER
Brookhaven National Laboratory
Upton, L.I., New York

10. The Inheritance of Hemoglobin H

Hemoglobin H, an abnormal hemoglobin in humans, occurs in 13 Chinese individuals on Oahu. It is associated with a severe anemia. Most frequently it cannot be detected in the parents or offspring of an affected individual. However it occurs in family groups frequently enough to indicate that it is an inherited condition. A study was made to attempt to detect its mode of inheritance.

Since the number of Chinese individuals on Oahu is known (36,000), it is possible to estimate the frequencies of occurrence of the genes thought to be responsible for the appearance of hemoglobin H. One should understand that since all the cases of hemoglobin H among this group have probably not been discovered, all the figures given below are probably an underestimate of the actual frequencies.

Calculations involving the Hardy-Weinberg law reveal that probably only two genes are required to produce hemoglobin H. If both genes occur in identical frequencies, as in a homozygous condition, the frequency of each gene in this population is 0.019. If three genes are required to produce hemoglobin H, their frequencies would average 0.07; this would be an abnormally high frequency for genes which result in a defective condition (anemia) even in the heterozygous state. Hemoglobin H probably is not caused by the presence of only one abnormal gene, since the condition is usually not detected in the parents.

Eighteen relatives of three hemoglobin H individuals were examined; and among these, thalassemia minor was always found in the parents and offspring of hemoglobin H patients. (Thalassemia minor is an inherited condition associated with a mild anemia. It is considered to be caused by the presence of a single abnormal gene.) Thus hemoglobin H may represent a homozygous thalassemia, with one gene for thalassemia inherited from each parent. Another explanation may be that two different genes are involved, each producing a different type of thalassemia when present alone, but producing hemoglobin H when present together in one individual.

CLAIRE BALL
University of Hawaii

The Hawaiian Academy of Science and Science Education in Hawaii[1]

Albert J. Mangelsdorf

THE EARLY YEARS

In the *Proceedings* of the first annual meeting we find a statement outlining the considerations which led to the founding of the Academy:

"With the idea in mind that the proposed organization might become a branch of the American Association for the Advancement of Science, a meeting was called (April 2, 1925) of the members of the Association resident in Hawaii, and a committee was appointed to formulate plans for a permanent organization.

"The Council of the American Association for the Advancement of Science discouraged the plan of forming a local 'Branch' or 'Division' of the Association, but suggested that an Academy of Science be formed to affiliate with the Association. At a meeting of the Hawaiian members of the Association on June 10, 1925, the suggestion of the Council of the AAAS was adopted."

In his presidential address on May 19, 1926, the first president of the Academy, Professor F. C. Newcombe, discussed the role which he envisaged for the new organization:

"In the meetings of the Academy, all scientists in Hawaii will have an opportunity to present the results of their studies to their fellows, to state their problems, to learn of the work and problems of their fellows in other sciences, and thus to contribute to the solidarity of science in Hawaii, to the good of Hawaii, and thus also to do all that can be done to overcome the scientific isolation which our geographical isolation necessarily entails.

"Besides these benefits of contact, there may be other opportunities presenting themselves to the Academy for usefulness. The natural features of the Hawaiian Islands in plant and animal life, in geology and physiography, the natural resources of the Islands, the development of movements now going on in agriculture, in industry, in education, in sociology, and in esthetics, in some or all of these, *and in other ways not now perceived,* the Academy may be called upon to bear a part." (The italics are mine.)

The founders were concerned first of all with providing a forum where ". . . all scientists in Hawaii will have an opportunity to present the results of their studies to their fellows." In framing their constitution, however, they were careful to avoid needless restrictions; they defined the objects of the Academy as "the promotion of research and the diffusion of knowledge" — a definition broad enough to provide ample freedom for the exploration of other opportunities.

In his historical review President Cox tells us that until its tenth year the Academy held only one scheduled session each year, that in the spring. The present custom of a two-session annual program had its beginning with a fall session in 1935. The average number of papers presented per year has been about twenty.

During its first 25 years the Academy devoted itself mainly to its initial objective, that of providing a forum for the presentation of scientific papers. One departure from this course was the sponsoring in 1935 of an expedition to the summit of Mauna Kea.

THE AFFILIATION MOVEMENT

In the minutes of Council meetings of the early 1950's we find sporadic indications of discontent with the passive role of the Academy as a mere forum and of tentative probings for other possibilities, particularly in the area of science education.

In November 1951 the Academy voted to take the long-deferred step of applying for affiliation with the American Association for the Advancement of Science. Acceptance by the AAAS in 1952 gave the Academy representation on the AAAS Council and membership in the Academy Conference, which represents all of the 44 affiliated state academies of science. This affiliation afforded a means whereby the Academy Council was enabled to keep abreast of the undertakings of other state academies.

President Cox tells us that:

". . . through the Academy Conference we were aware, when reorganization of the Academy was considered in 1953, that many state academies were organized by sections of restricted interest. There

[1]The assignment given me by the Council, that of reviewing and evaluating the science education activities of the Hawaiian Academy of Science, has been facilitated by the generous cooperation of many Academy members. In sketching the background, I have drawn upon the presidential address of 1959, in which Doak C. Cox gives an excellent account of the 33-year history of the Academy.

were in Hawaii strong and active local societies, and local sections of national societies of restricted scientific interests. It would have been absurd for the Academy to attempt either to compete with or to absorb these societies, but it did appear that a tie of some sort between the Academy and the specialized societies would be of value, and so there was written into the 1953 revised Constitution a provision for 'Associated Societies, whose objects are in keeping with those of the Academy'.

"During the 1953-1954 year, seven of the specialized societies accepted the invitation of the Council to Associate status. These were the American Society of Agronomy, Hawaii Chapter; American Chemical Society, Hawaiian Section; Anthropological Society of Hawaii; Geophysical Society of Hawaii; Hawaii Medical Association; Hawaiian Entomological Society; Society of Sigma Xi, Hawaii Chapter."

Within the next several years four additional organizations, the Hawaiian Botanical Society, the Hawaiian Psychological Association, the American Statistical Society, Hawaii Chapter, and the Hawaii Dietetic Association had affiliated themselves with the Academy as "Associated" societies.

Thus the Academy groped its way toward what has come to be accepted as one of its natural functions, that of providing a central organization through which the various specialized organizations can coordinate their efforts toward a common end. In retrospect, we can see that it was the action of the Academy in affiliating itself first with the AAAS and subsequently with the various local scientific societies that was to provide the essential framework for the ensuing developments which are summarized below.

EARLY EFFORTS IN SUPPORT OF SCIENCE EDUCATION

Upon the heels of the Korean truce came reports that Russia had succeeded in developing a hydrogen bomb. Concern about the national shortage of scientists and engineers in the face of growing Russian capabilities led to widespread discussion. It was widely recognized that the problem had its roots in the inadequacies of science teaching, particularly at the secondary school level.

The response of the Academy first took the form of an effort to activate a high school science teachers organization. Repeated attempts in this direction brought momentary successes, only to be followed by lapses into inactivity. While concern about the inadequacies of science teaching was widespread, a feeling of urgency was as yet to be found among a small, farsighted minority.

In spite of disappointments, the Academy persisted in its efforts. In 1955 it organized its first series of science lectures for high school teachers. In 1956 it organized a symposium on "The Need for Scientists and Opportunities in Science" and it supported the reactivation of the Oahu Science and Mathematics Teachers Organization. It accepted the proposal of Robert Clopton's special committee that the Academy participate in the AAAS Traveling Science Libraries program. And finally, it accepted the recommendation of its Affiliation Committee that support be given to the organizing of a Science Fair. Since the Science Fair program has come to play such an important role in science teaching at the secondary school level, its history is reviewed in some detail.

THE SCIENCE FAIR

On October 24, 1956, L. J. Rhodes, in his capacity as Chairman of the American Chemical Society, Hawaii Section, proposed to the Affiliation Committee of the Academy the organizing of a school science fair. It will be recalled that the revised Constitution of 1953 had provided for the establishment of an Affiliation Committee ". . . to foster cooperation between the Academy and other societies with similar objects. The President of the Academy, the Secretary and the delegate to the Council of the AAAS shall be ex officio members of this Committee. Other members may be appointed by the President with the approval of the Council, and one each by Associated Societies."

In enlisting support for his science fair idea, Mr. Rhodes followed a logical procedure. Having first ascertained that his own organization, the Hawaii Chapter of the American Chemical Society, was willing to participate in a science fair effort, he submitted his proposal to the Affiliation Committee, which promptly endorsed the idea and referred it to the Academy Council for approval. The minutes of a meeting of the Council on December 6, 1956, state that ". . . after extensive discussion, the following resolution was adopted:

> "Resolved that the Council of the Hawaiian Academy endorses the proposal for a Science Fair, and that the Affiliation Committee be instructed to explore actively the early organization of such a Fair, with the assistance of the Science Teachers' Committee and Program Committee."

As a result of the discussions of the Affiliation Committee, a Science Fair Executive Committee was set up, representing the Academy and eight of the ten associated societies, with Michael M. Frodyma as Chairman. This Committee soon found that there was an impressive amount of spade work to be done and a great deal of inertia to be overcome in initiating a new project which would require for its success the cooperation of nearly a hundred schools and many other organizations and individuals.

When it became apparent that the initial objective of a science fair in the spring of 1957 could not be achieved, that target was abandoned and sights were shifted to 1958.

Upon Dr. Frodyma's departure for the Mainland in the summer of 1957, Mr. Rhodes was named to succeed him as chairman of the Science Fair Committee.

The first concrete development came on September 13, 1957, when the Board of Commissioners of the Department of Public Instruction approved participation of the public schools in the "First Annual Hawaiian Science Fair." The second came a few days later when Dr. Ralph Heinicke accepted the chairmanship of the Exhibits Committee.

Before proceeding further, let us first review some of the circumstances which helped to set the stage for this pioneering effort. The inauguration of the International Geophysical Year in the summer of 1957 was accompanied by a great deal of publicity about our instrumented Vanguard satellites, which were to play a major role in the IGY effort. On October 4 of that year came the announcement that Russia had succeeded in orbiting Sputnik I, a 184-pound vehicle, many times the size of our projected satellites. With Sputnik beeping derisively as it traversed our skies the nation was at last thoroughly aroused. But there was more to come. On November 3, Russia placed in orbit Sputnik II, a satellite weighing more than 1,000 pounds and carrying as a passenger the ill-fated bitch Laika. Concern about our shortcomings in this field was further aggravated when on December 6 our first attempt to orbit the Vanguard, a 6-inch sphere, ended in failure. Our wounded pride was only partially assuaged when on January 31, 1958, the Army succeeded in launching the 18-pound Explorer I capsule.

The early appeals of the Science Fair Committee for cooperation had been met with assurances of interest but, on the whole, with a disinclination on the part of scientists and community leaders to participate actively. With the orbiting of the Sputniks came an impressive change in attitude which permeated to the grass roots. Encouraged by the aroused concern of their teachers, intermediate and high school students were soon embarked upon a wide diversity of science projects. Professional scientists and laymen alike rallied to the cause and willingly accepted the tasks assigned to them by the Science Fair Executive Committee. In December 1957, Chairman Rhodes requested each of the ten affiliated organizations to name two or more members who would be willing to serve on Science Fair committees. From this group of volunteers three additional committees were formed to round out the following organization:

Executive Committee, Chairman: L. J. Rhodes
Exhibits Committee, Chairman: Ralph M. Heinicke
Community Participation Committee, Chairman: Dr. Clarence E. Fronk
Public Relations, Chairman: Mrs. Monte J. Hickok
Sites and Props, Chairman: H. Wayne Hilton

Although the school science fair program was new to Hawaii, it had by 1957 become well established on the Mainland. The several committees were thus able to benefit materially from the science fair literature and the advice supplied by Science Service.

Science Service under the directorship of Watson Davis had long been active in promoting school science fairs. Science Service was organized in 1921 as a non-profit corporation for the popularization of science. It was endowed by the late E. W. Scripps ". . . whose long experience as a newspaper editor and proprietor convinced him of the importance of scientific research as the foundation of the prosperity of the nation and as a guide to sound thinking and living. He realized the need for an independent agency that would bring the results of research to the attention of the entire people."

According to Watson Davis, the first science fair was held in New York in 1935. By 1941 school science fairs were being held in several cities. By the late 1940's local and regional science fairs had become numerous. At this point the officers of Science Service became interested in the possibility of a national fair. They proceeded to work toward this objective with the result that the First National Science Fair was held at Franklin Institute in Philadelphia on May 21, 1950. That this was indeed a small acorn is indicated by the fact that it included only thirty finalists from thirteen regional fairs as contrasted with the Thirteenth National Science Fair held last May in Seattle which included 387 finalists from 208 regional fairs.

One of the many questions confronting our Science Fair Executive Committee was whether to affiliate with the National Science Fair with the object of entering two finalists from the Hawaii fair. The major obstacle, of course, was financing. The Ninth National Science Fair was scheduled to be held on May 7-10, 1958, in Flint, Michigan. The cost of travel to Flint for two students and their escort was estimated at $2,000. The decision was deferred until January, by which time the financial prospects appeared encouraging enough to warrant a last-minute application for affiliation, which was promptly accepted by Science Service.

At its meeting on February 10, 1958, the Executive Committee named Friday, April 11, as the opening date and Sunday, April 13, as the closing date for what was hopefully designated the First Annual Hawaiian Science Fair. The intervening period was one of arduous activity for all committees. A prospectus had to be prepared, printed, and distributed; funds had to be raised; a suitable site had to be found; judging of school fairs had to be provided for; and Island coordinators had to be appointed for each of the neighbor Islands.

Countless details had to be arranged, such as federal tax exemption; liability insurance; newspaper, radio, and television publicity; transportation, accommodations, and tours for the students from the neighbor islands; certificates of participation for each of the thousand or more students working on science projects; a catalog of exhibits for the Territorial Fair; awards for the winning exhibits; speakers for the opening ceremony; and invitations to government officials, community leaders, and top military commanders.

From nearly 1,000 exhibits at the school fairs 157 were selected for the Territorial Fair, including 18 from Hawaii, 6 from Maui, 6 from Lanai, and 8 from Kauai. Attendance during the 3-day period was estimated at 12,000. The Ft. DeRussy site proved to be admirably suited for the Fair; it afforded excellent facilities and adequate parking space.

The two finalists chosen to represent Hawaii at the National Science Fair were Naomi Kuniyuki from Kaimuki High School with her project on "Culturing Paramecia" and Steven Gouveia from St. Louis High School with his "Satellite Electronics" project. They were accompanied to Flint, Michigan, by L. J. Rhodes, Chairman, and Mrs. H. Ivan Rainwater, Secretary, of the Executive Committee and by Dr. Clarence E. Fronk, Chairman of the Community Participation Committee. Neither of the two finalists had previously visited the Mainland. The accounts which came back to Hawaii of their reactions to this experience were heartwarming.

The remarkable success of the first science fair must be credited to sound organization and hard work stimulated in part by the concern aroused by the orbiting of two Sputniks. In spite of the lack of previous experience in such an undertaking, problems were anticipated with remarkable foresight and delegated to the appropriate committees for attention. Chairman Rhodes prepared and distributed each week an issue of his "Weekly Highlights," which kept each committee member informed of the problems and progress of the other committees. At the conclusion of the Fair he wrote a personal letter of appreciation to each committee chairman and to others who had contributed in one way or another. He maintained a comprehensive file of minutes and correspondence which he later turned over to the Affiliation Committee for the guidance of his successors.

It would be impossible to name all of the many individuals and organizations who contributed to the success of the fair. However, I recall in particular a handful of ladies who were always ready to help wherever help was needed, among them Marian Adachi, Constance Hartt, Peggy Hickok, Beatrice Krauss, and Dorothy Rainwater. Not the least among the unnamed and unsung contributors were the various secretaries upon whom these extra-curricular activities of their principals sometimes imposed a heavy burden. All in all it was an impressive example of effective cooperation. Mr. Rhodes summed it up aptly in his address at the opening of the First Annual Hawaiian Science Fair when he said "What you see here today is evidence that he who has a worthy cause and courage will find friends."

INTER-SOCIETY SCIENCE EDUCATION COUNCIL

On May 22, 1958, soon after the return of the Hawaii delegation from the National Science Fair, the presiding officers of the associated societies met with the Academy Council to consider plans for future activities. It was voted at this meeting to establish an Inter-Society Science Education Committee (subsequently changed to Council) whose responsibility it would be ". . . to assure the holding of annual science fairs and to coordinate and actively undertake such other activities in the field of science education as the Academy of Science and its Associated Societies may deem desirable. This Committee will consist of members appointed, one each by the several Associated Societies, including a chairman appointed by the President of the Academy with the approval of its Council. It is left to the Committee itself to propose any further details in organization, including means for obtaining representation from schools and teachers."

The initial membership of the newly established ISSEC included one representative from each of the associated societies plus the chairman appointed by the Academy. The Council thus formed subsequently augmented its membership by adding representatives of the Department of Public Instruction, the private schools, the Engineering Association, and the Armed Forces.

The first meeting of ISSEC, on June 26, 1958, was devoted to a general discussion of various science education activities that might be undertaken. At subsequent monthly meetings projects were submitted for approval and committee chairmen were appointed. In each instance the committee chairman was authorized to name his own commitee members and to formulate a program for consideration by ISSEC. During the next several months the following committees were organized.

Committee Chairman

Science Fair: Saul Price, Director

H. Wayne Hilton, Associate Director

Science Library Resources: Robert Clopton

Teachers' Science Seminars: Sterling Wortman

Student Science Seminars: Albert B. Carr

Counseling and Scholarships: Shosuke Goto

Science Teaching Aids: Y. Baron Goto
Science Clubs: Donald C. McGuire
Budget: J. H. Payne
Community Participation: Nils P. Larsen
Legislation: Wilfred Greenwell

FINANCIAL SUPPORT

The newly-established ISSEC began its career with hopeful plans and an empty treasury. In response to a request for advice on the problem of financing, Dr. Warren Weaver, then vice-president of the Rockefeller Foundation, approached the Alfred P. Sloan Foundation, which promptly indicated its willingness to award a grant of $5,000 in support of the ISSEC program. Within a few months a similar amount from local contributions had been added to the treasury through the efforts of the Community Participation Committee under the chairmanship of Dr. Nils P. Larsen.

Soon after ISSEC was organized, the National Science Foundation announced its decision to entertain requests from state Academies of Science for support of activities in the following areas:

1. Development of collaborative efforts by professional scientists and high school science teachers to improve science instruction, and

2. Development of coordinated programs for stimulating interest in science among young people, principally at the pre-college level, and providing them with opportunities for science experience.

Since these were areas with which ISSEC was particularly concerned, proposals were formulated by several of the committees and forward to the National Science Foundation for consideration.

ISSEC PROJECTS

The activities of ISSEC are carried on by the following committees:

1. *Science Fair*

This activity continues to gain strength. During the 1961-1962 school year more than 5,000 students in public and private schools engaged in science projects and prepared exhibits, under the direction of Dr. Gerald G. Dull, who has been affiliated with Hawaiian Science Fair activities since their beginning. From this number 112 were selected for entry at the Fifth Annual Hawaiian Science Fair, which was held on March 23-25, 1962. At the Awards Banquet 67 awards were presented. The two finalists selected to represent Hawaii at the Thirteenth National Science Fair at Seattle were Lana Yong of Hilo High School and Richard Onouye of Waipahu High School. They were accompanied by Mrs. H. Ivan Rainwater, Chairman of the Exhibits Committee, and Robert E. Coleman, Associate Director of this year's Fair and Director of the 1963 Fair.

2. *Science Library Resources*

Like the Science Fair, this activity antedates the establishment of ISSEC. In 1957, Robert Clopton suggested that the Traveling High School Science Libraries program which was being initiated by the AAAS might play a useful role in Hawaii. He was accordingly authorized by the Academy Council to organize a committee to pursue this possibility. As a result, several 200-volume sets were provided by the AAAS for circulation among the smaller high schools, both public and private.

This committee also arranged for displays of science libraries at the science fairs, and for distribution to the high schools of annotated bibliographies listing selected high school science reference texts. Subsequently the Committee extended its activities to the elementary school libraries. It promoted the placement of several of the 160-book sets of the Traveling Elementary Science School Library, and it distributed copies of the AAAS Science Book List for children to each of the elementary schools. In 1960, Carolyn Crawford succeeded Dr. Clopton as Committee Chairman.

3. *Teachers' Science Seminars*

This activity also antedates ISSEC. In the spring of 1957 the Academy's program committee under the chairmanship of Sterling Wortman cooperated with the Department of Public Instruction in arranging a series of six lectures by members of the Academy for Honolulu teachers. The success of this series led to a request from the D.P.I. for a similar series the following year.

With the help of National Science Foundation support, this program has now been extended to the neighbor Islands. The Committee also co-sponsors a Teachers' Workshop in conjunction with the Annual Science Fair.

James Moomaw served as Committee Chairman after Dr. Wortman's departure for the Philippines. When Dr. Moomaw left Hawaii to join Dr. Wortman, he was in turn succeeded by Paul Ekern, the present chairman.

4. *Hawaiian Science Clubs Service*

With the establishment of ISSEC in 1958, one of the first committees to be organized was the Science Clubs Committee under the chairmanship of Donald C. McGuire. Soon thereafter the National Science Foundation announced its decision to entertain requests for financial support of coordinated programs for stimulating interest in science among young people, particularly at the secondary school level. In response to this invitation the Science Clubs Committee submitted a detailed program, which met with favorable response in the form of a substantial grant.

The National Science Foundation grant has since been renewed each year, with some modification. It supports a far-flung program which reaches all of the Islands. Its activities include the following:

a. Providing guest speakers for science clubs, of of which there are now more than 60,
b. Arranging field trips for science clubs.
c. Distributing scientific and technological literature.
d. Circulating science films and film strips.
e. Organizing weekend science camps and cruises.
f. Advising on student science projects.
g. Conducting a loan program of surplus electronic equipment.
h. Conducting workshops for science club advisors and science teachers.
i. Assisting with the Teachers' Science Seminar Series.
j. Cooperating with the Science Fair program.
k. Producing a weekly "Science in Hawaii" television program.

Until his departure for Washington, D. C., on a special NSF assignment, Dr. McGuire served as director of the Hawaiian Science Clubs Service with Donald Li as Associate Director. Wallace Sanford succeeds Dr. McGuire as Director.

5. *Student Science Seminars*

In 1958 the Student Science Seminars Committee, under the chairmanship of Albert B. Carr, organized its first series of 11 weekly evening seminars for 15 highly selected high school students. In 1959 the group was expanded to 25 students. In 1960 the program was extended to include the island of Maui.

Thanks to National Science Foundation support the program now covers each of the four major Islands. During the past year 26 seminars were held on Oahu, 20 on Hawaii, 17 on Maui, and 16 on Kauai. In supervising the program Dr. Carr has had the assistance of Allan Kondo on Hawaii, Michael Hazama on Maui, and Barton Nagata on Kauai.

6. *Museums in Miniature*

Some years ago the Bishop Museum began to explore the possibilities of portable exhibits as teaching aids for elementary and secondary schools. In 1959 the "Museums in Miniature" Committee under the chairmanship of Wilfred Greenwell collaborated with Alexander Spoehr, then Director of the Bishop Museum, in formulating an expanded program, which was submitted to the National Science Foundation for approval. The resulting NSF grant has financed the preparation of a number of additions to the series, in the preparation of which the participating students have gained valuable experience. Included with each exhibit is a manual for the guidance of teachers in presenting the material.

7. *Elementary Science Texts*

The purpose of this project is to provide for the elementary schools a graded series of texts under the title "Exploring Nature in Hawaii." This series was initiated in 1955 by Sister Mary St. Lawrence under the auspices of the Roman Catholic Diocese of Honolulu. It is designed ". . . to guide elementary school children in the study of plants and animals in Hawaii and other local phenomena not usually covered in school texts of the temperate zone."

With Book VIII in manuscript form the series is nearing completion. Meanwhile the first edition of 10,000 copies of Book I has been sold out and a revised edition has been published.

While not initially an ISSEC project, members of the Academy and associated societies have cooperated with Sister St. Lawrence in the preparation of the later manuscripts. The Series has been endorsed by ISSEC and the Hawaiian Academy of Science and has been approved by the State Department of Education for use in the public schools. There has also been an unexpected demand from Pacific island schools outside of Hawaii.

8. *Junior Academy of Science*

This project has had a long period of incubation. In 1959 Robert Clopton, as chairman of a Committee on Student Papers, addressed a memorandum to all high school principals, informing them that the Academy hoped to include, as a part of its regular spring program, two scientific papers by high school students. This resulted in the presentation at the April 23, 1959, Academy meeting of a paper by Marshall Eto of Roosevelt High School on Corrosion Studies and on the following evening a paper by Jack Semura, also of Roosevelt High School, of a paper on Liesegang Ring Research. High school students presented papers at the 1960 and 1961 spring meetings also.

Under the guidance of ISSEC Chairman Mrs. H. Ivan Rainwater, the Hawaiian Junior Academy of Science held its first meeting on April 25, 1962. At this meeting seven papers were presented by students. Abstracts of these papers are to be included in the Academy *Proceedings*.

9. *Teacher Coordination and Science Talent Search*

Under the chairmanship of Edwin Y. H. Chinn, this Committee provides liaison between ISSEC and the Oahu schools. It also coordinates the Science Talent Search for the Westinghouse scholarships.

10. *Elementary School Mathematics*

At the recommendation of the Budget Committee a committee is to be formed under the chairmanship of Wilfred Greenwell ". . . to study possible contributions toward strengthening teaching of mathematics at the elementary level."

11. *Others*

The Counseling and Scholarship Committee under the chairmanship of Arthur Dole has cooperated in high school "Career Day" programs.

The Community Participation Committee enlists community support for ISSEC projects. Last year's committee under the chairmanship of L. D. Baver reports cash contributions amounting to $6,605. In addition to this sum there were other contributions, including the many Science Fair awards.

The Budget Committee with John H. Payne as chairman scrutinizes the budgets for each of the ISSEC projects.

The Public Relations Committee arranges newspaper, radio, and television coverage for the Science Fair and other ISSEC activities. Robert Wiemer served as chairman for last year's committee.

Dwight H. Lowrey has served as Treasurer of ISSEC since its inception, a service for which the Academy has reason to be grateful.

Although not an ISSEC responsibility, mention should be made also of the NSF-sponsored science education programs administered by the University of Hawaii, in which many Academy members are participating. These include

a. The science teachers' institutes aimed at improving subject matter competence and teaching techniques, and

b. The Junior Science Apprentice Program in which selected high school students are assigned to work with qualified scientists for a 7-week period of research experience during the summer months.

NATIONAL RECOGNITION

In her 1961-1962 annual report, the ISSEC Chairman, Mrs. H. Ivan Rainwater notes that ". . . . ISSEC was the recipient of a Certificate of Achievement in the 1960-1961 'Action in Education' awards program sponsored by Better Homes and Gardens magazine in cooperation with the National Education Association and the National School Boards Association."

"The Classroom Science Bulletin, published by the Jersey City State College, devoted its January 1962 issue to education in Hawaii. The work of ISSEC was featured."

"The chairman of ISSEC was notified of her appointment to serve a 3-year term as a member of the National Science Fair-International Council, the governing body of that organization."

APPRAISAL

The history of ISSEC epitomizes the capacity of democratic processes for adaptive response to a wide diversity of problems. Each of the many activities in which ISSEC is engaged was initiated, not by edict, but as a response of a small group to an apparent need.

The successes of ISSEC may be credited to the enthusiasm of its participants and to the stimulating cross-fertilization of ideas which tends to occur naturally when diverse disciplines join in a common cause. Such intangible assets as these can hardly be generated at will by decree from above. The best that can be done is to provide an environment in which they are able to develop spontaneously. It seems unlikely that an authoritarian approach would have met with as great a measure of success as that which ISSEC's explorative, empirical approach has achieved.

In the rural setting of fifty years ago the right of children to learn by participating in the work of their elders was taken for granted. Urbanization, industrialization, unionization, and the wage and hour laws have conspired to deprive our young people of this natural right. It is hardly surprising that the resulting vacuum should lead to boredom and sometimes even to delinquency. All who participate in the fostering of such activities as science projects, science fairs, student science clubs, science seminars, the Junior Academy, and summer science training programs for students may take satisfaction in the knowledge that they are helping to meet an urgent need.

In comparison with many other communities, Hawaii is indeed fortunate. It is fortunate in the diversity of its population and in the native intellectual endowments of its youth. It is singularly fortunate also in the wealth of its science resources. ISSEC has been remarkably effective in mustering these resources for the improvement of science teaching at the elementary and secondary school levels. We may well take pride in the knowledge that the ISSEC program ranks among the Nation's best.

Since ISSEC has done so well, we might now ask ourselves whether it would not be wise to let well enough alone. Mankind in general and the scientific fraternity in particular are by nature disinclined to let well enough alone. It is apparent from the ISSEC minutes that the various committees are continually reappraising their projects.

The Council may therefore wish to ask itself whether the time is ripe for a comprehensive appraisal of ISSEC projects by an external reviewing body. If the decision should be in the affirmative it would seem that the Affiliation Committee would be a logical body to undertake such a review. This Committee would presumably name a subcommittee chairman for each major ISSEC project. Each subcommittee chairman would organize his own subcommittee, taking care to include in its membership not only competent scientists, but also teachers qualified to represent the viewpoints of the group which ISSEC is endeavoring to help. In conducting its review, each subcommittee would of necessity collaborate closely with the ISSEC committee whose project it is appraising.

It would be the responsibility of the Affiliation Committee to evaluate the findings of its respective subcommittees and to transmit its recommendations to the Academy Council for consideration.

If such a review were to be undertaken it should be made clear at the outset that its aim would not be to find fault, but rather to ascertain where and how the limited time, energy, and funds at ISSEC's command might be most effectively employed.

CONCLUSION

ISSEC's resources in time, energy, and funds are limited. It cannot undertake all of the many things that might be done. It must therefore concentrate upon those activities which promise to be most productive. The more productive areas will presumably be those in which the efforts of ISSEC can act as a catalyst to stimulate and enhance the efforts of others. Continuing appraisal will enable ISSEC to curtail the less productive of its activities and to intensify its efforts in the more productive areas.

MEMBERSHIP MAY 1962

Abbott, Agatin T.
Abramovitz, Melvin
§Ai, Raphael A. C.
Akamine, Ernest K.
Akamine, Ralph N.
Akau, Thelma I.
Aldrich, W. W.
‡Alexander, Henry A.
Alexander, William P.
§Alicata, J. E.
§Allison, Samuel D.
Amioka, Shiro
§Anderson, Earl J.
Anderson, Eleanor S.
Anderson, James W.
Appleton, Vivia B.
Aragaki, Minoru
Arkoff, Abe
§Arnold, H. L., Jr.
§Arnold, H. L., Sr.
Arzadon, Rosalina V.
Au, Stephen
‡Ault, Wayne U.
Aust, Ruth A.
Austin, Thomas

Babbitt, Howard C.
§Baker, Gladys E.
*Baker, R. J.
‡Baldwin, Helen S.
‡Baldwin, Robert I.
§Ballard, Stanley S.
§Balock, J. W.
§Banner, Albert H.
Barkley, Richard A.
‡Barrel, Robert
Bartz, Ellwood L.
§Baver, L. D.
Baxter, Robert S.
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* Member, American Association for the Advancement of Science
§ Fellow, American Association for the Advancement of Science
‡ Member, Hawaii Division, Hawaiian Academy of Science

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LET US BE REASONABLE, OR A RECONSIDERATION OF THE WORLD'S OLDEST PROFESSION

Leonard D. Tuthill[1]

Perhaps I made a mistake in the title. Some of my friends have been confused as to what I intend to discuss. I am aware that the statement that prostitution is the oldest profession has wide credence, but as you are scientists, or at least have a scientific orientation, I am sure that you do not accept this popular fallacy. The real problem of determining what is the world's oldest profession stems from two points: (1) What is a profession? There are various definitions and this could therefore be argued—I choose to consider the active pursuit of Science as a profession. I consider a physicist a practicer of a profession, for example, or a botanist. (2) The second questionable point is at what stage of development of such an activity did it become a profession—here I admit I can present no method for decision as to what degree of sophistication in a human activity deserves the name of profession.

Hence, I have proposed to consider that activity which, now a profession, was first practiced by sapient man as the oldest profession. Here, I have gotten into difficulty again. Several friends have accused me of intending to make a case for entomology as the oldest profession—if limited to applied entomology, i.e., pest control, one could perhaps make a case for such a proposal. Perhaps teaching has the oldest roots of all, and so forth —various possibilities could be argued. I propose, however, that the oldest activity of man which in its present development deserves the name of profession, or at least the oldest scientific activity, is *Taxonomy.* The first step on the long road to our present level of scientific sophistication must have been the ability to communicate. In common with many subhuman animals, the first level of communication must have been action or emotion ideas, of course: come, flee, content, alarm, etc. The next step would appear to have been the assigning of names to categories of things. This, of course, was and is classification or taxonomy.

If any of you are unconvinced by this speculation, I refer to the written record—the cornerstone of scientific evaluation. I quote from the second chapter of the book of Genesis: "He [God] brought all animals to the man to see what He would call them; and whatever the man called every living creature that was its name. The man gave names to all cattle, and to the birds of the air, and to every beast of the field; but for man there was not found a helper fit for him." The job has still not been completed of course — largely I suppose because next God provided the man with a helper who as we know distracted him from his work. This account, of course, completely scotches any idea that prostitution can be older than taxonomy, if such proof should be needed.

Let us consider, then, briefly, modern scientific taxonomy and specifically, biological taxonomy, as it is the most highly developed portion of this branch of science. At the time of Linnaeus, the 1750's, from which period we begin our current system of names, the purpose of taxonomy was still very clearly to complete the job assigned to Adam and interrupted by Eve, that is the assigning of a name to each kind of organism occurring in the world. For convenience's sake, organisms with similar structures were assigned to more inclusive categories to form an ascending hierarchy from genera to kingdoms. The task of the taxonomist thus envisioned is enormous because of the multitude and variety of organisms which occur in the world. However, it is conceivably possible of completion. This view of the taxonomists' work has the purpose of a *usable* system of names. The taxonomists' function then is a basic *service* function for mankind in general and other scientists in particular. The criterion of proper work under

[1]Professor of Entomology and Assistant Dean, Graduate School, University of Hawaii.

this concept is simply "is it a usable system?" The entire system of categories above the species is elaborated as functional agglomerations to enhance the usefulness of the system.

With the development of the concept of organic evolution — that organisms were related through common ancestry — the idea has become generally accepted that the system of classification should indicate these relationships. With the growth of this concept a division of purpose has developed and a conflict between the pragmatic and theoretical has created and continues to create problems. Such an attempt to use a system of names to show relationships, causes constant rearrangement as more is learned about the organisms concerned and to match opinions of different investigators. The consequent lack of stability in both the names and the system destroys, to a considerable degree, the usefulness of the system. For, to everyone who is not a "systematist," the principal and perhaps only function of classification remains that of a usable system of names for communication. For this purpose maximum stability is desirable. In biology this should mean a system whereby any educated individual could determine the generic and, hopefully, the specific name of any organism and thus be able to communicate information about it without confusion.

I propose that if taxonomosystematists would be reasonable, as all scientists are supposed to be, it is possible to have stability in scientific names and at the same time have sufficient flexibility in the system of names to allow for changing concepts of relationships. How would I propose to achieve this feat of "eating the cake and having it, too?" I propose a return to a concept of the genus as an easily recognized, *inclusive* group of species, readily identifiable. What matter if it become enlarged as more of the world is explored? There is no inherent evil in large numbers. Within such a genus groupings of species which are more alike than others will, of course, occur. These can be grouped into *subgenera,* a category long established, but little used and one which when used, is ordinarily short lived. Once established, subgenera almost invariably seem to be elevated to generic status and thus the scientific cognomen which it is most desirable to preserve is changed. I suggest that the developing ideas of relationships of species can be adequately shown by the use of subgenera. The resulting inflexibility of genera coupled with extensive use and flexibility of subgeneric names would allow both stability of the scientific name and adequate working space for testing and developing ideas of relationships.

The system of biological classification as it now exists allows such a dual procedure at all levels. If my fellow taxonomosystematists will be reasonable, we can supply stability in scientific names for the rest of the world and have our own fun in the "sub" categories. This, of course, will require a recognition that our activities are primarily a service function to other scientists, i.e., a degree of humility, another attribute which the scientist is supposed to have.

To you who are not taxonomists, I suggest there is at least one implication in the foregoing which is valid for all scientists. All our scientific endeavour is to learn and understand more. For what purpose? For the service of mankind. Let us remember then, even though we are living in the first golden age of science, that we are performing a service function in society—let us all then be reasonable and not think more highly of our profession than we ought.

ANNUAL REPORT 1962-63

HAWAIIAN ACADEMY OF SCIENCE

The thirty-eighth year of the Academy ended with a total membership of 794.

An Amendment to the Constitution of the Hawaiian Academy of Science was unanimously approved by members present and voting at the Fall business meeting of the Society. The revised Constitution reads as follows: ARTICLE V. OFFICERS, Section 1. The officers of the Academy shall be a President, a President-Elect, a Secretary, a Treasurer, and five Councilors.

Section 3. One of the Councilors shall be ex officio, the retiring President. The other four Councilors shall be elected, two each year, to serve for terms of two years, or until their successors are elected.

Robert L. Fox, Secretary

MEMBERSHIP

A total of twenty applications have been processed and recommended for membership into the Academy since September, 1962. The applicants are as follows: Ivars Gutmanis, Harry B. Clagg, Robert M. Warner, Frederick L. Reichert, Robert L. Fox, Daniel D. Palmer, Bernard H. Shinbara, Jack S. Semura, Myron P. Schlesinger, Leonora H. Tani, Tamotsu Sahara, David H. Butchart, James Kim, Jonathan T. Kajiwara, Hing Kai Luke, Virginia A. Rautenberg, Rowlin L. Lichter, Charles W. Rutschky, III, Dale H. Habeck, James W. Bernard.

Edwin Y. Chun, Chairman

AAAS FELLOWS

The following individuals were nominated for Fellows of the AAAS January 17, 1963: Robert L. Fox, Mitsuno Fukuda, Edward T. Fukunaga, and Simes T. Hoyt. These names were submitted to the Executive Office of the AAAS by President L. D. Tuthill.

Fred A. Bianchi — Alison Kay
Edward Britten — Toshiyuki Nishida, Chairman

INDEX

Information concerning members of the Academy has been punched on cards. Following the arrival in May of the University of Hawaii's 1401 computer, a program will be written which will make any portion of the information available in listing and summary form.

John Digman, Chairman

PROGRAM COMMITTEE

The fall meeting of the Hawaiian Academy of Science was held on November 15 and 16 at Agee Auditorium of the Hawaiian Sugar Planters' Association Experiment Station. The first evening was devoted to four contributed papers and a 30-minute motion picture produced by the United States Information Service on the Tenth Pacific Science Congress. At the time of the deadline, only three persons had submitted titles for contributed papers, and therefore an increased time allotment was granted one of the authors upon request. One week after the deadline, another title was received, and the author was asked to resubmit it for the spring session.

The second evening was devoted to two invited papers on two rather unrelated topics. Dr. Joseph Stokes, III, Director of Medical Education at Queen's Hospital, reported on a study of coronary heart disease in the Hawaiian races, and Mr. Saul Price, of the U. S. Weather Bureau, spoke on meteorological satellites—past, present, and future. Both of these papers were of excellent quality and they were enthusiastically received by the small audience.

The poor participation in these Academy activities as reflected in the paucity of contributed papers and the number of persons attending these meetings should be a matter of concern to the Academy, particularly in view of the increased size of the scientific community in Hawaii.

This report is being written prior to the spring meetings which are scheduled on April 25, 26, and 27. On April 25 and 26 the programs will consist of an invited speaker as well as contributed papers. The invited speaker for the first evening will be Mr. Ray Alden, Vice-President of the Hawaiian Telephone Company, who will speak on "Communication Satellites."

Both invitational and contributed papers will be presented on the evening of the 26th, and the winners of the Hawaiian Science Fair will make brief presentations of their projects during each evening.

The annual banquet will be held on April 27 in the Empire Room of the Hawaiian Village Hotel, at which time President Leonard Tuthill will speak on "Let Us Be Reasonable, or a Reconsideration of the World's Oldest Profession."

Philip Helfrich, Chairman

NOMINATIONS

The following people have been nominated by the Nomination Committee for the offices of the Hawaiian Academy of Science: President-elect: Dr. Roland Force and Dr. George Stanford; Secretary: Dr. R. L. Fox; Treasurer: Mrs. Eleanor Anderson; Members of the Council: Dr. J. M. Digman, Dr. D. Elmo Hardy, Dr. J. C. Gilbert, Dr. Alison Kay.

G. Donald Sherman, Chairman

PUBLICITY

Public Relations activity for the Hawaiian Academy of Science consisted of publicizing the spring and fall meetings of the Academy.

Other activities consisted of public relations work associated with the Sixth Hawaiian Science Fair and the Inter-Society Science Education Council.

Robert D. Wiemer, Chairman

HAWAII DIVISION

Officers of the Hawaii Division for the year 1962-1963 were as follows: Henri P. Minette, Chairman; Harry C. Chuck, Secretary-Treasurer; Chester K. Wentworth, Council Representative.

As of the end of June, there were 64 members in the Division.

Statement of Cash Receipts and Expenditures
for the Year Ended March 31, 1963

Receipts			
Dues			$ 1,316.00
Interest—First Federal Savings & Loan Association of Hawaii			29.37
Annual Dinner			425.35
Grants—National Science Foundation			
G22636 (Teachers Science Seminar)	$ 2,900.00		
Less amount disbursed for travel and subsistence	(604.51)		2,295.49
G22477 (Students Science Seminar)	4,220.00		
Less amounts disbursed:			
Salaries	(1,800.00)		
Travel and subsistence	(1,817.45)		
Clerical assistance	(190.00)		
Postage and telephone	(13.76)		
Office supplies	(12.15)		386.64
G17248 (Students Science Seminar)			100.00
G22478 (Hawaii Science Clubs Service)	19,205.00		
Less amount disbursed (to U.H.)	(19,205.00)		–0–
Grants—AAAS	274.25		
Less amount disbursed	274.25		–0–
Total			$ 4,552.85
Less:			
Grants—National Science Foundation 1961-62:			
G17248 (Students Science Seminar)			
Supplies and clerical assistance	245.93		
Travel and subsistence	138.80		384.73
G17101 (Teachers Science Seminar)			
Workshop	1,293.35		
Travel and subsistence	208.87		
Radiogram	3.96		
Refunded to NSF	928.82		2,435.00
Supplement to AAAS grants			30.00
Hawaii Division, HAS			43.00
Donation to operating fund—AAAS, Academy Conference			16.86
Annual Dinner			408.70
Operating and general expenses:			
Mailing	237.10		
Printing	79.28		
Supplies	93.55		
Miscellaneous	75.67		485.60
Total			$ 3,803.89
Excess of Receipts over Expenditures			748.96
Cash Balance, April 1, 1962			3,840.11
Cash Balance, March 31, 1963			$ 4,589.07

Status of Dues Payments:

March	1962	1963
Advance	$157.00	$197.00
Arrears	180.00	245.00

Cash Balance, March 31, 1963		$ 4,589.07
Consisting of:		
Cash in Bank of Hawaii	$ 3,913.64	
Cash in First Federal Savings & Loan Association of Hawaii	675.43	$ 4,589.07
Distribution of Balance in Bank of Hawaii		
National Science Foundation Grants	$ 2,682.13	
Academy Operating Funds	1,231.51*	
	$ 3,913.64	

Status of National Science Foundation Grants

Hawaii Science Clubs Service (administered by University of Hawaii)

G17046 (1961-62)	
Balance April 1, 1962	$ 2,938.46
Expended	2,938.46
Balance March 31, 1963	–0–
G22478 (1962-63)	
Received April 1, 1962	$19,205.00
Expended Feb. 28, 1963	11,518.57
Estimated expenditures March 1963	1,102.85
Estimated balance, Mar. 31, 1963	$ 6,583.58

Students Science Seminar

G17248 (1961-62)	
Balance April 1, 1962	$ 384.73
Expended	384.73
Balance March 31, 1963	–0–
G22477 (1962-63)	
Received July 1, 1962	$ 4,220.00
Expended	3,833.36
Balance April 1, 1963	$ 386.64

*Approximately $700 of this will be allocated for payment of printing costs of 1961/62 *Proceedings*.

Teachers Science Seminar
G17101 (1961-62)

Balance April 1, 1962		$ 2,435.00
Expended	$1,506.18	
Refunded to NSF	928.82	2,435.00
Balance March 31, 1963		–0–

Teachers Science Seminar
G22636

Received Sept. 1, 1962	$ 2,900.00
Expended	604.51
Balance March 31, 1963	$ 2,295.49

The following funds are administered by Cooke Trust Co.:

Science Education Fund

Receipts		
Charles and Anna Cooke Trust	$ 1,000.00	
Juliette M. Atherton Trust	1,000.00	
McInerny Foundation	1,000.00	
S. N. and Mary Castle Foundation	500.00	
F. C. Atherton Trust	500.00	
Frear Eleemosynary Trust	250.00	
Hawaiian Electric Co.	200.00	
Sears Roebuck and Co.	200.00	
Castle and Cooke	100.00	
H. C. & D.	100.00	
Bank of Hawaii	100.00	
First National Bank of Hawaii	100.00	
Watumull Foundation	100.00	
Earl and Leonora Bilger	100.00	
Miscellaneous Contributions	810.42	
Travel Allowance—National Science Conference	672.00	$ 6,732.42
Expenditures		
Fifth Annual Science Fair	$ 4,035.50	
Printing	104.81	
Supplies	57.03	
Miscellaneous	71.15	4,268.49
Excess of Receipts over Expenditures		2,463.93
Balance April 1, 1962		14,119.27
Balance March 31, 1963		$16,583.20
Fifth Annual Science Fair Expenditures (total)		$ 4,035.50
Sixth Annual Science Fair Expenditures (to March 31, 1963)		$ 354.07

Respectfully submitted,

Eleanor S. Anderson
Treasurer

OFFICERS

1962-1963

Leonard D. Tuthill	President
Donald P. Gowing	President-Elect
Robert L. Fox	Secretary
Eleanor S. Anderson	Treasurer
Samuel D. Allison	Councilor
William M. Bush	Councilor
Alexander Spoehr	Councilor (ex officio)

1963-1964

Donald P. Gowing	President
Roland Force	President-Elect
Robert L. Fox	Secretary
Eleanor S. Anderson	Treasurer
D. Elmo Hardy	Councilor (2 years)
E. Alison Kay	Councilor (2 years)
Samuel D. Allison	Councilor (1 year)
William M. Bush	Councilor (1 year)
Leonard D. Tuthill	Councilor (ex officio)

INTER-SOCIETY SCIENCE EDUCATION COUNCIL

ANNUAL REPORT FOR 1962-63

ORGANIZATION

The societies now included in the membership, their presiding officers and their representatives on ISSEC are as follows:

American Association of University Women, Honolulu Branch: Constance Hartt, Leonora Bilger.

American Chemical Society, Hawaiian Section: Charles E. Mumaw, L. J. Rhodes, John H. Payne.

American Society of Agronomy, Hawaii Chapter: D. H. Smith, R. B. Campbell.

American Statistical Association, Hawaii Chapter: Otto Orenstein, Richard Takasaki.

Anthropological Society of Hawaii: Tom Maretski, H. Ivan Rainwater.

Engineering Association of Hawaii: Robert Britten, Doak C. Cox.

Geophysical Society of Hawaii: Paul Ekern, Bessel van't Woudt.

Hawaii Dietetic Association: Matsuko Kawakarada, Marjorie Abel.

Hawaii Medical Association: Nils P. Larsen, Clarence E. Fronk.

Hawaii Psychological Association: A. Leonard Diamond, Joseph C. Finney, Edgar Vinacke.

Hawaii State Dental Association: F. A. Sandberg, Marilyn Bradshaw.

Hawaiian Academy of Science: Leonard D. Tuthill, Dorothy T. Rainwater.

Hawaiian Astronomical Society: George Bunton.

Hawaiian Botanical Society: Maxwell Doty, Robert E. Coleman, Alvin Chock.

Hawaiian Entomological Society: Clifton Davis, Henry A. Bess.

Institute of Food Technologists, Hawaii Section: Edward Ross, Leroy Miller.

Society of Naval Architects & Marine Engineers, Hawaii Section: Captain Nathan Sonenshein, Alvin T. Hansen.

Society of the Sigma Xi, Hawaii Chapter: E. J. Anderson, Gerald G. Dull.

Society of Mechanical Engineers, Hawaii Section: S. Fryer, Fred Cordes.

ACTIVITIES

It has been the aim of this Council, formed five years ago, to grow and change with the science education needs of our young people. These changing needs are reflected in the varied activities of the members of the Council.

Science Fair: The Sixth Hawaiian Science Fair, held March 15-17, was most successful in terms of the number of projects, quality of the individual exhibits and the number of people who were able to view them. There were 39 school fairs held on Oahu and about 20 school fairs on each of the islands of Hawaii, Maui, and Kauai. Separate county fairs were held on Hawaii and Maui.

An estimated 25,000 people visited the Hawaiian Science Fair at the Hilton Hawaiian Village Dome to enjoy the 121 projects, 51 of which came from high schools and 70 from intermediate ones. The Neighbor Islands were represented with 20 projects from Hawaii, 15 from each of the islands of Maui and Kauai, and one from Lanai. The panel of judges, selected from the many scientific disciplines, felt that the quality of exhibits this year warranted awarding 12 "wish awards" in the Senior division and 15 in the Intermediate. These were in addition to the two finalists and some 56 other awards given by affiliated societies, the military and community organizations. Each year an increasing number of awards go to Neighbor Island students which may be indicative of the role this program is playing in science education throughout the State. This year, for instance, the top award in the Intermediate division went to two students, Vern Yamanaka and Duane Kanuba, of Hilo Intermediate School.

Dr. Thomas H. Hamilton, President of the University of Hawaii, addressed the 335 students, teachers, and parents who attended the Awards Banquet. Dr. Hamilton's talk, "Some Observations for the Scientists," left some very thought-provoking ideas with the students and professional scientists who attended.

The climax of the Awards Banquet was the announcement of the two finalists who attended the National Science Fair-International at Albuquerque, New Mexico, May 6-11, 1963. The finalist receiving the Pineapple Award, sponsored by the Pineapple Research Institute, was Priscilla Chow, a sophomore at Maryknoll High School. Her project was, "Slide Rule for Modulo 7." The Sugar Award, sponsored by the Hawaiian Sugar Planters' Association, went to Ross Mobley, a senior at Kaimuki High School for his project, "Papaya Constituents Affect Sporangial Production." Miss Chow won a fourth-place award at the National Science Fair.

Bernard J. Winter, M.D., Associate Pathologist at Queen's Hospital, will be Director of the Seventh Hawaiian Science Fair.

The Science Fair Committee wishes to express its gratitude to the Key Clubs, Kaimuki High School Science Club, and Kaimuki Intermediate students for their help in staffing the Hawaiian Science Fair office at the Dome, distributing programs and helping with the clean-up after the Fair.

Student Science Seminars: During 1962-63, the Student Science Seminar program was conducted on the islands of Oahu, Kauai, Maui, and Hawaii. It received financial support through a grant from the National Science Foundation.

This program, in operation since March 1959, is designed to stimulate and encourage the scientific interests of selected groups of secondary students through evening seminar meetings involving scientists, mathematicians, and engineers.

From all indications, the program continued to challenge the talents of "science prone" students by providing them instruction in scientific concepts, methods, and applications more advanced, rigorous, and individualized than is presently offered under the regular high school curriculum.

Reactions from parents, teachers, and participating scientists were favorable. Highest level of prize winners has been from the select student members of the seminar groups. They received no stipends, advanced credit, or other inducement, yet, on the four islands involved, their attendance averaged about 90 per cent.

During 1962-63, about 30 high school students were members of each of the four groups. Twenty-five meetings were held on Oahu and sixteen on each of the other islands.

Teachers' Science Seminars: Co-sponsorship of a Science Teachers' Workshop, held in conjunction with the Sixth Hawaiian Science Fair, was the major undertaking of this seminar program which is intended to keep science teachers and others informed of current developments in the scientific disciplines. This project also received support from the National Science Foundation.

Hawaiian Science Clubs Service: The main objective of this program, which is supported by a grant from the National Science Foundation, has been to encourage and help secondary public and private schools to establish science clubs. It has been encouraging that more clubs have been established each year since 1959 when the project first started.

In order to help the science clubs, guest speakers have been provided and science materials and literature have been distributed. Subsidized field trips for science club members have been extremely popular, particularly to the Kaena Point Tracking Station and the Standard Oil Refinery. Because of increased costs, financial support of these field trips has been curtailed.

This year two science camps were held at Camp Erdman, one in February for Grades 7-9, and another in March for Grades 10-12. Approximately 30 Honolulu scientists volunteered to lecture to these students at the two camps. A camp was held on Maui in the Fall for which HSCS provided the speaker.

The film loan library continued to be very popular with both public and private schools. About 47,000 students viewed the films. Additional films have been added to the library by both HSCS and ISSEC.

During the Fall, three weekly TV programs were produced by HSCS. These were *Science in Hawaii, Science Panorama,* and *Science Showcase*. *Science Showcase* was discontinued but the other two weekly programs have been continued. Programs covered astronomy, anthropology, biology, dentistry, chemistry, medicine, physics, and other disciplines.

Support of the Hawaiian Science Clubs Service by the National Science Foundation was discontinued on June 30, 1963. However, a NSF grant has been obtained for a Visiting Scientists Program starting in July, 1963.

Hawaiian Junior Academy of Science: The Hawaiian Junior Academy of Science held its first meeting in April 1962 with seven students presenting papers. The Junior Academy's first year of existence was under the guidance of the Chairman of ISSEC.

The Junior Academy was founded to give high school students the opportunity to present papers of original research, results of which do not lend themselves readily to the exhibit type of presentation. (However, as a matter of interest, it should be noted that the student who presented a paper on mathematics at last year's Junior Academy meeting was a top award winner in this year's Hawaiian Science Fair.) The Junior Academy is a prestige organization for science and mathematics students. Membership is divided into two classes: (1) active—those who present papers, and (2) associate—those who by attending the meeting(s) have expressed their interest and support of the project.

The first year's program was more or less limited to the Island of Oahu, with only one speaker from another island, while the second year's program encompasses the Neighbor Islands as well. The annual meeting this year was held on April 26 at 4:00 p.m. in Agee Hall, HSPA.

Westinghouse Science Talent Search: Nine high schools (six public and three private schools) requested 71 sets of examination materials on the 22nd Annual Science Talent Search for Westinghouse Science Scholarships and Awards conducted in December 1962.

In this fourth year of participation by Hawaii students, two students were selected for the Honors Group: James Sweeney of St. Joseph High School, Hilo, and Bernice Chang of Roosevelt High School, Honolulu.

Hawaii was represented in the top forty winners in the 22nd Science Talent Search when it was announced that Bernice Chang had won an all-expense paid trip to the Science Talent Institute, Washington, D.C.

Both students who won national recognition in the Science Talent Search were honored by the presentation of Award of Honor medals from ISSEC at the annual banquet of the Hawaiian Academy of Science.

Teacher Coordination: Science teachers in all Oahu schools were kept informed of ISSEC activities, especially the Science Fair, Teachers' Science Seminars, Student Science Seminars, and Science Talent Search. Information sheets and posters, and other printed materials were distributed and occasional meetings were called to promote and coordinate the participation of teachers and schools in ISSEC sponsored activities.

Public Relations: The first activity of this committee was to revise the ISSEC brochure for community circulation. Newspaper coverage of the Hawaiian Science Fair, as a result of the co-sponsorship of The Honolulu Advertiser, was excellent. The continued interest of their staff in this project is a reflection of the response of our community to the science education needs of our youth.

Community Participation: More than thirty Honolulu business firms, foundations, institutions, and individuals contributed funds in support of ISSEC activities. In addition, other support in the form of materials and services made possible the work of this Council.

Budget Committee: The Budget Committee approved budget requests for 1962-63 as follows:

Sixth Hawaiian Science Fair	$5,100
Junior Academy of Science	1,500
Public Relations	85
Community Participation	25
Contingency	300
Total	$7,010

The Council started the year September 1, 1962, with a balance in the Cooke Trust Company, Ltd., account of $15,059.34. As of March 1, 1963, the balance was $20,534.30.

* * *

The Chairman of this Council wishes to express her sincere appreciation to all the members of the Council who have so capably carried out their responsibilities and to the representatives of the affiliated societies who have ever been willing to come forward with suggestions for the improvement of our program. All members of the Council wish to express their appreciation to the hundreds of scientists who have given so willingly of their time and effort. Few if any, other communities are as fortunate in this respect.

ISSEC Council
Dorothy T. Rainwater, Chairman
Adrienne Kaeppler, Secretary
Dwight H. Lowrey, Treasurer

COMMITTEES

Budget: John H. Payne, Experiment Station, H.S.P.A.

Community Participation: Alexander Spoehr, East-West Center.

Student Science Seminars: Albert B. Carr, University of Hawaii; Barton Nagata, Kauai; Clifford Kekauoha, Maui; Allan Kondo, Hawaii.

Science Teacher Coordination and Science Talent Search: Edwin Y. H. Chinn, Department of Education.

Public Relations: Robert Wiemer, Experiment Station, H.S.P.A., Jim Bernard, Van Waters & Rogers.

Science Fair: Director, Robert E. Coleman, U.S.D.A. & Experiment Station, H.S.P.A.; Associate Director: Donald H. Smith, Pineapple Research Institute, Bernard J. Winter, M.D., Queen's Hospital; Secretary: Setsuko Nakata, Bishop Museum; Treasurer: Dwight H. Lowrey, Cooke Trust Company, Ltd.; Awards: Goro Uehara, University of Hawaii; Exhibits: Dorothy T. Rainwater, Bishop Museum; Sites and Props: Howard McAllister, University of Hawaii; Judging: Toshio Murashige, University of Hawaii; Hospitality:

Bertha Sakimura, Department of Education; Public Relations: Robert Wiemer, Experiment Station, H.S.P.A., Jim Bernard, Van Waters & Rogers; Press Sponsor: The Honolulu Advertiser.

Teachers' Science Seminars: Paul Ekern, Pineapple Research Institute.

Hawaiian Science Clubs Service: Director: Wallace Sanford, Pineapple Research Institute; Associate Director: Donald Li.

Junior Academy of Science: Alvin Chock, U.S.D.A.

DONORS TO ISSEC

Samuel N. and Mary Castle Foundation
The Watumull Foundation
F. C. Atherton Trust
Frear Eleemosynary Trust
Gaspro Limited
Lewers & Cooke, Ltd.
McInerny Foundation
Oahu Transport Company
Juliette M. Atherton Trust
Charles M. & Anna C. Cooke Trust
Harland Bartholomew & Associates
Hawaiian Telephone Company
Honolulu Gas Company
Hawaiian Electric Company, Ltd.
City Bank of Honolulu
The Honolulu Advertiser
Hilton Hawaiian Village Hotel
Pineapple Research Institute
Hawaiian Sugar Planters' Association
James W. Glover, Ltd.
Sears, Roebuck & Company
Foster Equipment Company, Ltd.
Coca-Cola Bottling Co. of Honolulu, Ltd.
Bank of Hawaii
First National Bank of Hawaii
Honolulu Construction & Draying Co., Ltd.
Kaneohe Ranch Company
Castle & Cooke, Inc.
Edward R. Bacon Co. of Hawaii, Ltd.
First Insurance Company of Hawaii, Ltd.
Dr. and Mrs. Earl M. Bilger
Van Waters & Rogers, Inc. B.K.H. Div.
Chemical Rubber Company
Cooke Trust Company, Ltd.
National Science Foundation

The 38th
ANNUAL MEETING 1962-63

Program

FIRST SESSION

November 15, 1962, Agee Auditorium, HSPA, Honolulu

1. Frank C. Spencer and Douglas S. Yamamura: Cytology—Then and Now.
2. Dora S. Dien and W. Edgar Vinacke: Self-Concepts and Parental Identification of Children with Caucasian-Japanese Parentage.
3. Paul C. Ekern: The Fraction of Sunlight Retained as Net Radiation in Hawaii.
4. U.S. Information Service: The Tenth Pacific Science Congress (Movie).
5. John M. Digman: A Hierarchal Model of Personality Organization in Children.
   John M. Digman: Geometrical Model of Personality (Exhibit).

November 16, 1962, Agee Auditorium, HSPA, Honolulu

6. Joseph Stokes, III: A Study of Coronary Heart Disease in Hawaiian Races.
7. Saul Price: Meteorological Satellites—Past, Present, and Future.

FINAL SESSION

April 25, 1963, Agee Auditorium, HSPA, Honolulu

1. Sidney L. Halperin: Longitudinal Psychological Studies of One Child Over a Ten-Year Period.
2. Donald W. Strasburg: Employment of Submarines for Scientific Research.
3. Raymond M. Alden: Developments in Long-Distance Communications.

April 25, 1963, Agee Auditorium, HSPA, Honolulu

4. Leon Rosen: Current and Planned Activities of the Pacific Research Section, National Institute ot Allergy and Infectious Diseases.
5. Ross Mobley: The Influence of Papaya Fruit Constituents on Sporangial Production of *Phytophthora parasitica* Dast.
6. Priscilla Chow: Slide Rule for Modulo 7.
7. Bluebell R. Standal: The Nutritional Implication of the Protein and Manganese in Duruka (*Saccharum edule*).
8. Joseph E. Alicata and Robert W. Brown: Observations on the Cause and Transmission of Eosinophilic Meningitis in Hawaii and the South Pacific.
   Joseph E. Alicata: Transmission of Parasitic Meningitis in Hawaii and the South Pacific (Exhibit).

April 27, 1963, Hilton Hawaiian Village, Honolulu

Banquet
Introduction of New Officers
Presidential Address
Leonard D. Tuthill: Let Us Be Reasonable, or a Reconsideration of the World's Oldest Profession.

HAWAIIAN JUNIOR ACADEMY OF SCIENCE

April 26, 1963, Agee Auditorium, HSPA, Honolulu

1. Patricia Yap: Some Practices Concerning Eating Habits Among the Different Races.
2. James E. Sweeney: Original Work on Elementary Function Theory.
3. Patricia Lum: A Comparative Study of the Methods Parents of Different Racial Groups Use in Dealing with Their Children.
4. Karen Kau: Are Mathematical and Musical Abilities Related?

Abstracts

FIRST SESSION

1. Cytology—Then and Now

No abstract available.

FRANK G. SPENCER
DOUGLAS S. YAMAMURA
Honolulu, Hawaii

2. Self-Concepts and Parental Identification of Young Adults with Mixed Caucasian-Japanese Parentage

This study explored, in a preliminary way, the impact upon personality development of having parents from different cultural or racial backgrounds. The Hawaiian environment, with its benign acceptance of intermarriage, makes it possible to focus on the positive aspects of accommodative processes rather than on the negative ones of conflict and maladjustment prevalent elsewhere. Three hypotheses were formulated on the basis of a pilot study and other research. (1) Persons with mixed parentage have smaller discrepancies between concepts of self and ideal-self than do persons of ethnically homogeneous parentage. (2) Persons of mixed parentage have, in general, smaller discrepancies among concepts of self, ideal-self, father, and mother. (3) There is a positive correlation between self-ideal discrepancy and discrepancy between ideal-self and concept of the parent of the same sex. The subjects of this investigation were eight males and seven females with Caucasian fathers and Japanese mothers; control groups with either homogeneous Caucasian or Japanese parentage were matched on several appropriate variables with the critical Ss. A simple seven-point rating form, consisting of 24 trait names, was used to secure from each subject ratings for four concepts, namely, self, ideal-self, father, and mother. These were compared in terms of discrepancy scores. All three hypotheses were confirmed at levels of significance beyond the .05 level for males, but none was confirmed for the females. Several alternative interpretations were suggested, but additional research is necessary to choose among them. It would be particularly valuable to replicate the study with subjects who have Japanese fathers and Caucasian mothers.

DORA SHU-FANG DIEN
W. EDGAR VINACKE
University of Hawaii

3. The Fraction of Sunlight Retained as Net Radiation in Hawaii

The net radiation has demonstrated effects on the heat and moisture budgets of soil and crops, hence is an important meteorological parameter of any area. The pattern of net radiation is closely linked to the pattern of sunlight. Forecast relationships between net radiation and sunlight can be made, based on the reflectance for the short wave and the estimated net long wave balance. The anticipated relationships are well borne out by measured relationships between net radiation and sunlight. The low values for the short wave reflectance and the small change in net long wave radiation with total net radiation, combine to produce a total net radiation in Hawaii that is a very large fraction of sunlight when compared to certain values measured under temperate latitude conditions.

PAUL C. EKERN
Pineapple Research Institute of Hawaii

4. The Tenth Pacific Science Congress

No abstract available.

U. S. Information Service

5. A Hierarchal Model of Personality Organization in Children

Previous research by the author indicated that a minimum of eight factor dimensions were required to order the inter-relationships among the manifest variables of child personality. Following report of this to the Academy, the inter-relationships among the dimensions were analyzed, suggesting a two-space factor system of Successful Socialization and Extraversion-Introversion.

An enlargement of the study was undertaken, utilizing 51 personality variables and 149 children. Factor analysis of the linear relationships among these manifest variables confirmed the chief findings of the first study, and suggested two additional factor dimensions. The dimensions confirmed have been labeled Hostility vs. Empathy, Competence, Ego Strength vs. Neuroticism, Ascendance vs. Submissiveness, Acceptance of the Cultural Code vs. Rejection of the Cultural Code, Social Interest vs. Withdrawal, Security vs. Insecurity, and Sensitive Imagination vs. Insensitive Practicality. The new factors have been identified as Excitement vs. Apathy and Tension vs. Calm. The inter-relationships among the 10 dimensions imply a three-space system, confirming two of the previously obtained higher-order factors (Successful Socialization, Extraversion), as well as suggesting Tension as a possible third.

Certain findings are at variance with traditional thought with respect to child personality; e.g., children with *high* neatness, orderliness, persistence are *low* in Neurotic Trend.

Some of the statistical problems involved will be *briefly* mentioned: e.g., obtaining the squared multiple correlations of each of the variables on the m-1 others; finding the characteristic roots and vectors of a 54-order matrix.

JOHN M. DIGMAN
University of Hawaii

6. A Study of Coronary Heart Disease in Hawaiian Races

No abstract available.

JOSEPH STOKES, III
Queen's Hospital

7. Meteorological Satellites—Past, Present and Future

No abstract available.

SAUL PRICE
U. S. Weather Bureau

FINAL SESSION

1. Longitudinal Psychological Studies of One Child Over a Ten Year Period

Intellectual and personality assessments of a normal child were tested from age 3 to 13. The projective data describe relatively stable and progressive patterns of emotional development, evidenced in increased capacity to integrate experience, noticeable improvement in accuracy of perception of form, increase in quality and quantity of the phantasy life, stronger emotional controls, and finer sensitivity to environmental stimuli.

The data suggest that periodic longitudinal testing of children, using projective procedures, could serve to identify precursors to maladjustment, add immeasurably to our understanding of the emotional factors in the learning processes, and assist in the clarification of expressed interests in vocational choice.

SIDNEY L. HALPERIN
U. S. Army, Tripler General Hospital

2. Employment of Submarines for Scientific Research

During the two thousand years of their existence, submarines have steadily evolved as weapons, and only in very recent years have their research capabilities been utilized. Actually there exist a number of extremely important research missions for which a submarine is the ideal tool. These missions relate to the exploration and development of the sea's living resources such as fish, shellfish, and algae; its mineral deposits including coal, oil, and metals; and numerous oceanographic features, such as the ocean currents, which have profound effects on man's activities ashore.

Surface ships are inherently limited as oceanic research tools. Samples obtained by their use are acquired in a blind, groping manner; seasonal storms or ice exclude them from operating in many areas; and their motion often precludes the use of such delicate instruments as balances and microscopes. Submarines are not beset by these problems. They can place man in intimate contact with almost any oceanic feature he wishes to observe, eliminating blind sampling. With modern propulsive means, they can remain submerged beneath the most severe storms or ice. At such times they are sufficiently stable to permit many types of delicate research.

The vehicles used for underwater research today cover a broad range of designs and capabilities. At one end of the scale are devices which simply relieve divers of the task of propulsion. Farther up the array is a series of midget submarines suitable for short, shallow dives. More elaborate vessels have been built for deep exploration, one such craft already having reached the bottom of the Marianas Trench. The most complex research vehicle is Russia's converted naval submarine *Severyanka,* which is being used for extensive studies of fish behavior and gear performance.

The United States Department of the Interior has planned a submarine to undertake research missions for two of its branches, the Bureau of Commercial Fisheries and the Bureau of Mines. This vessel will be used for the study of fish behavior, oceanic productivity, oceanography, bioacoustics, gear performance, and other fishery missions, and in addition for visual, magnetic, and radiological prospecting and drilling for mineral resources. The vessel is envisioned as being about 150 feet in length, and capable of 20 knot speeds and 1,000 foot dives. It is hoped that automation will permit manning it with a relatively small crew, and that the use of modern propulsive power will allow extended periods of submergence. A large well-equipped laboratory is planned to accommodate the needs of 10 scientists.

DONALD W. STRASBURG
Bureau of Commercial Fisheries,
Biological Laboratory

3. Developments in Long-Distance Communications

We will examine, in general terms, recent scientific progress and the engineering applications of this knowledge to long-distance communications.

The primary obstacles to be overcome in establishing satisfactory long-distance communications are: (1) distance, both as a geographical or mechanical and as a transmission or electrical problem; (2) quantity requirements which are related both to information theory and bandwidth requirements, and to automation, which is fundamentally an economic problem; (3) barriers of language and national customs, including the absence, until recent years, of international standards.

An underlying consideration concerning the above problems relates to the contrasting economic conditions in various parts of the world and the resulting differences in the needs for various types of communications.

For convenience in analysis, the broad problem of communications can be reduced to two problems—switching and transmission. In the consideration of recent scientific developments and how they have been applied to these problems, it is useful to consider telephone switching systems from the viewpoint of computer technology. Progress in the design of computers, and in new uses for computers, can then be readily seen as applicable to the switching portion of the communications problem.

Significant advances in attacking the transmission problem have been principally in the areas of linear high-power amplification and low-level, low-noise amplification. Examples are traveling wave tubes and lasers.

Laser applications, while not of immediate practical significance in communications, justify considerable speculation concerning future possibilities for the transmission of great quantities of information under special conditions.

Economic considerations in transoceanic communications have led to significant developments in the manufacture of materials, components, and systems of extreme reliability. Modern underseas telephone cables are a direct product of the application of such manufacturing techniques to conventional systems designs. The same approach will lead within a few years to greater communications capabilities by applying high reliability manufacturing techniques to systems which are based upon recent scientific developments.

Prospects for commercial satellite communications depend upon a similar sequence of techniques, beginning with pure scientific research and progressing through accelerated engineering design and high reliability manufacture. The speed with which these efforts are carried out depends to a considerable extent upon the relative importance of economic and political considerations.

RAYMOND M. ALDEN
Hawaiian Telephone Company

4. Current and Planned Activities of the Pacific Research Section, National Institute of Allergy and Infectious Diseases

No abstract available.

LEON ROSEN

5. The Influence of Papaya Fruit Constituents Upon Sporangial Production of *Phytophthora parasitica* Dast

Phytophthora parasitica, a papaya pathogen, is known to produce sporangia abundantly on V-8 juice agar under illumination; few sporangia are produced in the dark on the medium. However, the fungus has been found to produce sporangia in large quantities on the green papaya fruit both in the dark and under illumination. Few sporangia are produced on ripe fruit in the dark or under illumination. Abundant sporulation occurred on autoclaved aqueous extracts of the combined exocarp and mesocarp of the green fruit. A fairly large number of sporangia was also formed in the dark when the fungus was grown on aqueous extracts of the green papaya mesocarp.

ROSS MOBLEY
Kaimuki High School

6. A Slide Rule for Modulo 7

The modulo system is a finite circular arithmetic which keeps repeating itself, such as Modulo 7: 0, 1, 2, 3, 4, 5, 6, 0, 1, ... The equation for the multiplication of Modulo 7 is as follows:

(number) x (number) $\div$ 7, the remainder = X.

The equation for division, which is as follows:

(a number factorable by 7 + dividend) $\div$ 7 = X,

was formed by using the multiplicative method of division. That is, the divisor times the quotient equals the dividend.

Since Modulo 7 is one of the prime number modular systems, and therefore a number field, a workable slide rule could be made. Because this was a circular arithmetic, a circular slide rule seemed more appropriate.

The relationships of the numbers on a regular circular slide rule were observed. After many attempts to develop this relationship for Modulo 7, it was discovered that the figures 1 and 6 must be 180 degrees apart. After much trial and error, the figures 2, 3, 4, and 5 were put in the right places to produce a workable slide rule.

PRISCILLA Y. C. CHOW
Maryknoll High School

7. The Nutritional Implication of the Protein and Manganese in Duruka *(Saccharum edule)*

Duruka, *Saccharum edule,* is a Pacific island vegetable which grows in Fiji and New Guinea and is widely accepted as a vegetable by the Europeans, Indians, Fijians, and other nationalities of Fiji. It is an important food product for 2-3 months of the year and is considered by the islanders to be one of the oldest vegetables. Two varieties, the red- and the green-sheathed duruka, were obtained from Fiji. The proximate analysis shows that both varieties contain a high amount of protein as analyzed by the Kjeldahl method (nitrogen x 6.25). One serving of duruka will provide the same quantity of protein as one serving of ground beef.

Of the two varieties, the green-sheathed one contains more fat, protein, and ash than the red one. The manganese content of duruka is higher than any of the reported values for foods. The red variety contains more manganese than the green one. A serving of duruka will provide 10 times as much manganese as one serving of liver.

Depending upon the quality of the protein, duruka may find a place in the partial solution of protein need for the underdeveloped areas where a combination of vegetable proteins is an important factor in the economy of such a consideration.

Man's requirement for Mn has been placed at 3-9 mg/day. The possibility of an excessive intake of Mn exists if duruka is eaten regularly. Although intracellularly Mn excess appears to have no damage, massive intake of Mn has been shown to interfere with the absorption of calcium and phosphorus and of iron.

BLUEBELL R. STANDAL
University of Hawaii

8. Observations on the Cause and Transmission of Eosinophilic Meningitis in Hawaii and the South Pacific

Available information on the geographical distribution and normal migration of the lungworm *Angiostrongylus cantonensis* to the brain of the rat host (Austr. J. Zool. 3:1-21, 1955) in February 1961 led the senior author to theorize that this parasite may be the causative agent of eosinophilic meningitis in the Pacific. As a result, work was started to explore this theory through animal experimentation and field trips to Tahiti, and New Caledonia, where the disease was known to occur.

In support of the above theory the following demonstrations and observations were thereafter made:

(a) Finding, at autopsy of young adult, *Angiostrongylus cantonensis* in the brain of man in Hawaii who had shown symptoms of eosinophilic meningitis (Rosen, L. *et al.*, J.A.M.A. 179:620-624, 1962).

(b) Report of two cases of eosinophilic meningitis following willful ingestion of raw slugs from areas where the rat lungworm was common (Horio, S. H. and Alicata, J. E., Hawaii Med. Jour. 21 (2):139-140, 1961; Alicata, J. E., So. Pac. Comm. Tech. Paper, 1963, in press).

(c) High incidence of lungworms among rats and mollusk and planarian vectors in Tahiti and New Caledonia (Alicata, J. E., Canad. Jour. Zoo. 40:5-8, 1962, and So. Pac. Comm. Tech. Paper, pp. 139, 1963).

(d) Common consumption of raw prawns in Tahiti, 4 per cent of which were found to harbor the infective larvae of *A. cantonensis* (Alicata, J. E. and Brown, R. W., Canad. Jour. Zoo. 40:755-760, 1962).

(e) Transmission of eosinophilic meningitis to simian primates following experimental administration of larvae of *A. cantonensis* (Alicata, J. E., Loison, G. and Cavallo, A., Jour. Parasitol. 49:156-157, 1963).

JOSEPH E. ALICATA
University of Hawaii

ROBERT W. BROWN
Institut de Recherches Médicales
(Papeete, Tahiti)

HAWAIIAN JUNIOR ACADEMY OF SCIENCE

1. Some Practices Concerning Eating Habits Among the Different Races

The purpose of this project was to find a relationship among the different races in Hawaii. The procedure was to form questions, to distribute questionnaires, to sort the questionnaires according to races, and then to form a conclusion. A total of 496 second and third graders in public and parochial schools participated in this survey.

In the conclusion the average of the percentages of the severest answers of the third or more generations to the questions asked were found. The severest answers were a "Yes" to the questions:

Do your parents allow you (1) to eat between meals?
(2) to a second helping?
(3) to eat only things you like?

and a "No" to the questions:

Do your parents (1) punish you if you don't eat everything on your plate?
(2) make you eat what you don't like?

The Filipinos were the strictest and the Chinese the most lenient.

PATRICIA YAP
Maryknoll High School

2. Original Work on Elementary Function Theory

A simple method has been found whereby one can analyze some sets of ordered pairs, and, if the ordered pairs in these sets are produced by the operation of a rational polynomial function, one can determine the polynomial function that defines the functional set. The sets which are capable of being analyzed are those which satisfy the following condition: if the function is a rational polynomial function, and if the highest power of the polynomial is n, then the function may be determined if there are at least $n+2$ ordered pairs whose x values increase from a lowest to a highest value in a precisely stepwise fashion. Thus, the difference between each x value must be a constant (denoted E) for at least $n+2$ ordered pairs.

One first arranges one's x values in ascending order. Below this line one writes the y (or $f(x)$) values corresponding to the x values immediately above. One then subtracts each y value from the y value immediately to the right of it (naturally this doesn't apply to the y value immediately below the greatest x value), thus obtaining line d_1. Here too, one proceeds as before, subtracting each d_1 value from the one immediately to the right of it. One proceeds with this iterative subtraction process until one obtains a line of differences, all of which are equal, line d_n.

It has been found empirically that, if the n^{th} line is the last line, then the highest power of the polynomial is n. Further, the value of the numerical coefficient of this highest power x term is equal to $d_n / [(n!)\ (E^n)]$, where d_n is the final constant term and $n!$ is n factorial. Thus, one has obtained the first term of the polynomial, ax^n, $a = d_n / [(n!)\ (E^n)]$.

One next proceeds by subtracting ax^n from every $f(x)$ value, obtaining a set of ordered pairs of the form: $(x_1, f(x_1) - ax^n_1)$, $(x_2, f(x_2) - ax^n_2)$, etc. This new set is, of course, determined by a polynomial which is exactly the same as the original polynomial except that it lacks the ax^n term. One proceeds with this set exactly as with the original set, obtaining the highest power term which is, of course, the second highest power term of the original polynomial.

Thus, one is able to continue in this fashion until one obtains all the terms of the original polynomial function.

Of course, interesting as this process may be, there are but few natural phenomena which can be completely described by a simple polynomial, so the process will see at best limited use in the laboratory. It is, nevertheless, a very interesting mathematical tool.

JAMES E. SWEENEY
St. Joseph's High School, Hilo

3. A Comparative Study of the Methods Parents of Different Racial Groups Use in Dealing with Their Children

A study was conducted to discover whether there was any difference in the manner in which parents of various racial groups reacted toward their children in different situations. A questionnaire was made with questions asking the children how their parents responded to situations concerning schoolwork and grades, relationship with friends, and allowances. These questionnaires were answered by 315 ten- and eleven-year-old students from city schools representing the middle income group. This age group was selected because it was felt that they were more likely to be honest and forthright with their answers.

In processing the responses to the questionnaires, the children were separated into six racial categories: Caucasian, Chinese, Cosmopolitan, Filipino, Hawaiian, and Japanese.

The most significant difference was found in the methods used by parents in punishing children for disobeying and for making poor grades in schoolwork. The most common method used, by parents of all racial groups, was to give the children a scolding. However, the Cosmopolitan, Filipino, and Hawaiian parents tended to use physical punishment, whereas the Caucasian, Chinese, and Japanese parents tended to use other methods, such as taking away privileges and discussing problems.

The survey showed that the greatest differences lay in the manner of punishment, not in the presence of punishment.

PATRICIA LUM
Maryknoll High School

4. Are Mathematical and Musical Abilities Related?

The two tests used to determine the mathematical and musical abilities of subjects were the Differential Aptitude Test in Numerical Ability and the Seashore Measures of Musical Talent in pitch, rhythm, and tonal memory. The tests were given during class time on separate days to prevent fatigue.

Subjects were volunteers from the eighth to twelfth grades. There were boys and girls in the eighth grade age group and girls only in the ninth to twelfth grade age groups. In all, there were 115 subjects. As far as biases are concerned, all students were probably similarly motivated, and as far as testing experience was concerned, students in each group level were most likely on an equal par.

Percentiles were compiled and were punched on computer cards to find the correlation coefficient according to the product moment equation: $r = (xy \div N - M_xM_y) \div SD_x\,SD_y$, where xy is the sum of the products of each pair of score values, N equals the number of measures, M_x is the mean of the distribution of x scores, M_y is the mean of the distribution of y scores, SD_x is the standard deviation of the distribution of x scores, and SD_y is the standard deviation of the distribution of y scores. The correlation coefficient r was found to be 0.17. To be significant, r must be three times the standard error SE, which was calculated according to the equation: $SE = 1 \div$ (a square root of N-1), and it was found to be 0.094. Three times O.094 is 0.28. Since r was only 0.17, it is not significant.

Because r is not significant, it can be concluded that for this sample there is not a valid relationship between mathematical and musical abilities. It is hoped that when a larger sample of the population is tested, a general conclusion may be drawn for the entire population, thus resolving the question, "Are mathematical and musical abilities related?"

KAREN KAU
Star of the Sea School

CONSTITUTIONAL AMENDMENT

Hawaiian Academy of Science

Adopted November 15, 1962

Revise Article V, OFFICERS, Sections 1 and 3 to read as follows:

Section 1. The officers of the Academy shall be a President, a President-Elect, a Secretary, a Treasurer, and five Councilors.

Section 3. One of the Councilors shall be ex-officio, the retiring President. The other four Councilors shall be elected two each year, to serve for terms of two years, or until their successors are elected.

NECROLOGY

The Academy records with sorrow the death of the following members during the year:

Sumner Price
Fred LaFon
Edward Y. Hosaka
Frederick G. Krauss

MEMBERSHIP JUNE 1963

Abbott, Agatin T.
Abramovitz, Melvin
Ai, Raphael A. C.
‡Akamine, Ernest K.
Akamine, Ralph N.
Akau, Thelma I.
Aldrich, W. W.
*Alexander, Henry A.
Alexander, William P.
‡Alicata, J. E.
‡Allison, Samuel D.
Amioka, Shiro
‡Anderson, Earl J.
Anderson, Eleanor S.
Anderson, James W.
Appleton, Vivia B.
Apt, Walter J.
Aragaki, Minoru
Arkoff, Abe
‡Arnold, H. L., Jr.
‡Arnold, H. L., Sr.
Au, Stephen
Aust, Ruth Ann

Babbitt, Howard C.
Baker, Gladys E.
†Baker, R. J.
*Baldwin, Robert I.
*Baldwin, Mrs. Robert I.
‡Ballard, Stanley S.
‡Banner, Albert H.
Barkley, Richard A.
*Barrel, Robert
Bartz, Ellwood L.
‡Baver, L. D.
Beardsley, John W., Jr.
Bennett, Thomas S.
Benson, Homer R.
Berk, Morton
Bernard, James W.
Bernatowicz, Albert J.
‡Bess, Henry A.
‡Bianchi, Fred A.
Bilger, Earl W.
Bilger, Leonora N.
Bishop, Brenda
Bonk, William J.
Boroughs, Howard
Bowen, Robert N.
Bowers, Neal M.
Bowers, Rohma L.
Bowles, Herbert E.
Bowles, John
*Bowman, Hannah K.
Boyle, Frank P.
‡Britten, E. J.
‡Britton, John R.
Broadbent, Frank W.
Brown, Charles S.
Brown, Donald W.
Bruce, Frank J.
Bryan, Edward C.
Bryan, E. H., Jr.
*Bryan, L. W.
Burgess, C. M.
Burnett, Gilbert
‡Burr, George O.
Bush, William M.
‡Bushnell, O. A.
Butchart, David H.
*†Buttles, W. William
Buzzard, Betsy

Campbell, R. B.
Campbell, Robert L.
Canty, Daniel J.
*Carlsmith, Donn W.
*Carlson, Norman K.
†Carr, Albert B., Jr.
Carr, Elizabeth B.
*Carter, A. Hartwell
‡Carter, Walter
Castle, Molly
*Castle, Northrup H.
Ching, Kim Ak
Chinn, Edwin
Chiu, Arthur N. L.
Chiu, Wan-cheng
Caver, C. V.
*Chang, Leon M.
Chang, Raymond M.
Chapson, Harold B.
Chock, Alvin K.
Chong, Mabel T.
*Chow, Matthew
‡Christenson, Leroy D.
‡Chu, George W.
*Chuck, Harry C.
Chuck, Mrs. Harry C.
Chun, Alice Yang
Chun, Edwin Y.
Chun, Raymond K.
Chun, Wallace K. C.
*Chun, William H.
Chun-Ming, Archie
Civin, Harold W.
†Clagg, Charles F.
Clagg, Harry B.
Clark, H. B., Jr.
‡Clements, Harry F.
Clopton, Robert W.
Cloward, Ralph B.
‡Cobb, Estel
†Coleman, Robert E.
Contois, David E.
Cooil, Bruce J.
Cooke, Richard A., Jr.
Cooksey, Lewis C.
Cooper, John W.
Corboy, Philip M.
‡Cornelison, A. H.
‡Cox, Doak C.
‡Cox, Joel B.
Cox, Marjorie L.
‡Cox, Richard H.
Craig, Robert S.
Crawford, Carolyn
Crowell, David
Curtis, Walter
‡Cushing, Robert L.
Custer, Charles C.

Davis, Clifton J.
‡Davis, Dan A.
Davis, David W.
Davis, Rose
Davis, Walter E.
Defibaugh, Betty Lou
‡Degener, Otto
†Deibert, Austin V.
Deiter, Robert V.
deJesus, Cesar B.
Denison, F. C.
Denison, Harry L.
‡Diamond, Aaron L.
‡Digman, John M.
Doi, Asao
Doi, Mitsugi
†Dole, Arthur A.
Doolittle, S. E.
‡Doty, Maxwell S.
Downer, J. M.
‡Dull, Gerald G.
Dunmire, William W.
Durant, Richard C.

*‡Easley, John A. , Jr.
‡Edmondson, C. H.
†Ego, Kenji
Ego, Winifred T.
Eguchi, George
‡Ekern, Paul C.
†Eller, Willard H.
Emery, Byron E.
Emory, Kenneth P.
†Enright, J. R.
Estoque, Mariano A.
Ewart, George Y.

Fankhauser, Adolph
‡Farden, Carl A.
Feiteira, Thomas M.
Feldwisch, W. F.
Felton, George
Fernandez, Leabert R.
†Fine, Jules
Florine, Charlotte M.
‡Forbes, Theodore W.
Force, Roland W.
‡Fosberg, F. R.
‡Fox, Robert L.
Frazier, Frances
Frings, Hubert W.
Fujimoto, Giichi
Fujita, Robert K.
Fujitani, Miharu
‡Fukuda, Mitsuno
Fukui, Iris
*‡Fukunaga, Edward T.
Fullaway, D. T.
Furumoto, Augustine
Furumoto, Howard H.

Gaines, Henry D.
Gaston, John Z.
Gay, Frank E.
Gebauer, Paul
‡Gilbert, Fred I.
Gilbert, James C.
Gima, Paul
*Glass, Eugene E.
Glick, Clarence E.
Glover, Mary A.
Glover, Myrtle H.
Go, Mateo L. P.
Golden, P. J.
‡Gortner, Willis A.
Gosline, W. A.
Goto, George
‡Goto, Shosuke
Goto, Y. Baron
‡Gowing, Donald P.
Gray, Ross H.
*Greenwell, Alice B.
*Greenwell, Amy
Greenwell, Wilfred A., Jr.
‡Gressitt, J. Linsley
Gustuson, Donald I.
Gutmanis, Ivars

Habeck, Dale H.
*Hahn, Dorothy
*Hahn, Henry
Hall, Donald
Halperin, Sidney L.
†Halpern, Gilbert M.
Halsted, Ann L.
Hamada, Dorothy K. I.
‡Hamre, Christopher J.
‡Handy, E. S. C.
*Hansen, Violet
Hanson, Noel S.
Harada, Glenn K.
Harada, M. B.
†Haramoto, Frank H.
†Harbinson, John A.
‡Hardy, D. Elmo
Hargrave, Vernon E.
Harry, J. V.
Hart, William E.
‡Hartt, Constance E.
Hartwell, Alfred S.
Hayashi, Toshiichi
‡Heinecke, Ralph M.
Heinz, Don J.
Heisterkamp, Charles, III
Helfrich, Philip
Henke, Louis A.
Henry, George W.
Herrick, Colin J.
Herrick, Raymond B.
Herschler, L. H.
‡Hiatt, Robert W.
Hilker, Doris
‡Hilton, H. Wayne
*Hind, Robert L., Jr.
Hinrichsen, Erik C.
Hiraoka, Edith S.
Hirokawa, Sueko
Hitch, Thomas K.
Hiu, Dawes N.
Ho, Richard K. B.
Holladay, Natalie
Holmes, Wilfred J.
Holmes, William John
Holt, Ernest G.
Holtwick, Chester B.
Holtzmann, Oliver
Honda, Howard H.
Honl, L. A.
Honnert, Henry
Hood, Ernest L.
Hormann, Bernhard L.
Hoskins, Charlotta M.
‡Hosoi, Hiyoshi
‡**Hoyt, Simes T.**
‡Hsiao, Sidney C.
Hubbard, Howard
†Hudson, Loring G.
Hunter, Robert G.
Hurdis, John W.
Hutchison, Frieda M.
Hylin, John W.

Ihara, Teruo
Ihara, Violet K.
Ihrig, Judson L.
Iida, Kumizi
Ikawa, H.
*Ikeda, Warren
Ing, Lucille L.
Inskeep, Richard G.
Ishii, Mamoru
†Ito, Kiyoshi
Iversen, Robert T. B.
Iwanaga, Isaac I.
*Iwane, John Y.
Izuno, Takumi

Jackson, Dean C.
Jacobson, J. Robert
Jacobson, W. N.
Jenkins, Irving A.
Johannessen, George A.
†Johnson, David
Johnson, Harold M.
†Johnson, Nels E.
Johnson, Rockne
Johnston, Fred T.
Jones, Everet C.
Jones, Thomas S.
Joyce, Charles R.
Judd, Charles S., Jr.

*Kadota, Shizuto
*Kagehiro, George
Kainuma, Richard T.
Kajiwara, Jonathan T.
‡Kamasaki, Hitoshi
‡Kamemoto, Haruyuki
Kamsat, Abraham N.
Kanehiro, Yoshinori
*Kaneko, Yoshiyuki
Kato, Tadayuki
Katsuki, I.
Kaulukukui, Felice W.
Kawahara, Lloyd T.
Kawamura, Setsuji
Kawano, Henry
‡Kay, Alison
*Kealamakia, Anum Y.

*Member, Hawaii Division, Hawaii Academy of Science.
†Member, American Association for the Advancement of Science.
‡Fellow, American Association for the Advancement of Science.

Keeler, Joseph T.
Keiser, Irving
Kekauoha, Clifford
Kelly, Marion
Kent, Martha J.
Kern, Charles I.
‡Kerns, Kenneth R.
Kilpatrick, Thomas E.
Kim, James
Kimura, Nagato
†Kinch, D. M.
King, Mary Eleanor
King, Maurice V.
King, Will Norman
*Kishimoto, Richard H.
Kiuchi, Marian
Kleman, John P.
‡Klemmer, Howard W.
Kline, James W.
Klopf, Donald
†Kobayashi, Clifford K.
‡Kohn, Alan J.
Kohn, Marian A.
‡Koike, Hideo
Kondo, K. C.
‡Kondo, Yoshio
Kong, Ronald A. K. W.
†Kopf, Kenneth
Kortshak, Hugo P.
Koshi, James H.
Krajina, Vladimir J.
‡Krauss, Beatrice H.
‡Krauss, N. L. H.
*Krivoy, Harold L.
Kruse, Arthur G.
Kudar, John C.
Kunimitsu, Kenneth
†Kuninobu, James T.
Kuwahara, Iwao

Lam, Margaret M.
Lam, Robert L.
Lamoureux, Charles
Larm, Edwin
Larsen, Nils P.
Lau, Elizabeth
Lau, Howard K. S.
Lau, Lawrence L.
Lau, L. Stephen
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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

THIRTY-NINTH ANNUAL MEETING 1963-1964

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THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

PRESIDENTIAL ADDRESS 1964

URANIA AND AGORA: SCIENTIFIC CONTRIBUTIONS OF AN INDUSTRIAL RESEARCH ORGANIZATION

Donald P. Gowing[1]

IN HIS highly interesting book *Science for the Citizen,* Lancelot Hogben develops the theme that a large number of scientific discoveries were made as a result of directed searching in response to meeting a human need. He cites many instances of this, among them the investigations of the physics and thermodynamics of the behavior of gases that followed Newcomen's invention of the steam engine. A good deal of this was the direct or indirect result of efforts to improve the efficiency of steam engines for pumping water out of mines. To find evidence in other fields, one has only to consider the advances in knowledge of human physiology and health made by medical practitioners, past and present, and the enormous increase in knowledge about the nature of electromagnetic phenomena developed within the electronics and communications industries. I think the principle is well established. However, this does not mean that it is well recognized.

In the period of my association with a private industrial research organization, the Pineapple Research Institute of Hawaii, there have often been occasions when professional visitors have questioned this principle. It is argued that research time oriented toward the solution of practical problems is "wasted," particularly if any portion of the results are withheld from the public domain. Moreover, so runs the argument, our scientists fail to meet the obligations to the masters who trained us in the expectation that our work in turn would be solely directed to the advancement of scientific knowledge and its free disclosure.

Taking these things one at a time, I am convinced that the PRI professional staff over the years has been both busy in applied research and productive of scientific information available to everyone. That pineapple agriculture in Hawaii has had (thus far at least) a technological superiority over that in most other areas needs no debate. And my evidence of the scientific contributions of the staff is the number and range and content of papers published in the professional and technical journals by the PRI scientists, dating from those days in the early 1920's when the pineapple experiment station of the Hawaiian Pineapple Packers Association was first organized.

Proposing such evidence assumes, of course, that reviewers for papers for scientific journals, and their editors, do not accept any paper unless it does make a contribution. One could argue that this standard was not set on the early series of circulars and bulletins from the Pineapple Experiment Station. One could argue that articles for the *Pineapple Quarterly* and *Pineapple News* of former years might not have been subjected to as rigid a scrutiny as that of the journals of the national scientific societies. This view, however, is too narrow. There is a wealth of valid original scientific information on insect, fungus, and nematode ecology and taxonomy, plant morphology, identification and descriptions of pineapple fruit and plant diseases, and other material in these publications. Also, the greater latitude allowed in such papers, in the discussion of research findings, makes them in some respects more significant than the new-data-only format insisted on by today's editors of journals with more limited space.

Moreover, there are a number of papers concerned with methods of investigation. Someone will write a book one day on how much scientific discovery has awaited the development of the simple appropriate technique. The use of agar in bacteriology, the Warburg apparatus in enzyme

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[1]Plant Physiologist and Acting Director, Pineapple Research Institute of Hawaii.

chemistry, and the powerful paper and gas chromatography techniques are obvious examples.

At PRI, the devising of field plot techniques, of objective characterization of fruit quality, and of the instrumentation of field and laboratory measurements did much to reduce and codify the research data within the pineapple investigations. Some of these inventions have since been adopted or adapted for standard approaches by scientists in other fields.

But setting aside the sympathies of local reviewers and local journal series, Institute scientists have also published nearly 300 papers in the Technical Paper series, and some 50 Miscellaneous Papers. There have been over 80 in entomology, 45 in plant pathology and microbiology, almost 40 relating to nematology and soil fumigation, 60 in plant physiology, over 30 in chemistry and biochemistry, 10 in genetics, about 25 in meteorology, more than 15 in agronomy, some in engineering, and another 20 or more in botany, botanical history, and the like. In addition, two books by retired members of the Institute have been recently published: J. Lloyd Collins' *The Pineapple,* and Walter Carter's *Insects in Relation to Plant Disease.*

Dr. Carter covers in one chapter his work on mealybug wilt of pineapple. Quite apart from the very considerable accomplishment in working out a practical control of this disease, Carter's thorough description of the syndrome, and of the complex relationships of mealybug feeding, and the development and epidemiology of mealybug wilt, stands as a landmark in entomological and phytopathological lore. Equally important to the student is his insistence on the biological approach to plant virus problems, and the illustrations of it in his own work. Attempts in the laboratory to isolate and identify a virus from wilt-infected plants have not been successful, but Carter's demonstration of the disastrous effects of mass-feeding of mealybugs following transmission of the infective entity by a single bug, placed mealybug wilt in a unique category amongst virus diseases. These phenomena and that of the pineapple plant's recovery from wilt had implications both in the field control of the disease and as an example of information that would escape a researcher with the "test tube" attitude. (The expression is Carter's.)

Maurice B. Linford was equally committed to the biological viewpoint in his investigations on the yellow spot of pineapples. This virus disease is transmitted by a thrips for which pineapple plants are apparently only an incidental host. The thrips is normally found on the Flora's paintbrush *(Emilia sonchifolia),* a common composite weed in pineapple fields, and on some other hosts. Disturbance of these weeds by weed control operations causes the movement of the infective thrips to the pineapple plant. The key to control of yellow spot was control of *Emilia* before it became big enough to become diseased.

Kanjyo Sakimura's later work establishing the identity of this virus with that of tomato spotted wilt, and his extensive work in thrips taxonomy and ecology in ensuing years have been important contributions to the study of this group of insects. And indeed, the additional papers by these and Schmidt, Illingworth, and other PRI authors on the ecology and life histories of ants, beetles, and other forms, the taxonomy of symphilids, etc., have given our entomological work international recognition.

Equally stimulating and substantial contributions have been made in the fields of plant pathology, microbiology, and nematology. The careless might dismiss the granting of patents to PRI scientists for two of the three most widely used fumigants in the world as mere improvements in technology. However, to PRI workers must go a great deal of the credit for recognizing the extent of damage by two nematode species. And, moreover, in agricultural research, a scientific principle often cannot be tested because some uncontrolled factor limits the response. The practical control of nematodes has since permitted the investigation of many another set of experimental variables whose effects had been masked on plants whose root systems were under attack. I think the discovery of the effectiveness of these fumigants was a scientific advance. The ingenious methods and devices, and the improvements in standard techniques used in the study of root diseases and pathogens—window boxes, mist chambers, trap-crop, partial sterilization, and others—have also been widely adopted. Our controlled laboratory experiments with soil fungus pathogens and our field experiments with control agents have yielded information that has a wider application than the single instance. For example, the work of Anderson and others showing that root rot from *Phytophthora cinnamomi* was controlled by chloropicrin, not because of a direct effect of the fumigant on the fungus but because of the antagonism of a burgeoning population of *Trichoderma,* is a case in point. The chloropicrin fumigant apparently was effective in controlling those organisms which normally hold *Trichoderma* in check.

While on the topic of plant disease, it is interesting that pineapple root diseases are mostly related to pythiaceous fungi, and much less to the *Fusarium* and *Rhizoctonia* species held to be most important elsewhere in the tropics. Further, in contrast to other areas, our major *Pythium* offender appears to be *P. arrhenomanes,* rather than *P. debaryanum.* The moral is there for those who uncritically hold the view that these other forms are universally the most important fungus pathogens in tropical crops. They would do well to examine again the evidence in their own fields of interest.

On quite another topic, an opinion widely held by plant physiologists at one time was that plants grew better on nitrate rather than ammonium as a nitrogen source. This view derived from solution culture work, and was re-examined profitably some years ago. Here, too, PRI work provided some of the basis for this reappraisal. I refer to the work of Tam, Sideris and co-workers, Clark and co-workers, and Nightingale, comparing pineapple plant growth with the two nitrogen sources, examining the interaction of nitrogen with other plant nutrients, and demonstrating that soil fumigants inhibited nitrifying bacteria but improved the growth of the plants, in spite of the supply of ammonium nitrogen.

Nightingale is actually best known for his work on nitrogen nutrition, or carbohydrate/nitrogen balance, and for his work on the "crop log." This system of tissue analysis and measurement of growth is a device for assuring that at least the factors studied will be adjusted during plant growth. These steps provide odds that these factors will not be limiting plant growth. The principle, seemingly obvious, still awaits adaptation and adoption by agricultural scientists. Only a handful of crops are "logged" at present.

Sideris worked in microbiology, analytical chemistry, and soil science, as well as in plant physiology, and in my opinion his conclusions have a particular authority because of his familiarity with these several fields. He published most extensively in the area of mineral nutrition, and his researches on iron-nitrogen relationships especially will have a cogency for years to come.

Another area in physiology in which outstanding contributions have been made is that relating to experimental morphogenesis, and in particular to the physiology of flowering and growth regulator metabolism. The demonstration by Clark and Kerns that flowering could be induced by naphthaleneacetic acid, and the controlled production of slips by 4-chlorophenoxyacetic acid, still stands as a unique response of the pineapple, or of bromeliads at least. The subsequent series of papers by Gowing and Leeper demonstrating induction of flowering by hydroxyethylhydrazine, developing the theory of activity of growth regulators in induction of pineapple flowering, and discussing chemical structure in relation to this and other growth regulator responses, is still too new to have been widely assessed. However, it is clear that the popular view that differences between chemicals which influence growth ("auxins") are only quantitative in any response in which some are active, is untenable. Particularly in morphogenetic responses—differentiation responses—certain of them have unique and nongeneral properties. The important differences are qualitative as well as quantitative.

Gowing's theory on the reduction of the actual or effective level of indoleacetic acid (the major native auxin of the pineapple plant), as responsible for initiation of flowering in the pineapple, has found support in several experimental approaches, and in some circumstantial evidence as well. Part of this lies in the work of Gortner and colleagues on the indoleacetic acid oxidase system, its naturally-occurring stimulators and inhibitors, and the climatic conditions which affect the levels of phenolic compounds in the plant. The tissue levels of the phenolics fluctuate in ways which well could be related to natural flowering, but further work in which the connection may be tested by experiment, rather than by correlation only, is required. The relation of these results to other plants—oats, peas, beans, and barley—has yet to be investigated.

We should not fail to mention the improvements in methodology of growth regulator assay made by Gortner and Kent. The characterization of potency on which theories of activity are based is obviously critical to the validity of the theories. Miss Kent's many-fold improved sensitivities of the standard *Avena* and split-pea stem curvature tests make it obvious that other workers have been content with less than accurate data. And Young and Sideris have published a number of papers on new or improved chemical methods for growth regulators and other chemicals as well.

Several other quite different lines of scientific contributions should also be discussed, and the brevity of their consideration here is no reflection on the quality or importance of the work. Beatrice Krauss and Marion Okimoto authored a classic series on the morphology and anatomy of the plant and fruit, and it is a tribute to their thorough treatment that no one has yet had the courage to attempt a similar study of the differentiating inflorescence—desirable as this would be.

Dr. Lloyd Collins, as an avocation, collected the history of the pineapple. This comprises a chapter in his book, as well as being the subject of several scholarly papers. And the monumental work of Collins and Kerns on the cytology and genetics of the pineapple also stands unchallenged and unparalleled by current work on the plant. Not that all the pineapple genetics problems have been solved, but the span of time and amount of work that supports the published papers by Collins and Kerns appears to have discouraged others from extending this base. It may be that we do not now have the time; I suspect it is also that we lack some of the perseverance and patience of 25 years ago. They found it worth it; they determined 50 to be the correct chromosome number of *Ananas comosus,* and determined which of numerous plant and fruit characters were fixed and which were stable, and learned which to select for and which to gain by hybridization, and to recognize, develop, and confirm in pineapple material the established or tentative principles of plant breeding of the time.

Perhaps it is mostly in the reaffirmation or illustration of principles (as well as in the more thankless task of collection of data) that the merit lies in the work of the PRI meteorologists and climatologists. But I remember that I was surprised to learn that rain in Hawaii did not generally develop from freezing clouds and formation of ice crystals aloft, the way it does mostly over continental masses. Under our conditions, the nuclei for clouds are more often salt particles, raised through ocean spray and carried up by air currents. Being hygroscopic, they grow with moisture until the droplets fall and, in falling, contact other droplets and coalesce until they are big enough to become rain. This, at least, is one theory developed in some of the papers dealing with meteorological subjects. Another has to do with the formation of orographic clouds—those around the mountains. In Hawaii, these are warm clouds, and are continually being made as long as there is sufficient moisture at the lower level, a temperature inversion aloft, and even moderate air movement upward. When the moisture droplets coalesce, they return to us as rain. Depending on the humidity at the lower level, such clouds can appear "stationary," although they are constantly dissipating at one edge while forming at the other.

In summary, my thesis has been that original research of scientific importance can be and is being done under the philosophy that work be not only good, but good for something. And, moreover, that Institute scientists are conscious of their obligations to science as well as to the pineapple industry.

I must admit that there is a very great deal of additional information at PRI of significance in applied science which has not been made available in the open literature. And regrettably, there is a good deal more information of basic scientific importance which has not been published because the researcher has not had the inclination, or more often because he was too busy to stop what he was doing in order to go to the trouble of getting out a publication. PRI scientists are not unique in that respect!

To paraphrase Hogben's essay by warping his title slightly, "Science for Civilization" is not a dead-end street but an advancing frontier.

ANNUAL REPORT 1963-64

HAWAIIAN ACADEMY OF SCIENCE

The thirty-ninth year of the Academy ended with a total membership of 711. The Academy Council met four times during the year: June 19, October 2, January 16, and April 1. The minutes of these meetings are on file.

The Academy Council again approved presentation of a $35 wish award for meritorious projects entered in the Science Fair. This year, $15 went to Melvin Sakurai, Arthur Young, and Clifton Ching of Highlands Intermediate School at Pearl City, for their project on the effects of varying constituents of air on white mice. The balance, $20, went to Bessie Frantz and Christianne Friese of Stevenson Intermediate School for their project on poisonous plant juices and bacterial growth.

Robert L. Fox, Secretary

MEMBERSHIP

The following persons have been elected to membership since April of 1963: Otto Orenstein, Richard K. B. Ho, Robert M. Worth, Fred T. Johnson, Walter J. Apt, Ralph M. Beddow, James L. Brewbaker, Austin W. Cheever, Myrtle H. Nelson, Richard B. Hine, T. T. Chao.

In order to expedite the processing of membership applications, these are now circulated to the Council by mail and approval obtained in this way; ratification then follows at the regular Council meetings.

George A. Johannessen, Chairman

AAAS REPRESENTATION AND FELLOWS

In the fall, H.A.S. members who were not already members of the American Association for the Advancement of Science were provided with a booklet describing the Association, and a membership application form. It is not yet known how many new memberships resulted. The AAAS returns to affiliated state academies (such as ours) a certain amount for support of research at the secondary school level, in proportion to membership in the AAAS. In 1964, this amounted to $204.

It was hoped that the Committee would also thus develop a wider base of members from which recommendations as to AAAS Fellows could be proposed.

Shosuke Goto, Chairman

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The membership lists of the Academy have been compared with those of nine other societies in Hawaii to see how much overlap occurs. The greatest duplication was found in the rolls of Sigma Xi, with more than 120 persons being Academy members also. The Hawaiian Botanical Society lists showed overlap of 95 names, and the list of the Hawaiian Section of the American Chemical Society contained names of 61 Academy members.

In percentages, approximately 65 per cent of Sigma Xi members, 48 per cent of Botanical Society members, and 40 per cent of Chemical Society members are also members of the Hawaiian Academy. Conversely, only about 16 per cent of Hawaiian Academy members are members of Sigma Xi, 13 per cent are members of the Botanical Society, and 9 per cent are members of the Chemical Society.

There does not seem to be any immediate possibility of maintaining present levels of dissemination of information at reduced cost by combining mailing lists. However, it is clear that joint sponsorship of events by the Academy and affiliated societies, announced through the Academy mailing list, will reach a much larger group than the societies themselves provide. Moreover, it is clear that the affiliated societies represent elements of the scientific community not presently included in Academy membership.

Albert J. Bernatowicz, Chairman

CONSERVATION COUNCIL FOR HAWAII REPRESENTATIVE

Periodic reports on conservation activities in Hawaii have been made to the Academy. The Academy has been asked to act on one conservation matter, relating to future control of the Leeward Hawaiian Islands, and it is anticipated that such action will be taken at the Annual Meeting.

Charles H. Lamoureux, Representative

NOMINATIONS

The Nominating Committee presented the following slate of candidates for Academy offices during the year 1964-65:

President-Elect (one to be elected): Shosuke Goto, Richard Lee
Secretary: Robert E. Coleman
Treasurer: Eleanor S. Anderson
Councilors (2) (2 years): Nels E. Johnson, John C. Marr, Toshiyuki Nishida, Robert A. Nordyke

Additional officers for the year will be:

President: Roland W. Force
Councilors (1 year): D. Elmo Hardy, Alison Kay, Donald P. Gowing (ex officio)

Doak C. Cox, Chairman

PUBLICATIONS

During the Academy Year 1963-64, the Proceedings for the Thirty-Seventh and Thirty-Eighth Annual Meetings were completed and distributed to the membership.

O. A. Bushnell, Chairman

PUBLICITY

The activities of this committee consisted in obtaining publicity in connection with the Fall and Spring Sessions and the symposia on "Advances in Medicine" and "Controlling the Population Explosion," and in connection with the Science Fair, sponsored by the Inter-Society Science Education Council of the Academy.

James Bernard, Chairman

PROGRAM

The fall meeting of the Academy was scheduled for the evenings of November 25 and 26 at Agee Auditorium.

The first evening was postponed owing to the national day of mourning, and the second was devoted to five contributed papers.

On January 29 and 30, two symposia were held, one on "Advances in Medicine," with four speakers, and the second on "Our No. 2 Problem: Controlling the Population Explosion," with three speakers.

On February 27, the Academy co-sponsored with the Bishop Museum and the Hawaiian Botanical Society a lecture at the Museum by Dr. Kazimierz Wodzicki on "The Status of Some Exotic Vertebrates in the Ecology of New Zealand."

Both invitational and contributed papers were presented at the final session of the Annual Meeting, on April 23 and 24 at Agee Auditorium. Seven contributed papers made for a full evening on the 23rd, and a symposium on "Oceanographic Research" made the evening of the 24th particularly interesting. Five speakers participated.

At the Annual Banquet, guests of honor were Science Fair winners Stephen Ferreira and Karen Maeda, and five students whose participation in the Westinghouse Science Talent Search was particularly noteworthy. Three of these students, Judith Meyer, Trudy Ann Porter, and Judy Kimura won national honors and were awarded the ISSEC silver medal. Also, Mr. Lloyd Kawahara, winner of the Outstanding Biology Teacher Award of the National Association of Biology Teachers, was the guest of the Academy.

The Annual Banquet was held on April 25 at the Beach Club of the Hilton Hawaiian Village, and retiring President Donald P. Gowing spoke on "Urania and Agora: Scientific Contributions of Industrial Research Organization."

John M. Digman, Chairman

HAWAII DIVISION

Hawaii Division Officers for the year 1963-64 were as follows: Shuichi Tanaka, chairman; Harry Chuck, secretary-treasurer; Matthew Chow, East Hawaii coordinator; John Iwane, West Hawaii coordinator.

As of April 1, there were 62 members of the Hawaii Division.

FINANCES

Balance April 1, 1963			$ 4,589.07
Receipts:			
Dues		$1,119.50	
Miscellaneous			
For supplies and contingencies re NSF grants	$408.62		
Banquet reservations (1963)	380.00		
AAAS grantee refund	100.00		
Donation	10.00	898.62	
NSF Grant Funds		13,897.01	
ISSEC Grant Supplementary Funds		1,500.00	
First Federal Savings & Loan—interest		32.42	17,447.55
			22,036.62
Disbursements:			
Stationery, Mailing Expense		662.61	
Printing			
1961-62 Proceedings	466.39		
1962-63 Proceedings	347.76		
Programs	39.07	853.22	
Miscellaneous			
Banquet (1963)	389.27		
Haskins & Sells—1962-63 audit	50.00		
AAAS grant	70.00		
Sen Co.—file cabinet	83.63		
AAAS Academy Conference	15.58		
ISSEC—1964 Science Fair Wish Award	35.00		
Honoraria	10.00		
Flowers, gifts	18.26		
P. O. Box Rental	9.00		
Supplies	26.37		
Incidentals	26.40	733.51	
NSF Grant Expenditures		15,107.93	
ISSEC Supplementary Funds		981.07	18,338.34
Balance March 31, 1964			$ 3,698.28

Distribution of total cash balance:	
Bank of Hawaii	2,990.43
First Federal Savings & Loan	707.85
	$ 3,698.28

Distribution of funds in Bank of Hawaii:	
HAS operating funds	1,000.29
NSF grant funds	1,471.21
ISSEC supplementary funds	518.93
	$ 2,990.43

Status of NSF Grants

G-22636—Teachers Science Seminar		
Amount of grant		$ 2,900.00
Expended 1962-63		604.51
Balance on hand April 1, 1963		2,295.49
Disbursements:		
Lecture-Demonstrations	$ 351.26	
Workshop	1,213.57	
NSF refund	730.66	2,295.49
Balance March 31, 1964		—0—
G-22477—Students Science Seminar		
Amount of grant		4,222.00
Expended 1962-63		3,833.36
Balance on hand April 1, 1963		386.64
Receipts:		
Refund		25.00
		411.64
Disbursements:		
Secretarial assistance	149.55	
Office supplies	80.00	
Postage and telephone	14.09	
Instructional materials	10.00	
Travel and per diem	158.00	411.64
Balance March 31, 1964		—0—

GE-1609—Students Science Seminar

Amount of grant		4,220.00
Cash received		3,760.00
Disbursements:		
Program Director	415.00	
Associate Directors	900.00	
Secretarial Assistance	270.00	
Office supplies	10.00	
Postage and telephone	25.00	
Travel and per diem	1,753.00	3,373.00
Cash balance on hand March 31, 1964		387.00
Balance of grant		847.00

GE-1849—Visiting Scientist Program

Amount of grant		$15,065.00
Cash received		10,112.01
Disbursements:		
Associate Director	$4,050.00	
Secretarial Assistance	1,264.95	
Visiting Scientists & TV Honoraria	1,045.00	
Transportation & per diem	512.43	
TV Production costs & Moderator	253.34	
Office supplies	617.81	
Telephone	188.64	
Contingencies (overhead, FICA, etc.)	618.98	
Transportation to NSF meeting in Washington, D.C. (to be refunded by NSF)	476.65	9,027.80
Cash balance on hand March 31, 1964		1,084.21
Balance of grant		6,513.85

ISSEC funds to supplement NSF grants

Received		3,888.65
Disbursements:		
NSF refund for film library	2,388.65*	
NSF GE-1849 for secretarial assistance	981.07	3,369.72
Cash balance on hand March 31, 1964		518.93

Status of Dues Payments

	As of March 31, 1963	1964
Advance	$197.00	$129.50
Arrears	245.00	318.00

Eleanor S. Anderson, Treasurer

*This amount is recorded in general report as receipt of NSF funds, not as ISSEC supplementary funds.

OFFICERS

1963-64

Donald P. Gowing	*President*
Roland Force	*President-Elect*
Robert L. Fox	*Secretary*
Eleanor S. Anderson	*Treasurer*
Samuel D. Allison	*Councilor*
William M. Bush	*Councilor*
D. Elmo Hardy	*Councilor*
E. Alison Kay	*Councilor*
Leonard D. Tuthill	*Councilor (ex officio)*

1964-65

Roland Force	*President*
Richard K. C. Lee	*President-Elect*
Robert E. Coleman	*Secretary*
Eleanor S. Anderson	*Treasurer*
D. Elmo Hardy	*Councilor*
E. Alison Kay	*Councilor*
John C. Marr	*Councilor*
Toshio Nishida	*Councilor*
Donald P. Gowing	*Councilor (ex officio)*

INTER-SOCIETY SCIENCE EDUCATION COUNCIL

The Council has functioned during the year in keeping with its responsibility ". . . to assure the holding of annual science fairs and to coordinate and actively undertake such other activities in the field of science education as the Academy of Science and its Associated Societies may deem desirable."

The brief reports of the committee chairmen, which follow, do no more than hint at the hours of diligent effort which have made the ISSEC program useful and successful in science education in Hawaii this year. These reports will be allowed to speak for themselves.

We were disappointed not to find leadership for the Junior Academy of Science and Elementary Mathematics areas this year, and the Elementary Science Texts will await the return of Sister Mary St. Lawrence who does such excellent work with them. Moreover, the level of National Science Foundation support will be somewhat less next year, causing the loss of the position of associate director of the Visiting Scientist Program, and restriction of this activity to Oahu. In the future, requests to the NSF for grants for science education programs in the secondary schools will have to compete with similar requests from universities, museums, and the like. The NSF will be discontinuing its State Academies of Science Program, and this function will be diffused to the other divisions of the NSF. We are confident, however, that on the basis of our past accomplishments, our proposals will merit attention.

Dr. Howard Hausman, director of the NSF Program for secondary schools, visited the NSF-supported programs in an on-site inspection from April 2 to 16. He was a luncheon guest with committee chairmen on April 13, visited ISSEC headquarters and the Science Club Camp in session at the time, and was shown other ISSEC activities.

It should be also noted in this annual stock-taking that community support for, and attention to, science education continues at a very creditable level. Evidence for this is the generosity of the donors, the high interest shown by the participating individual scientists and scientific organizations, and by conversations with leaders of two newly interested organizations. One of these was with Col. D. Vanallen, of the Hawaii Council of Engineering Societies, who wished to explore the possibilities of wider engineering participation in the Science Fair. The other was with Dr. George Woollard and Admiral Thomas, both of the Hawaii Institute of Geophysics, who were interested in providing the help of the Institute staff and facilities in stimulating interest of students in the geophysical sciences.

It is also encouraging to report the growing roster of science-oriented individuals, alone and in their associations, who are willing to donate time and effort to the advancement of science education. This year, representatives of the Hawaii Science Teachers Association and the Institute of Electronics and Electrical Engineers have participated in Council meetings. Mr. Theodore Ozawa, president of the former, has taken the chairmanship of two committees and Mr. Roy Oshiro of the HSTA has taken the chairmanship of a third.

Finally, the chairman of the Council wishes to express his personal and official appreciation to the Council members, to the Society representatives and committee chairmen who have accepted and discharged their responsibilities so capably, and to the many scientists who have participated in the ISSEC programs.

Donald P. Gowing, Chairman

ORGANIZATION

Officers

Chairman .... Dr. Donald P. Gowing, PRI
Vice Chairman .... Dr. H. Wayne Hilton, HSPA
Secretary .... Miss Adrienne Kaeppler, Bishop Museum
Treasurer .... Mr. Dwight H. Lowrey, Cooke Trust

Committee Chairmen

Community Participation..........Dr. John H. Payne, HSPA
Public Relations .... Mr. James W. Bernard, Van Waters & Rogers
Budget .... Dr. Walter Steiger, U of H
Student Science Seminars .... Dr. Albert B. Carr, U of H
Science Teacher Coordination .... Mr. Edwin Y. H. Chinn, Dept. of Education
Science Talent Search .... Mr. Edwin Y. H. Chinn, Dept. of Education
Science Teacher Workshop .... Mr. Theodore Ozawa, University High School
Science Fair .... Dr. Bernard J. Winter, Queen's Hospital; Mr. Jules Fine, Plant Quar. Serv.
Visiting Scientists Program....Dr. Wallace G. Sanford, PRI; Mr. Donald Li, ISSEC HQ
Science Clubs Service .... Mr. Theodore Ozawa, University High School
Science Clubs Camps .... Mr. Theodore Ozawa, University High School

REPRESENTATIVES OF ASSOCIATED SOCIETIES

AAUW .... Dr. Leonora Bilger
Amer. Chem. Soc. .... Dr. J. Hylin
Amer. Soc. Agron. .... Dr. G. Stanford
Amer. Soc. Mech. Eng. .... Mr. Fred Cordes
Am. Stat. Assoc. .... Mr. Otto Orenstein
Anthrop. Soc. .... Mr. Robert Bowen
Eng. Assoc. of Haw. .... Mr. Paul Joy
Hawaii Med. Assoc. .... Dr. Nils Larsen
Geophysical Soc. .... Dr. Nels Johnson
Hawaii Dietetic Assoc. .... Dr. Boletha Frojen
Haw. St. Dental Assoc. .... Dr. Marilyn Bradshaw
Haw. Astron. Soc. .... Mr. Robert Britton
Haw. Entom. Soc. .... Dr. Henry Bess
Haw. Psychol. Assoc. .... Dr. Gilbert Sax
Haw. Bot. Soc. .... Dr. Robert Coleman
Inst. Food Tech. .... Dr. Lyle Allen
Soc. Naval Arch. & Mar. Engrs. .... Mr. Ian Smith
Soc. Sigma Xi .... Dr. Laurence Snyder
Inst. Electric. & Electron. Eng. .... Mr. H. E. Williamson

FINANCIAL REPORT

As in the past, the ISSEC funds were administered by the Cooke Trust Company.

Contributions (* restricted to Science Fair)

Harland Bartholomew and Associates	20.00
City Bank of Honolulu	50.00
Hawaii Medical Association (* 150.00)	250.00
First Insurance Company of Hawaii	25.00
Hawaiian Telephone Company	200.00
The Liberty Bank of Honolulu	25.00
The Medical Group	25.00
First National Bank of Hawaii	100.00
Earle M. Alexander, Ltd.	5.00
R. M. Towill Corporation	10.00
Oahu Transport Company	50.00
The Hawaiian Electric Company	200.00
Bank of Hawaii	100.00
Honolulu Gas Company	25.00
Central Pacific Bank	25.00
Lewers & Cooke, Ltd.	50.00
McInerny Foundation	1,000.00
*Frear Eleemosynary Trust	250.00
Foster Equipment Company	10.00
*Samuel N. & Mary Castle Foundation	1,000.00
Castle & Cooke	200.00
James W. Glover, Ltd.	10.00
Sears, Roebuck & Co.	50.00
Chas. & Anna Cooke Trust	250.00
G. N. Wilcox Trust	500.00
*Juliette M. Atherton Trust	1,500.00
Watumull Foundation	100.00
F. C. Atherton Trust	500.00
Rotary Club of Waikiki	150.00
*Hawaiian Sugar Planters' Association	1,198.17
*Pineapple Research Institute	1,198.17
Van Waters & Rogers Inc.	25.00
Police Officers Accommodation Fund	25.00
Lockheed Air. Serv. Honolulu Management Club	25.00
*Society of the Sigma Xi	25.00
*Geophysical Society of Hawaii	5.00
*Institute of Food Technologists	18.75
*Hawaii Psychological Society	19.00
*American Society of Agronomy	20.00
Hawaii Dietetic Association (* 25.00)	35.00
*Engineering Association of Hawaii	25.00
*Hawaiian Academy of Science	35.00
*Weed Society of Hawaii	10.00
*Hawaiian Botanical Society	25.00
*Comm. & Telephone Engineers	10.00
J. B. Castle High School (lost films)	530.00
Total Receipts	$ 9,909.09

Expenditures

Office Furnishings and fixtures	509.50
Printing & Postage	95.70
Secretary	1,500.00
Junior Academy Science Program	42.20
Science Clubs Camps	192.00

National Science Foundation (repayment)	2,388.65
Science Talent Search (1963 prog. $120.15)	162.65
Film Service to Science Clubs	835.20
Films (1963 obligation)	521.40
6th Annual Science Fair	5,012.50
7th Annual Science Fair	115.75
Total Expenditures	$11,375.55
Excess of Expenditures over receipts	$ 1,466.46
Balance March 31, 1964	$14,956.26

SCIENCE FAIR

The Seventh Hawaii Science Fair, which was viewed by approximately 20,000 people, was held in the Hilton Dome from March 20-22, 1964. It was judged to be a highly successful Fair by many viewers, science teachers, judges, and interested scientists.

There were a total of 125 exhibits present, 57 in the senior division and 68 in the intermediate division. Seventy-six of these came from Oahu schools, 15 from Kauai, 13 from Maui, 20 from Hawaii and 1 from Lanai. Seventy-two awards were given to 41 individual projects. Oahu schools received 57 of these awards, Kauai 9, Maui 4 and Hawaii 2.

These awards were given formally to the students at the Annual Awards Banquet in the Long House Saturday evening. Two hundred and eighty people attended the banquet and heard Dr. Andrew Berger of the University of Michigan Medical School deliver the major address. The two major award winners, the recipients of the Sugar award of the Hawaii Sugar Planters' Association and the Pineapple award of the Pineapple Research Institute were Karen M. Maeda of Waianae High School, Waianae, Oahu and Stephen Anthony Ferreira of Kauai High School in Lihue, Kauai. These awards, as before, consist of an expense-paid trip to the National Science Fair. At Baltimore, Stephen won a second place and Karen a fourth place.

Mr. Jules Fine, the associate director and award chairman, accompanied the winners to Baltimore, Maryland, and will be the director of the Eighth Hawaiian Science Fair next year.

B. J. Winter, M.D., Director

SCIENCE TALENT SEARCH

Three Hawaii high school seniors were selected for the Honors Group in the fifth year of participation in the nation's top science competition, the Annual Science Talent Search for Westinghouse Scholarships and Awards. Sixteen high schools in the state requested entry materials which were completed in December. To date, Hawaii's record shows one national winner and five honors students. Students were selected on the basis of a science aptitude examination, scholarship records, teacher-principal recommendations, and a 1,000 word project report. Entries are automatically entered in the Hawaii Science Talent Search for awards and recognition.

Five students were recognized by ISSEC for meritorious achievement in the Science Talent Search at the Hawaiian Academy of Science Annual Banquet. The students with national honors recognition were Judith L. Meyer and Trudy Ann Porter of Radford High School and Judy T. Kimura of Roosevelt High School. Stephen Ferreira of Kauai High School and Alan Yong of Farrington High School won state honors recognition. Awards of Handbooks of Chemistry and Physics were given and in addition ISSEC awarded medals to the three in the Westinghouse Honors Group.

Edwin Chinn, Chairman

SCIENCE TEACHERS COORDINATION

Information on various ISSEC-sponsored science education activities was disseminated to public and private schools on Oahu to promote interest and participation. These included the Science Fair, Science Talent Search, Teachers Science Workshop, and Teachers Science Seminars.

Edwin Chinn, Chairman

SEMINARS FOR SCIENCE TEACHERS

A series of presentations by scientists on six Wednesday evenings in April and May were scheduled. All programs were held at the Hawaii Institute of Geophysics auditorium, and were open to all secondary schools science teachers, grades 7-12.

The topics covered were "The Age of the Hawaiian Islands," by Dr. Lynus Barnes; "Geologic Structure and Geology of the Hawaiian Islands," by Dr. Agatin Abbott; "Basic Ideas of Geochemistry," by Dr. Murli Manghnani; "Recent Advances in Marine Geology," by Dr. Theodore Chamberlain; "Climatology and Weather Forecasting in the Hawaiian Islands," by Mr. Saul Price; "Terrestrial Life in Antarctica," by Dr. Linsley Gressitt.

Donald Li, Chairman

FILM SERVICE TO SCIENCE CLUBS

This program is carried out at the ISSEC headquarters at the Bishop Museum by the part-time secretary, Miss Charmaine Pung, under the general supervision of Mr. Donald Li.

Wide use is made of the service as shown by the statistics compiled as of March 31, 1964. There were 19 private schools and 16 public schools on Oahu that have used the library of films and filmstrips, a total of 35 schools. There were also 13 schools which used the films on the outer islands, including 2 on Maui, 6 on Kauai, and 5 on Hawaii. In addition, 8 additional organizations used the films.

This gave a total number of bookings (films and filmstrips) of 1,203 from September 4, 1963 to March 31, 1964. Since the average number of viewers per film was 130, this gave nearly 157,000 total viewers. It might be added that this total is much higher if we include viewers watching films we show on our "Science in Hawaii" TV program.

We are still receiving free bonus films and filmstrips under the EBF biology film program. It was definitely a bargain to have completed the purchase of the whole series.

A number of additional titles can be listed next year, since the Geophysical Society of Hawaii will make available films in their library for school booking also.

It is recommended that ISSEC continue support of this program by providing funds to purchase additional films in the future.

BUDGET COMMITTEE

The Budget Committee approved budget requests for 1963-64 as follows:

Seventh Annual Science Fair	$ 5,645.00
ISSEC secretary (½ time)	2,000.00

Office furniture	500.00
Films for Hawaiian Science Clubs services	810.20
NSF reimbursement for films	2,500.00
Teacher Workshop	825.00
Science clubs	397.75
Science Club Camp	231.50
Science Talent Search Awards	80.00
TOTAL	$12,989.45

W. R. Steiger, Chairman

VISITING SCIENTISTS PROGRAM

This program is designed to improve the quality of science and mathematics education in private, parochial, and public high schools by making available to them the services of experienced scientists, mathematicians, and engineers to discuss current knowledge in various disciplines. The program was started in July 1963, and is supported by a grant from the National Science Foundation.

More than 100 scientists in the community have indicated their willingness to participate in this program. As of March 31, 1964, 53 scientists visited high schools. It appears at the present time that the 100 visits allotted by the grant will be filled by the end of June 1964. Requests from high schools of the outer islands have been disappointing despite the fact the scientists are provided at no cost to the schools. As of April 1, Maui has had 13 visits, Kauai 3, and Hawaii none.

In addition, the "Science in Hawaii" TV program, which is prepared and put on weekly, has included a number of visiting scientist's lecture-demonstrations. These programs are well received, as indicated by a recent American Research Service Bureau Survey. This survey indicated that one-sixth of the homes in which television was being used were turned to "Science in Hawaii," competing at 10:30 a.m. with a Japanese TV revue on one station and films on another.

The National Science Foundation has approved a grant to continue this program for 1964-65, but the visits will be restricted to Oahu.

W. G. Sanford, Director

SCIENCE TEACHERS WORKSHOP

The Annual Workshop for Science Teachers of grades 7–12 was held at the Empire Room, Hilton Hawaiian Village, with 88 registrants, of which 23 were from the other islands. The Council provided half the plane fare for outer island participants.

The program included comparative judging of Science Fair entries with the help of Dr. Terence Rogers and Dr. Bernard Winter of the Science Fair Committee, and talks by Drs. Nixon Wilson of the Bishop Museum, and Taivo Laevastu, John D. Vaughan, and E. R. Mertz of the University of Hawaii.

Theodore Ozawa, Chairman

SCIENCE CLUBS CAMPS

Two camps are scheduled during April, with the following objectives:

1. To provide valuable learning experiences in science to supplement the students' regular school curricula.
2. To provide a meeting place where science club students from all over Oahu can become better acquainted with each other and to enhance their common interests.
3. To provide pleasant surroundings where students can combine fun with learning.
4. To provide excellent resource people in different scientific fields for science-career information.
5. To provide a meeting place for science club advisors, who can learn while renewing acquaintances with each other and with the students.

The camp for science club members of grades 9–12 is scheduled for April 10–12 at the Kokokahi YWCA Camp in Kaneohe. More than two dozen scientists will participate. The program will include eight hours of talks, demonstrations, and discussions with scientists, telescope-observing with the Hawaii Astronomical Society, and adequate opportunity for recreations.

The camp for members of grades 7 and 8 will be at Camp Homelani in Waialua, with a similar program, but including some science films.

Both programs will run from Friday evening through 3:30 p.m. Sunday afternoon.

Theodore Ozawa, Chairman

PUBLIC RELATIONS

The function of this committee is to bring to the attention of the community the activities and programs of the Academy, those of ISSEC Council being of primary concern.

The activities included the revision of the ISSEC brochure for community circulation, and newspaper coverage of the Seventh Annual Hawaiian Science Fair.

James W. Bernard, Chairman

STUDENT SCIENCE SEMINAR

During 1963-64, the Student Science Seminar program was conducted on four islands—Kauai, Oahu, Maui, and Hawaii. The program was financially supported by a grant of $4,220 from the National Science Foundation (NSF-GE1609). Associate directors were Mr. Barton Nagata (Kauai), Mr. Clifford Kekauoha (Maui), and Mr. Allan Kondo (Hawaii).

The program, in operation since March 1959, is designed to stimulate and encourage the scientific interests of selected groups of secondary school students through evening seminar meetings involving scientists, mathematicians, and engineers.

From all indications, it appears that the program continued to help challenge the talents of "science-prone" students by providing them instruction in scientific concepts, methods, and applications, offered under the regular high school curriculum.

Reactions from parents, teachers, and participating scientists have been very favorable. The highest level of praise has been from the selected student members of the various seminar groups. They receive no stipends, advanced credit, or other inducement to attend the meetings and yet, on the four islands involved, their attendance averaged about 90 per cent.

During 1963-64, about 30 high school students were members of each of the four seminar groups. Twenty-five meetings were held on Oahu and sixteen on each of the other islands.

The program will be continued in 1964-65, again supported by a NSF grant (NSF-GE4239—$6,375.00).

Albert B. Carr, Director

COMMUNITY PARTICIPATION

As of March 5, 1964, a total of $6,540.00 had been received in cash. In addition, the Hawaiian Sugar Planters' Association and the Pineapple Research Institute have agreed to finance expenses up to $1,500.00 each for travel of the two top award winners to the National Fair.

John H. Payne, Chairman

SCIENCE CLUBS COMMITTEE

The Science Clubs Committee was active again, as in previous years. The Hawaiian Science Clubs Service was discontinued because the National Science Foundation curtailed funds after June 30 of 1963. However ISSEC continued to support science club activities, relying on Miss Pung for secretarial help.

Science club advisors continued to receive the following support from ISSEC: (1) literature and recommendations for organizing and maintaining an active science club; (2) science films and filmstrips for science club meetings; (3) arrangements for visiting scientists to give presentations at science club meetings; (4) two science club camps; (5) providing science club membership cards to over 2,000 science club members in Hawaii; (6) preparation of a list of field trips available on Oahu.

Roy Oshiro, Chairman

The 39th ANNUAL MEETING 1964-65

Program

FIRST SESSION

November 25, 1963, Agee Auditorium, HSPA, Honolulu

(The Symposium scheduled for this evening was postponed because of the National Day of Mourning for President John F. Kennedy.)

November 26, 1963, Agee Auditorium, HSPA, Honolulu

1. Andrew W. Lind: A Theory of the Family in Hawaii Re-examined
2. Sidney L. Halperin and Paul G. Yessler: Prospects for Psychotherapy in the Light of Nature-Nurture Relationships in Emotional Illness
3. Arthur A. Dole and John M. Digman: Factors in Educational Choice.
4. A. Furumoto, M. Manghnani, L. Marcheski, and W. Strange: Results of Gravity Surveys on Oahu, 1963
5. Richard B. Hine: Endogenous Respiration in the Fungus Pythium Aphanidermatum.

SPECIAL SESSIONS

February 27, 1964, Bishop Museum, Honolulu

Lecture: Kazimierz Wodzicki: The Status of Some Exotic Vertebrates in the Ecology of New Zealand

January 29, 1964, Agee Auditorium, HSPA, Honolulu

Symposium: Advances in Medicine

6. Douglas Bell II: Radioisotopes in Medicine
7. Calvin Sia: Advances in Neonatology
8. Carl Mason: Advances in Cardiovascular Surgery
9. Frederick R. Shepard: Rehabilitation as an Advance in Medicine

January 30, 1964, Agee Auditorium, HSPA, Honolulu

Symposium: Our No. 2 Problem: Controlling the Population Explosion

10. Edmund R. Barmettler: Problems of Feeding a Growing Population
11. Nils P. Larsen: Does Birth Control Work?
12. Frederick K. F. Lee: Urban Planning for Tomorrow's City

FINAL SESSION

April 23, 1964, Agee Auditorium, HSPA, Honolulu

13. Augustine S. Furumoto: Field Survey of the Earthquake and Tsunami of March 27, 1964, in Alaska
14. Martin Vitousek: Geophysical Research in the Leeward Islands
15. Felicitas S. Cabbat and Bluebell R. Standal: The Determination of the Eessential Amino Acid Content of Five Hawaiian Fish by Column Chromatography on Ion-Exchange Resins
16. Herbert B. Weaver and Abe Arkoff: Measurement of Attitude Toward Sex
17. Harold E. Dent, John A. Galston, and Arthur A. Dole: Hospitalization as a Component in Social Distance
18. E. H. Bryan, Jr.: Who Knows What About Pacific Science?
19. R. Kenner and J. A. Lockhart: Studies on Plant Stem Elongation

April 24, 1964, Agee Auditorium, HSPA, Honolulu

Oceanographic Research: A Series of Invited Papers

20. Lucian M. Sprague: A New Look at an Old Ocean
21. Brian P. Rothschild: Skipjack Tuna Oceanography
22. Richard A. Barkley: Studies of Ocean Currents Near the Hawaiian Islands
23. Gunter R. Seckel: Climate Oceanography and Its Applications to the Hawaiian Skipjack Tuna
24. John J. Magnuson: Activity Patterns in Scombrids
25. E. L. Nakamura: A Method of Measuring Visual Acuity of Scombrids
26. R. M. Gooding: Observations on Fish from a Floating Observation Raft at Sea

April 25, 1964, The Beach Club, Hawaiian Village Hotel, Honolulu

Banquet
Introduction of New Officers
Presidential Address

Donald P. Gowing: Urania and Agora: Scientific Contributions of a Private Industrial Research Organization

Abstracts and Papers

FIRST SESSION

1. A Theory of Family Structure in Hawaii Re-examined

Romanzo Adams' analysis of the family structure peculiar to Hawaii, as stated in his *Interracial Marriage,* is still the most comprehensive and authoritative statement available. More than a quarter of a century has elapsed since it was published, and developments in the intervening period suggest the need of re-examination, particularly with regard to family solidarity and morale in certain ethnic groups. Analysis of official records of marriage and divorce over the 5 years 1958–62 tend in general to confirm certain of Adams' conclusions derived from comparable data in 1927. Changes in the social climate of the Islands during the past generation have, however, occasioned new developments deserving attention.

Although Adams qualified his conclusion that divorce rates are highest among the ethnic groups which outmarry the most, subsequent students have been prone to overlook the qualifications and to focus only on the major proposition. The recent data indicate that the two ethnic groups with the highest outmarriage rates—the Hawaiians and the Koreans—also have the highest divorce rates, and the Japanese with the lowest outmarriage rates also have the lowest divorce rates. The other six groups, however, vary quite considerably in the degree of correspondence between their outmarriage rates and their divorce rates. The Chinese, for example, whose record of family solidarity is second only to the Japanese, have an outmarriage rate well above the average, whereas the Caucasians, with outmarriage rates well below the average, have divorce rates considerably above average.

Contrary to the popular impression that interracial marriages always involve greater risks of failure than intraracial marriages, among five of the nine ethnic groups —the Hawaiians, Koreans, Puerto Ricans, Filipinos and the Caucasians, all with divorce rates above the average— the evidence of family breakdown was significantly less among those who had married out than among those who found their marriage mates within the ethnic group. Even among the highly organized Chinese and Japanese groups, divorce rates were slightly lower for marriages between Japanese men and Chinese women than for Japanese in-marriages, and similarly they were lower for marriage between Chinese men and Japanese women than for Chinese in-marriages. Although the divorce rate is still somewhat higher among the entire group of out-married couples than among the much larger group of in-married couples, the evidence from the present study does not suggest that the anticipated increase in the proportion of interracial marriages will of itself induce an increase in the rate of family breakdown.

ANDREW W. LIND
University of Hawaii

2. Prospects for Psychotherapy in the Light of Nature-Nurture Relationships in Emotional Illness

The view is developed that man inherits general energy potential in which genes are the catalysts in the phychological activity that substains the central nervous system without determining specific patterns of emotional behavior. The personality structure is nurtured through mimicry, identification, learning, and the impact of culture, the most subtle and critical being parental influences. A state of equilibrium is soon established between the personality structure on the one hand, and environmental stress on the other. Excessive pressure would cause disruption in this delicate balance and its physiological processes, creating states of generalized anxiety. The peculiar mechanisms of defense which would be used in dealing with anxiety, whether neurotic or psychotic in nature, would be culturally and socially determined. Partly to support this view and its implications for psychotherapy, a comparison was made between the severity of emotional distress and the degree of traumatic influences during the formative years; highly significant values are reported in a sampling of 300 cases referred to the Psychiatry Service at the U. S. Army Tripler General Hospital. The view is expressed that there is a far greater flexibility to human adjustment than a genetically and deterministically based orientation would theoretically allow. The implication for therapy is that initially and perhaps primarily therapy should be aimed at quickly restoring ego equilibrium through techniques such as support and environmental manipulation. This is especially pertinent to the treatment of emotional problems arising in the early and formative years of life.

SIDNEY L. HALPERIN
PAUL G. YESSLER
U. S. Army Tripler General Hospital

3. Factors in Emotional Choice

The factorial structure of secondary school program preference determinants was studied by means of a questionnaire, "What I Want to Do." Subjects were 300 ninth graders in Dole Intermediate School (45 items in questionnaire) and 300 boys of Japanese ancestry showing a science preference in the ninth grade (35 items).

Six factors were obtained for the Dole School group and five for the science group. These sets of factors were compared and implications for theories of educational choice and of scientific career development were reviewed.

JOHN M. DIGMAN
ARTHUR A. DOLE
University of Hawaii

4. Results of Gravity Surveys on Oahu, 1963

A gravity survey of Oahu consisting of 354 points of observation was done by the staff members of the Hawaii Institute of Geophysics during October and November, 1963. Anomalies of +300 mgals were found in Kailua centering around Kawainui Swamp and in the northern section of Lualualei Valley of the Waianae Range. A ridge of gravity highs followed the shoreline of Kaneohe Bay and extended northwesterly along the crests of the Koolau Range. Anomalies of relative low gravity were found in Waimea Bay area, Pearl Harbor and southern end of Waianae Range.

In general, gravity contour maps corresponded very well with previously published geological evidence.

An attempted interpretation of the high anomaly in Kailua resulted in a buried vertical cylinder, 7.4 km in radius, 2.8 km to the top of the cylinder, 20 km to the bottom of the cylinder and density contrast of 0.7 g/cm^3.

The gravity survey provided valuable information for the seismic program of crustal investigation, which has just been initiated.

A. FURUMOTO
M. MANGHNANI
L. MACHESKI
W. STRANGE
University of Hawaii

5. Endogenous Respiration in the Fungus, Pythium aphanidermatum

The endogenous QO_2 of mycelium of *Pythium aphanidermatum* varied from 35 to 2. Young mycelium had the highest endogenous QO_2 values. Starvation of mycelia of different ages reduced the QO_2 value to an apparent endpoint value of 2 after 5 days of starvation. Maximum QO_2 values (35) were reached in mycelia grown for short-time periods in water extracts of lima beans. The QO_2 value of young mycelium grown in chemically defined liquid media containing only essential salts and sucrose and NO_3-N as carbon and nitrogen sources approximated 13. The addition of glucose or sucrose to mycelium held under starvation conditions for 5 days resulted in a 2-3-fold increase in oxygen consumption after 1 hour. Young mycelium with high endogenous respiration rates had the greatest capacity for sporangia and zoospore production.

R. B. HINE
University of Hawaii

SPECIAL SESSIONS

6. Radioisotopes in Medicine

No abstract available.

DOUGLAS BELL, II
Honolulu, Hawaii

7. Advances in Neonatology

The term neonate means literally, newborn, and the phrase neonatal period is used to indicate the first month following birth, but for statistical purposes this period is limited to the first 28 days of life. Neonatology, then, is the study of the newborn, with emphasis on the management of the infant during this critical period of life.

To review this subject briefly, it may be interesting to note the leading causes of death in the first 14 days of life in 10,000 deliveries between 1951 though 1954 at the Chicago Lying-In Hospital. These are in the area of malformations, prematurity, and "Hyaline Membrane" disease. In Hawaii during 1962, of the total live births of 17,932, there were 369 deaths, or a death rate of 20.6 per thousand live births. Those infants that died with mention of prematurity numbered 266, or approximately 72 per cent. Again, the leading problems faced by the neonatologist lay in the area of congenital birth defects or malformations, prematurity and immaturity and infectious diseases.

Let us now look into these various areas and consider the problems and advances in them.

In the realm of infectious diseases in the newborn, one has seen many areas of dramatic advances with the advent of antibiotics. Certainly the problem of syphilis and its effect on the infant has been well controlled. Ophthalmia neonatorum, the infections of the eyes of the newborn, has been eradicated with the prophylactic use of silver nitrate or antibiotics to the eyes of the infant immediately following birth. In recent years the neonatologist has been faced with the emergence of resistant organisms causing generalized infections as illustrated by the epidemic *Staphylococcus aureus* and pathogenic *E. coli.* The occurrence of pustules or impetigo in the infant in the nursery soon led to community-wide problems of abscess, furunculosis or boils, and overwhelming staph pneumonia that often led to death in early infancy. Various reports have been made correlating family infections, morbidity, and cost based on transmission from the newborn infant on arriving home. In a similar fashion, the gram negative *E. coli* has been found to be pathogenic, causing fulminating diarrheas and often death in the small infant. There are instances where the nurseries have had to be closed because of the epidemic diarrheas present in the hospital.

It has been interesting to note that in neonatology there has been a return to basic considerations in bacteriology, its transmission and control. An interesting example in this area relates to the work done by Drs. Shinefield and Eichenwald at Cornell Medical Center. They have found that the infants tend to colonize only one phage type of *Staph aureus* once infected. Thus, they have tried to introduce non-virulent *Staph aureus* to the infants during an epidemic and thus eradicate the "hot" or virulent strain from the nursery. These investigators have also used the term "cloud baby," feeling that a small number of infants have a high index of infectivity or contagiousness and are literally surrounded by clouds of bacteria. They felt that the factor responsible for the phenomenon of "cloudiness" is itself infectious and has a distinct epidemiology of its own. This factor consists of a few respiratory viruses occasionally encountered in the nursery. Thus, we find an example of bacterial-viral interaction and the importance of the "cloud baby" in interpreting staph infections in a crowded nursery.

In 1962 in Hawaii the number of infant deaths from congenital malformations was 4.2 per 1,000. The incidence of birth defects is also considerable. With the advance of medicine, the possibility of saving newborns from previously lethal malformations has increased. These trends that characterize the efforts to save life and restore normal function of the neonate are related to (1) completeness of the first physical examination of the newborn, (2) education of nurses to be on the alert for early "give away" symptoms such as abdominal distention, grunting respirations, excessive salivation or vomiting, cyanosis, jaundice, and other such signs, (3) improved methods for earlier diagnosis of abnormal function and anomalies, and (4) early surgical correction as indicated.

There are many examples here of congenital malformations that have been diagnosed early and treated. Pediatric surgery on the newborn or premature with good pediatric management is often dramatic. Today, many infants with various causes for intestinal obstruction in infancy have been saved with early diagnosis and therapy. In the realm of congenital heart disease, corrective surgery in the infant is dramatic but very seldom successful. Performance of a shunt procedure, for instance, in cases of extreme tetralogy of fallot or tricuspid atresia may prove lifesaving, but the mortality has to be considered at least 50 per cent.

On the medical side, considerable research has been developed in the areas of inborn errors of metabolism. For example, early diagnosis and treatment is mandatory in phenylketonuria or galactosemia, where with proper management the problem of mental retardation may be prevented.

Prematurity is the area of most concern to the neonatologist. In the statistics from Kapiolani Maternity Hospital in 1963, one notes that of the total deaths, prematurity is approximately 5.5 to 7.5 per cent of all deliveries. In Hawaii this incidence may be a little higher because of the Oriental make-up. The Filipinos, for example, have smaller babies by weight. The premature infant faces four major complications: immaturity, hyaline membrane disease, atelectasis, or infection. The problem of hyaline membrane disease has been of major concern to the neonatologist. This is a condition that occurs with higher incidence in the premature infant, in the infant born of a mother with diabetes, and in the infant born of a mother following C-Section. Clinically, the infant in a few hours after delivery develops rapid respiration with marked expiratory grunts and cyanosis. The breathing remains rapid and shallow the next ensuing 24 to 36 hours varying from a rate of 60–80 or more per minute. Many develop respiratory failure and die after 1 or 2 days, while those that pass this critical period improve with no further difficulty. On autopsy on those that expire, the lungs reveal microscopically hyaline membrane lining the alveolus, thus the term hyaline membrane disease. Incidentally, this entity, which has been a baffling problem to the neonatologist for a long time, received recognition during the late President Kennedy's premature infant son's struggle and death. There are many approaches in treating its symptoms but, as yet, there are no basic understanding of its causes.

Brief mention should be made of the "iatrogenic" diseases and problems that develop in this field. We are all well aware of the problem with Thalidomide and its effect on the fetus if taken by the mother in the first trimester. However, we will not dwell on this problem. We are concerned with the development of "iatrogenic" disease in the newborn period. This has been more marked with the advent of drugs and antibiotics used during this early period of life. Jaundice or hyperbilirubinemia in the newborn period has been found to be the factor in many instances in staining of the brain cord, resulting in kernicterus and subsequently death or a brain-damaged infant. It was soon found that Gantrisin or Sulfisoxazole and Vitamin K in large doses to the infant produced hyperbilirubinemia or jaundice. Chloromphenicol or chloromycetin in recent years was noted to cause sudden collapse, shock, and death in infants on high doses. This became known as the "Gray Syndrome" and was found to be related to the inability of the infant's liver to breakdown and excrete this drug. Tetracyclines have been another antibiotic that has been correlated with staining of the teeth and bones of infants and also causing some growth retardation during the course of treatment. Streptomycin in the doses used normally on adults was noted to have some ototoxicity in later life. Thus, a new area of concern in the use of drugs developed in the care and management of the newborn. Recognition was made that the infant had physiologic handicaps in the absorption and excretion of drugs.

Briefly, one should also mention the advancement in the early recognition of jaundice in the newborn related to the Rh and ABO incompatibility problem. The introduction of the exchange transfusion has lowered the mortality and morbidity in this area. We in Honolulu are having excellent results with the management of these problems.

And finally, two of the other areas of advancement in neonatology should be mentioned. First, is the development and change in the incubator. There has been considerable work involved in selecting the proper temperature for the care of the premature infant. Concern has also been shown about the proper use of oxygen, the advisability of using humidity, and the like. Secondly, the changing concepts in feeding are illustrated by Mead Johnson's development of the Beneflex feeder. The advantages of the Beneflex are many: the formula is premade, it is sterile with no bacterial growth, there are no errors in making up the formula, there is less chance for the infant to ingest air as the plastic container collapses, and finally the psychological factor.

In summary, when Hawaii's statistics in infant mortality are compared to those of the Mainland, we can see that the care given to the neonates has been good and of a high level. As we look into the future, we find that there are many areas of research and advancement that are necessary. One of the basic problems will be in solving the causes and prevention of prematurity.

CALVIN C. J. SIA
Children's Medical Clinic

8. Advances in Cardiovascular Surgery

No abstract available.

CARL MASON
Honolulu, Hawaii

9. Rehabilitation as an Advance in Medicine

No abstract available.

FREDERICK R. SHEPARD
Rehabilitation Center of Hawaii

10. The Problem of Feeding a Growing World Population

In Retrospect

While thinking about the subject of this paper I was often struck with the idea that man is indeed a magnificent creature. He is the only one of God's many creations which would or, for that matter, could assume the splendid audacity to deliberately plan his own survival against the most strenuous task master—nature itself.

The title of this discussion is unique to the degree that it suggests a change in man's attitude, and a shift in his thinking from the problem of a growing world population to the problem of feeding a growing population. Over the last 6,000 years man has developed a vast technology in industry and agriculture; however, it has been the expedient of waging war and conquering thinly populated and rich lands rather than to feed more people from the same land. Historically, war technology has facilitated adjustment through the exploitation of underemployed resources. Usually this form of adjustment has been more rapid than agricultural technology. Yet today man must seriously weigh the possibility that war in itself no longer has this same adjustment capabilities, that in fact war may result in serious maladjustments.

It is these developments which may have been the reason for the shift in thinking that perhaps there are possibilities of feeding the world's growing population without wars. At the same time man is awakening to the realization that if he does not find the means for controlling run-a-way fertility of the human race he may indeed eat himself into extinction. Considering our present situation and our present knowledge it would certainly seem that this fear has some rationale.

Our prehistoric forebears faced a problem that in their time and place must have been every bit as overwhelming. The difficulty of feeding his family, the competition of the family for food in relation to other families within the tribe, the tribe as related to adjacent tribal development must have sharply established the boundaries of the area within which the primitive culture could develop. Certainly as the limits of the food supply were reached the tribal leaders needed to take stock in order to determine the alternatives open to them. I would suspect that often the best solutions were less than satisfactory as measured in terms of our present day humanitarian concepts. Perhaps the most that can be said for this development was that it involved short term expedients, that the same problems were bound to reoccur as newly acquired hunting areas were exploited. The problem then as now required some sort of means which would provide a more permanent solution. What must have evolved, over time, in our primitive culture was the development of more intensive resource use. This was probably in the form of a primitive agriculture. This example is relevant to the degree that it points out that our primitive forebear adjusted not only in his normal pattern of nomadic migration as a gleaner from nature but that he was forced to recognize that the productivity of nature could be made more bountiful. The alternative of the nomadic tribal structure was to fight other tribes on richer grazing lands. Today the specter of atomic war forces us to consider the feeding of people from existing land resources.

One of the discouraging concepts found in the literature deals with equating food requirements to some sort of minimum standard. Both economists and technical scientists more or less adhere to this idea. The idea probably found its greatest voice in two economists, namely T. R. Malthus and David Richardo. It is also the fundamental thinking of such world organizations as FAO and WHO. The minimum standard idea is an important concept in that it provides the foundation for quantification. It is based upon the realization that most resources under the existing control of man are scarce.

Malthus conceived that as population increased there would also be more productive power in new hands and minds but at the same time these would demand more food, that ultimately the rate of food demand from the increasing population would outstrip the marginal productivity of the static resource land. From this rather complex concept David Richardo evolved the "Law of Diminishing Returns." Richardo's concept gave further strength to the fears expounded by Malthus.

The difficulty in dealing with the scarcity models developed by both Malthus and Richardo is that they do not or cannot allow for the sensitivity to his condition that man as a rational being must ultimately possess. It is adequate to say that over a very long but finite period any significant and constant population growth will present society with food production problems. The seriousness or degree of complexity of this problem will depend upon the real rate of population growth as compared to the rate at which man innovates. To us here, who must deal with the question of food adequacy for a considerably shorter time period—say over the next 100 years—the rate of growth in both population and innovational technology (resource productivity) are critical. To perceive within this time period seems possible; periods much longer than these would require considerations of important variables which are not part of our present topic.

In Future Growth

If we base our future demands upon some preconceived minima, and if we project a constant rate of population growth the problem of feeding future generations lends itself to a very neat mathematical equation which will tell us how much food we will need over time. This could be the basis for determining the urgency with which man must devote himself to the problem of increasing his productivity and controlling his rate of consumption. In reality man has always found it difficult to look very far into the future. He is mostly concerned with today, rather than the seemingly dismal specter which is indicated for the future from today's knowledge. For indeed most of today's knowledge is not adequate to meet the dimensions of tomorrow's demands.

The twofold problem—increasing productivity of available resources and the rate of demands made upon known resources—will probably continue to be the basis from which man must operate in order to equate supply to demand. In terms of increasing productivity, there are advances already made which will continue to add to the demand-satisfying potential of world food users. Others I shall talk about may be in the realm of speculation and perhaps wishful thinking.

Meeting Increasing Food Needs

As an economist I am perhaps naturally inclined to look at our problem from a rather broad cause and effect point of view. I tend to depend upon my discipline to give me the necessary tools to look at existing conditions and from this develop my analysis of what I think the future may look like as well as what conditions may be necessary to solve a particular human problem.

Natural Resources: The real foundation of future food as well as industrial productivity are our natural resources. These along with our scientific technology, arts, capital goods, and, most of all, our people and their institutions will shape the nature of things to come. The presently known natural resources are substantially fixed in quantity and as these are not replenishable and as we use them we are in fact faced with the real dilemma of finding alternatives.

The natural resources difficulty, which is after all related directly to food production in our modern world, will perhaps be solved through the employment of improved extractive technology and through the application of new discoveries. For example, we have yet to explore the seas as a source of minerals and of power. Similarly we have yet to explore fully the real potential of solar energy as a power source. These alternatives probably will not come into play until such time as existing sources for this vital ingredient to food production are depleted to a point where it can be economically practical to develop the presently more marginal sources.

A factor to which a considerable amount of attention has been paid historically is the natural resource land. We know that land is limited to both amount and productivity under prevailing technology. Insofar as productivity is concerned and in relation to world food demands it is obvious that much of this resource is not fully exploited. Agricultural techniques are not sufficiently applied to buy the productivity necessary to catch up with population expansion. Many reasons could probably be cited for this inadequacy; however, it suffices to say here that the race between food supply and population can be overcome for some considerable time by simply farming the available area under conditions of known agricultural technology. In many parts of the world the existing structure of subsistance farming simply is underemployment of food producing resources. Presumably when and if pressures of population become sufficient these would be bid into production of food demanders along with other land resources not fully exploited. In the latter instance are all of those lands upon the face of the earth that could produce food but are not bid into production because of the low purchasing power of the masses in the so-called underdeveloped countries.

The land resources presently underemployed for whatever reason of technology, scale of operation or institutional barriers within the underdeveloped area, are not easily brought into productivity. Often the leadership within these areas see a solution to their plight through some sort of resource mobility from agriculture to industrialization, but too often the cost of this mobility is exceedingly stringent in that it would and does require heavy investment in capital accumulation. Usually, at least in recent history, these countries have depended upon foreign aid from more prosperous countries. The problem has been that although this foreign aid in agriculture has brought considerable advances in some areas more often it is offset by the rate of population growth. In these latter instances the countries so involved have more or less remained at the subsistance or minimal level and possibly regressed even further into poverty. In any case greater intensity of land use will probably remain a major factor in staving off hunger over the relevant time period. It is also probable that there will remain inequities insofar as distribution is concerned from greater (more intensive) use of land. Some of the peoples of presently underdeveloped areas will probably continue to live on the margin of poverty as for that matter perhaps whole nations for the reasons cited above.

Productive Capital Goods: One of the reasons for advances in present food production efficiency must to a large measure be the result of the American farmers' ability to accumulate capital goods by which innovational techniques (new technology) could be employed. Man without proper tools has historically been able to provide bare minimal amounts of food for himself and that only if he had access to the essential ingredient land. Under minimal survival conditions very little potential existed or exists with which future productivity could be enhanced. Savings for future productive potential may need to come from a different direction than from internal capital generation by agriculture in those areas classified as underdeveloped or for that matter any area. The North American farmer's ability to accumulate capital was greatly enhanced by early land policy, when land was given to immigrants at little or no cost. Low capital investment (requirement) in land and large units 160 acres or more encouraged U. S. and Canadian farmers to adopt labor saving technology. Perhaps even more important than the above was that the North American farmer had the drive to do things more efficiently.

At this point we could discuss at length such issues as land reform, incentives to save, as well as a variety of other important contributory factors to increasing the productivity potential within underveloped areas. A more productive and perhaps a more essential line of reasoning is if we involve ourselves with some of the other factors. It may be adequate to say that food aid, technical assistance programs, and financial aid can all help in contributing to interim solutions. However, at best these are only temporary measures and will probably be offset by the constant pressure of population which may in itself be generated from the aid given. In the long run (within the framework of our time period) a more realistic means may be through self-help measures which are internally motivated.

Research and Technology: Included as a potential solution to the problem of food productivity must be the continued contribution being made in research and through technological innovation. It seems to me that this whole area we call agriculture has, at least for the more advanced countries, taken on a completely different attitude. The concept of food and fiber production is no longer simply a function of the tiller of the soil and the husbandman of livestock but a whole industrial complex of which these are only an integral part. Technology must be considered not only from the point of view of new farming techniques but also those involving food processing, preservation, transportation, and merchandising, and in recent times in the actual synthesis of essential food elements such as vitamins and certain amino acids. The chemist, physicist, and engineer have provided importantly to the means of increasing productivity. In those areas where actual synthesis has taken place these can and do release land and other resources for the production of food to feed an increasing population. To be practical there is no good reason why the wonders of chemistry should not ultimately yield the techniques to produce a great variety of nutrients more cheaply than now provided through the medium of plant and animal tissues.

In terms of technology and in addition to what I have already said about technology before, there are many areas of food potential in the world where technological innovations have had little or no impact—not only in backward nations but also with the more advanced nations of the United States, Canada, and countries in Europe. In this latter instance we can point to the sea that surrounds us—here we are still in the stone age of development—only about 1 percent of man's food supply is harvested from this source. Yet the sea is composed of a greater portion of the earth's surface. It may perhaps be the greatest source of future food supplies. Here the conditions are similar to those faced by the primitive man and early farmers—it is generally a hostile environment that we have yet to tame. Again, the progress in evolving a food culture from the sea will need science, including its many disciplines to give us suitable development.

The important difficulty in developing these resource potentials it seems to me are not limited in our present and future science but more within the ability of society to cope with the complexity of these changes. Taken all together these concepts are capable of advancing the cause of society's food requirements only to the degree by which society can accommodate these in practice. For all practical purposes one might suggest that man has built in resistance to change, and that perhaps he would sometimes prefer to starve a little rather than to incorporate new values in place of old traditions. I am not at all sure that people the world over are really equally capable of adjusting to new requirements as dictated for adjusting within his natural and physical environment.

That we have turned to science for solutions under our western culture may in part be the result of some unique motivational force. Perhaps our traditions are more easily bent to new demands and conditions or perhaps our system of incentives are based upon a different system of rewards. We do know that there is a revolution afoot the world over for improvement in all sorts of things from more adequate nutrition to greater expression in political self determination. The world is going through a period of rising expectations if our news media and leaders are to be believed.

If for the moment we could assume that the potential exists for greatly increasing our food supply, as might be the result of improving technology and increased scientific productivity, then we could address ourselves to the final issues of this paper which is the rate of adaptation of these solutions to population growth rate. Can, for example, the exceedingly productive capacity of U. S. agriculture and its related productive science be replicated in the less developed areas of the world? Or, for that matter, can U. S. technology maintain the forward momentum to maintain a continuing high productivity over the relevant time period to meet not only our own but also stimulate development in other world areas?

Successful and rapid development in U. S. agriculture has been attributed to three major factors by the Iowa State University Center for Agricultural and Economic Adjustment.

(1) The public subsidization of agricultural research and education to increase the supply and lower the real cost of information for technological improvement;

(2) Public participation in enlarging the supply and lowering the real cost of land and credit;

(3) Investment by private industry in research and organization to produce and distribute capital items of new technology at a low real price to farmers.

The problem of replicating advances, such as have developed in the United States over the last several generations, in countries suffering lags in food production are difficult because of some reasons cited earlier in this paper. Perhaps in addition to those problems already cited must be the real difficulty of communicating technological innovation to the potential participants of development. In essence, can the attitude of participants be molded to respond in such a way that adjustment will take active shape? Will, for example, the holder of land and labor resources be willing or able to make the changes research and technology show to be productivity increasing? These, the important decision making properties, can and often are limited by custom, tradition or simply because of an institutional framework which acts as a drag on change. In the area of credit, for example, the money lenders are often more interested in high interest rates than in higher productivity. This, under existing arrangements is not so important in the USA for example, but significant in underdeveloped areas.

The sluggishness in which these necessary adjustments can be made in certain environments permeate the whole socio-economic structure including both the public and private sectors. This contention could be supported from numerous examples where technical aid programs have been tried with much less than the hoped for success. Many times some of these efforts have been diverted to other purposes rather than to effectuate improvements in the productive efficiency of the region participating in programs specifically organized for improvement.

The sluggishness discussed above had another and perhaps more basic relationship to the nature and potential for change. For example, what if productivity can in effect be changed to where biological gains are realized as against a situation where technology simply displaces labor for which there may be no alternative employment? In some situations the marginal cost for labor may be very low in terms of alternative opportunities, in fact so low that the factor substitutions (technology) cannot effectively displace labor. Even considering that productivity could be increased it does not necessarily mean that producers would be better off to substitute machinery for labor—the increased marginal cost may more than offset gains. The problem then takes on a new dimension. Some way must be developed by which these underemployed resources in areas of very great population such as India, China and Indonesia can be mobilized into a situation which could bid them away from agriculture. This takes on magnificent proportions. The elasticity for labor outside of agriculture is such that transition is just not great enough to bring about the required change or innovational potential from a purely quantity point of view. The growth must somehow be such that it can be spread over existing populations in the form of greater buying power for better nutrition, more vitality, or to postpone consumption through the medium of greater capital accumulation at the agricultural and alternative industrial sectors of these economies. There must be some sort of arrangement of the factors to where effective demand can bring change into play. Anything short of this is manifested in poverty, the basic cause of hunger, and unfortunately this can continue to exist despite the world's potential to meet present and probably all future food requirements in our time periods.

I expect that the idea of continued poverty or hunger for a large share of the world population is contrary to most of our humanitarian feelings, and perhaps rightly so. Yet at least to me it seems that the job of the physical and natural sciences to overcome the many and varied difficulties within the world is expecting more than can be done by science alone. It will perhaps require great effort to overcome the educational, economical, traditional, cultural, and political barriers which stand at the doorway of adequate development. These perhaps more than the sciences are the limitations to adequate nutrition even though the sciences may have the technical solutions now and in the future.

EDMUND R. BARMETTLER
University of Hawaii

II. Birth Control in Full

The question to be answered is, can our present knowledge about birth control get into the hands for use by enough humans to stop the alarming upsurge before this rising tide of humanity overwhelms us and destroys all progress in economics, culture, and health. That this is a very important world problem is indicated by the fact that the president of the National Academy of Science recently issued the following statement.

"The problem of uncontrolled population quickly emerges as one of the most critical issues of our time since it influences the welfare and happiness of the world's citizens. It commands the attention of every nation and society: the problem is not less grave for the technically advanced nations than for the less developed.

"If we are to meet this challenge, we must make use of the knowledge that science and technology can bring to bear on the social, cultural and bio-chemical questions involved.

"I hope that this report of the Committee on Science and Public Policy of the National Academy of Science will serve as a stimulus to thought and action. It is addressed not only to the other scientists but to people generally, since all must bear the ultimate responsibility."

A few of the cold facts on the rising population tide might be in order. It took from the dawn of history to the year 1830 before humans reached the 1 billion mark. The next 100 years saw the tide rise to 2 billion, another 31 years brought the count to 3 billion, and by the year 2000 (36 years from now) at our present rate we will have between 6 and 7 billion people living on the globe, and if we continue to 2070, 25 billion people will be scrambling for their crust of bread or killing each other to attain it.

Asia at present has 1.8 billion (56%) of the world's population. The Americas have 441 million (14%), Europe, excluding Russia, 437 million (14%), Africa 272 million (8.5%), Russia 225 million (7%). Only 35% of the nations keep accurate census figures, hence many figures given are estimates by a United Nations formula.

On examining birth rates we find an amazing variation. The world rate is put at 36 babies born per 1000 population per year. The rate in Europe is 19, United States and Canada is 25, Africa 47, South East Asia 48. The fertility rate in the developing countries is twice that of the rates in the economically advanced countries.

A few figures from a United Nations report on the variation of the increase percentage of population gives further emphasis on our present situation. The United Kingdom increase is 0.4% per year. Italy 0.6%, Sweden 0.7%, Japan 1.1%, United States 1.7%, India 2%, Brazil 3.6%. With such rates it is evident that the proportion of the world's population will change dramatically. The United Nations assumption is, Asia's share will increase from 55.2% in 1950 to 61.8% in 2000. Latin America from 6.5% to 9.4%. Europe's share (including Russia) would decline from 23% to 15.1%, North America would drop from 6.7% to 5%. The United Nation's report put this dilemma thus: "The growth of the world population during the next 25 years, therefore, has an importance which transcends economic and social considerations. It is at the very heart of the problem of our existence."

Just a few more statistics to emphasize the urgency of our situation. Central America will increase by the year 2000 by 320%, South America by 252%, Asia by 180%, Russia by 109%, United States and Canada by 86% and Europe by 44%. The South American countries will double their population in 23 years, whereas it will take the United States and Canada 38 years to double theirs. Our next door neighbor, Mexico, during the next 20 years will expand its present 35 million to 70 million.

Since at the present time two thirds of the human family goes to bed hungry each night, how many more will be hungry with a 100% more mouths to feed. The best possible estimates on maximum increase in food production is 15%. Prof. Borgstrom who has made a world wide study of this problem also says, "We must realistically recognize that we are faced with an enormous shortage of soils, water, forests, minerals and other vital resources." The U. S. Soils Conservation Committee wrote, "food production would have to be doubled to provide adequate diets for the present population." And, "to feed one year's world's increment of people now requires a yield equivalent to that of 47 million acres. The limit on cropland resources of the planet could be reached well before the century ends." Our Ambassador to the United Nations, T. P. Plimpten, summed it up: "Immense progress is being made in the field of production, but it is being wiped out by the velocity of reproduction." At present rates, therefore, "the best that can be promised to the vast majority (if not to all the people) will be more starvation and more poverty." But also, among the growing millions of India, Egypt, Pakistan and the Latin American states, 70 to 80% cannot read or write, "and these billions are not only hungry . . . they are largely uneducated "masses" of hungry illiterate young men and women who will unthinkingly accept any leadership that promises them improved conditions."

The Catholic Church has also awakened to the seriousness of the problem. Rev. John A. O'Brien writing in *Ave Maria* (a National Catholic Publication) wrote in August of 1963, "How are we to deal effectively with the problem of population increasing with a speed unprecedented in history. It is especially acute in the undeveloped countries. . . . Contrary to widespread belief, the Catholic Church does not forbid birth regulation. . . . Catholics in the United States have been oversold on procreation and undereducated on the responsibilities it entails . . . indiscriminate procreation is no moral ideal but mere irresponsibility. . . . No country can long make reasonable provision for its population increase unless a good percent of its couples take some effective steps to regulate family size . . . family size is determined by conditions of health and well being for the individual family and for society." Pope Pius XII stated the position of the Roman Catholic Church as: "Regulation of offspring . . . is compatible with the law of God."

Sir Julian Huxley summed it up as, "We need a positive population policy for the world . . . such a policy will be in the highest degree moral in stressing the wickedness of allowing future generations to be born in increasing misery." The historian Toynbee has given many warnings about this great danger and a proclamation issued by a group of 25 U.S. leaders and 19 Nobel Laureates declared: "The urgent, indisputable need today is for intensified action to decelerate world population growth." Surely these facts and comments would seem sufficient to motivate us to want to do something to help prevent the approaching cataclysm, and this real threat to world peace.

Do we have evidence that this tide can be held back? Since the world largely mastered "death control," which is the cause of this sudden great upsurge, our aim must be toward birth control, to bring the number of people on earth to a level that allows them to be properly fed and housed.

Japan has cut its birth rate in half since the government stepped in after realizing that its very existence was at stake. Japan pays its 153,000 midwives to teach birth control. Abortions are allowed without restrictions. It is estimated that there is one abortion for each birth. Japan has journals and organizations and 900 clinics teaching the necessity of population limitation. "For the first time in years, there actually were empty seats in the lower grades of schoolrooms in Japan." In Japan birth control did work and the birth rate was lowered by 50%.

India is trying hard to keep its expanding population down to its ability to feed it. The Ambassador from India, M. C. Chagla, reported "We are one of the few countries in the world which has officially at government level adopted the policy of birth control and family planning. . . . But the task of spreading the gospel of birth control is a Herculean one and we have only made a beginning. Although the first birth control clinic was opened in India in 1925, today (1960) we have only about 2,500 clinics (by 1965 there will be 8,000) giving family planning advice and giving free contraceptives. We have earmarked the sum of $200,000,000 in our third five year plan. What we want to achieve is to cut down our present birth rate by at least ½. In Oct., 1961, at a government vasectomy camp, 3,000 men were sterilized." Since then one camp reported 7000 vasectomies. The government pays 30 rupees to each indigent parent who has 3 children if he undergoes sterilization operation. India is cutting its birth rate.

The Chinese hordes will be an increasing danger to the stability of the world. At the present time, due to food shortages, lack of consumer goods, falling living standards, excess of city populations and maladministration, China has begun another birth control movement with the slogan, "Reproduction must take second place to production." They have announced that no man should be a father until he is 26 years old and no woman a mother until she is 23. However, China's mainland population is increasing at a rate of 2%, or over 12 million a year.

France, in spite of being a Catholic country and with very stringent laws against birth regulations and abortions, has lowered its rate dramatically and "French writers saw evidence of France's most advanced civilization and well being in her slow population growth." It is estimated that they have one abortion to each birth.

In Sweden, a government board is appointed to study each case requesting an abortion. Sweden's birth rate is down to 1% with the world rate at 36.

Puerto Rico established one of the most extensive publicly sponsored birth control progress in spite of violent opposition by the church. They proved birth control pills can be effective. The people accepted the small family ideal. Compare this with the Assam (English) tea estates where for each 1,000 people another 30 is added each year, while in England the addition is only 5.

The Population Council recently published a "Study in Family Planning" which adds an encouraging note to our discussion, i.e., "a growing number of countries throughout the world are coming to recognize the impact of population pressures on economic and social development . . . between Nov. 1962 and April 1963, The Population Council sponsored three country missions to Korea, Tunisia and Turkey . . . to advise with government officers on the appropriate ways to proceed."

In Korea, which shows a 3% increase annually, the government is attacking the problem with vigor. They believe the problem of publicity and education are as important as the other aspects of the family planning program. Korea has given high priority to the program of population control with the objective of halfing their annual population increase by 1980.

In Tunisia the proposed family planning program is a joint endeavor of the Ford Foundation, The Population Council, and the Tunisian Government.

Turkey, where the government realized that its 3% annual increase will expand its 30 million people to 60 million by 1986, recognizes that such growth will defeat its efforts toward national development. They recognize that to attain a joint planning policy will involve a coordinating committee of responsible members from the ministries of Health, Education, Agriculture, Interior, Defense, Labor, Broadcasting, Finance and the State Planning Officer. Turkey's goal is to attain a decline of 10% in fertility every five years. They realize they must learn the most appropriate methods of communicating information on family planning to the people as well as the problem of distributing supplies. This is quite remarkable since until recently the giving out of birth control information was illegal in Turkey.

In Ceylon there is a Sweden-Ceylon Family Planning Pilot Project costing Sweden $145,000 a year. Sweden has decided to use practically all funds voted for foreign aid into channels for birth controls. In Ceylon's most intelligent pilot center the birth rate has lowered to 22% and 72% of the "producing families" indicated an interest in receiving information. In a second group only 62% indicated an interest. The latter literacy rate was 47% as against 86% for the first group. The increase of population in Ceylon is 2½% per year with a birth rate of about 40. In the first group the average age of marriage was 22.1 years whereas in the second group the average age at marriage was 15.7.

The United States figures are interesting. In 1790, the average family had 5.7 persons. This fell to 4.6 in 1900 and 3.5 in 1950. Since then, there has been a rise in 1960 to 3.7. Hawaii has the dubious distinction of having the fewest families with no children and more families with 3 or more children than any other state in the Union. However, in the United States contraceptives are widely available (except in Conn. and Mass.). Magazines and newspapers have many articles, and there are some 74 publications on the subject. There are 160 family planning clinics and most doctors from their offices help their mothers to stay solvent. In spite of this, there are an estimated 1,000,000 abortions, with 260 deaths and 200,000 illegitimate babies born each year. However, to indicate we are advancing, the 88th Senate was brought up to date on this subject by Senator J. S. Clark, who said, "Mr. President I now speak on the topic 'The Time has Come to Speak out on the Problem of Population Control.' The time has come to speak out in the Congress of the United States on the controversial subject of population control. The time has come to speak out in the congress to give serious study to the writings and speeches of Dr. John Rock, whose book *The Time Has Come* is sub-titled *A Catholic Doctor's Proposals to End the Battle Over Birth Control."* Wm. Draper said, "It can be done! Puerto Rico—along with France, Ireland and Italy, in the past—proved that even Catholic countries can curtail their population growth."

Perhaps it is not too late. The methods at present in use, if applied, are effective. Sterilization does work. The birth control pill does work but is expensive and has some disturbing side reactions, mechanical contraceptives and foam powders are quite effective but not acceptable to everyone, the rhythm method is used by all staunch Catholics and works if all the circumstances, difficult to evaluate, are right. Intrauterine devices have been used quite widely and are effective. At present, two plastic devices—a loop and a coil—are being used experimentally. They have been used in thousands of cases without side reactions and with a high percentage success. It is cheap and the woman can forget about fear of pregnancy for six months to a year when the device is painlessly changed. We have five sets of trials going on in Hawaii and already 200 of these plastic devices have been distributed. However, many research laboratories are working on perfecting something that will be acceptable to every one and be cheap, easy to apply, effective and safe. Progress is being made.

Our subject I think has been answered, namely birth control, does work if we apply known methods properly. The real question must remain, can it be applied extensively enough to save the world from an unprecedented disaster? This will take intensive education to create motivation in the great masses of people in the undeveloped countries whose rapid birth rate is keeping the majority of the citizens in these countries in a continuous state of malnutrition and poverty.

Or will it be that in the not too distant future, we will believe as the Greeks did long ago, namely that birth control, practiced by all their leading groups, was the cause for the decline of their country? As we pour more and more of our money into the countries south of us, we merely continue and increase the poverty and malnutrition of the new thousands because they continue to breed so fast, that they will almost double their numbers in half the number of years that it will take us to double ours. What can possibly be the outcome but tragedy? Without a world policy, birth control as it is today practiced can well be the path of the destruction of ours and of European civilization. The rising tide of ignorance, poverty and starvation, today is a reality. In a brochure written as a world tribute to Margaret Sanger, entitled "And Now, The Challenge Is Not Just A Better Life, But for Life Itself," is written: "This population explosion then, may be a more dangerous threat to peace and freedom than the nuclear arms and guided missiles stockpiled by nations. It's that simple."

NILS P. LARSEN
Honolulu, Hawaii

12. Urban Planning for Tomorrow's City

No abstract available.

FREDERICK K. F. LEE
City and County of Honolulu

FINAL SESSION

13. Field Survey of the Earthquake and Tsunami of March 27, 1964, in Alaska

The tsunami and after effects associated with the Alaskan earthquake were studied in the earthquake region by an international team of investigators with the support of the U.S.-Japan Cooperative Program for scientific investigations of the Pacific.

Two sorts of tsunamis appear to have been generated:

1) Local tsunamis resulting from slumping of deltas, such as tsunamis that washed on shores within minutes after the quake and caused serious damage at Valdez, Seeward, and Chenega;
2) a general tsunami, resulting from widespread tectonic displacements of the sea floor.

The shores of Prince William Sound have been elevated to a maximum estimated at 20 feet at Montague Island. The shores of Kenai Peninsula and Afognak and Kodiak islands have subsided to a maximum of about 6 feet. Directional characteristics of tsunami propagata in the Pacific may be related to the dipolar nature of the initiating displacement.

AUGUSTINE S. FURUMOTO
University of Hawaii

14. Geophysical Research in the Leeward Islands

A description of the physical features of a number of the Islands (Nehoa, Necker, French Frigate Shoal, Laysan, Kure), illustrated by colored slides, and a brief discussion of past and proposed research projects were presented.

MARTIN VITOUSEK
University of Hawaii

15. The Determination of the Essential Amino Acid Content of Five Hawaii Fish by Column Chromatography on Ion-Exchange Resin

Ahi, aku, mahimahi, ulua, and tako are popular food fish in the Hawaiian Islands and all the tropical areas. Ahi is the yellow-fin tuna, aku is the ocean bonito or skipjack, mahimahi is the common dolphin or mansaku, ulua is the adult papio, and tako is the octopus. Depending on the nationality, the above mentioned fish are consumed raw, salted, salted mixed with tomatoes or seaweeds, marinated, smoked, fried, baked, steamed, steamed in cordyline leaves, as fish cakes in soups, as appetizers, and as in-between meal snacks.

Fish constitutes an important part in the diet of the people of Hawaii. The 1963 recorded catch of fish for the State of Hawaii was 658,418 metric tons valued around 3 million dollars and was used mostly for food. A knowledge of the composition of the essential amino acids in the fish is basic to the definition of the quality of protein in the fish for food material.

The data obtained showed that the fish studies are good sources of protein judging from the composition of the amino acids. The pattern of essential amino acids was favorable and comparable to the proportions in the FAO "Provisional Pattern" and in the whole egg. Thus fish could supply sufficient protein of good quality for human requirement, especially in the underdeveloped areas of the world.

FELICITAO S. CABBAT
BLUEBELL R. STANDAL
University of Hawaii

16. Measurement of Attitude Toward Sex

Approximately 260,000 babies are born each day, with a net world population increase estimated at 100,000 daily. At the beginning of 1960 the world's population stood at 2.8 billion; within 36 years from now, in the year 2000, it will be somewhere between 6 and 7 billion as predicted by U.N. expert, or an increase of much more than two-fold. This so-called population "explosion" is widely regarded as ominous, and there is a clear implication that something must or should be done about it.

Before much of anything can be done, it is necessary to have measuring tools for assessing the attitudes of various social groups and peoples (national, ethnic, religious, community, and others) on such matters as contraception, abortion, and sex. Investigation of the literature showed an almost complete absence of means of measuring attitudes toward these socially significant topics. The authors have therefore undertaken to construct attitude scales of the Likert type, relatively precision instruments, as a first step, to provide the needed tools for further substantive research and possible social action. The scale reported is the basic one concerned with measuring attitude toward sex.

A pool of 142 statements covering a wide range of sexual behavior was administered to 176 subjects. Each of these items was scored on a five-point scale depending on the strength of agreement or disagreement expressed by the individual. A total score on all the items was obtained for each individual, and the highest 10% and lowest 10% of subjects were identified to serve as criterion groups, representing the most liberal and the most conservative subjects respectively. The mean difference between these groups was computed for each item, and the 60 items with the highest mean differences were selected and arranged into two equivalent forms of 30 statements each. No item used had a mean difference of less than 2.06. One or more items dealing with each of the following appear on each form: sex jokes, prostitution, cultural sexual values, abortion, sexual enjoyment, extra-marital intercourse, marital intercourse, pre-marital intercourse, adultery, censorship, pornography, homosexuality, masturbation, sex act freedom, sex parties, virginity, contraception, sexual standards, unusual sex practices, miscellaneous. Inter-form reliability was determined on two independent groups, yielding reliability coefficients of 0.97 and 0.95 respectively, with a combined-form reliability coefficient of 0.98.

HERBERT B. WEAVER
ABE ARKOFF
University of Hawaii

17. Hospitalization as a Component in Social Distance

If attitudes toward others are considered multidimensional, the knowledge that a person has been discharged from a mental hospital can be compared with other determinants of social distance. This pilot study was primarily concerned with the relative influence of mental health status, ethnic origin, competence and understanding of others upon social acceptance among students with diverse ethnic backgrounds living in a highly tolerant American city. Secondary objectives were, for this distinctive population, to investigate the relationship of national origin to social distance and to verify a number of theoretical constructions in respect to prejudice suggested by Triandis and Triandis (1960).

Subjects were 127 male and female students enrolled in an upper-division psychology course at a land-grant university. From this group 29 Caucasian Americans were matched with 29 Japanese Americans.

A nine-step Social Distance Scale similar to Triandis and Triandis' (1960) modification of the Bogardus was constructed. Evidence of internal consistency, scale interval values, and subject cooperation was obtained.

Following Rickard, Triandis and Patterson's (1963) study of employer attitudes toward disabilities, two levels of the four components were presented randomly in all possible combinations. S's rated each of the 16 stimulus persons for each social distance step on a five-point scale. Total social distance scores for each stimulus person and for each S yielded data which were analyzed by parametric techniques.

Competence, understanding of others, and race contributed more to the total variance than mental health status. The social distance scores of the American Caucasians were substantially similar to the American Japanese.

Rehabilitation specialists might fruitfully emphasize personal traits and cultural characteristics in helping discharged mental hospital patients to gain the acceptance of educated ethnically diverse persons. In general, the theoretical constructions of Triandis and Triandis were confirmed.

HAROLD E. DENT
JOHN E. GASTON
ARTHUR A. DOLE
University of Hawaii

18. Who Knows What About Pacific Science?

One of the projects of the Pacific Scientific Information Center at B.P. Bishop Museum, now four years old, has been to record the names and addresses of experts and their specialties in various lines of scientific investigation concerning the Pacific area. These include some 500 anthropologists, 1,500 botanists, and 2,000 entomologists. Many of these persons have attended congresses of the Pacific Science Association. An increasing number are employed by the administrations of the Pacific islands territories, especially in the fields of health, social development, and such phases of economic development as agriculture, forestry, fisheries, and minerals (where the geology warrants). These have been assisted materially by the South Pacific Commission. Meteorology has developed in response to the spread of air traffic. Geophysics has been advanced by the IGY and nuclear tests. Scientific assistance is being furnished by such international organizations as UNESCO, WHO, and FAO.

Some major Pacific countries give considerable scientific assistance to other groups: Australia assists Papua and New Guinea and adjacent Melanesian islands; the Dutch did much for West New Guinea; New Zealand helps the Cook Islands, Niue, Tokelau Islands, and Western Samoa; Fiji is a coordinating and training center for health; research in Micronesia has been coordinated by the Pacific Science Board; Hawaii assists American Samoa, Guam, and the Trust Territory of the Pacific Islands; and has supported research in Polynesia.

Expeditions to Pacific islands and resulting research have been sponsored by institutions in many lands, and the "experts" are scattered around the world.

E. H. BRYAN, JR.
Pacific Scientific Information Center

19. Studies on Plant Stem Elongation

The growth responses of pea stems and excised stem segments to auxin, gibberellin, anti-gibberellins, and light, were analyzed.

R. KENNER
J. A. LOCKHART
University of Hawaii

20. A New Look at an Old Ocean

The sea has from very early times been a source of fascination and perhaps despair to those interested in puzzling out its mysteries.

Scientific oceanography dates from the work of Maury, *circa* 1835, who published the first charts of winds and currents based on compilations of detailed records. His charts of average conditions formed the philosophical basis for modern oceanographic studies.

The study of marine communities began in about 1835 by Forbes, who established the modern discipline of marine biology by making extensive surveys and analyses of systematically collected specimens. The studies of average oceanic properties and the taxonomy and biogeography of marine communities can hardly be said to be complete. For very large parts of the ocean we know little or nothing of its properties, much less its inhabitants.

But important philosophical changes in our approaches to the oceans are taking place, in that there is a growing recognition of the importance placed by cyclical events which repeatedly occur in physical properties and biological communities. Intuitively, we know these events to depend on the influence of our nearest star, whose life-giving light is converted into biological energy and whose heat is moderated and distributed by the thin film of water which covers such a large part of our planet. In order to relate time sequence changes back to the primary energy sources, our attention is turning from descriptions of properties to a descriptive analysis of changes in individual properties and the effects of a change in one part of the system on other parts of the system.

Such an approach has led us to describe our work in general terms as a study of the animal in its environment, and needing to focus on some of the many animal communities, we have chosen the tunas and their associated companions.

LUCIAN M. SPRAGUE
U. S. Bureau of Commercial Fisheries

21. Skipjack Tuna Oceanography

The broad concepts of fisheries oceanography are discussed in the context of studies on the skipjack tuna (*Katsuwonus pelamis*). Fisheries oceanography relates the study of fisheries with features of the oceanic environment.

In essence, fisheries science is an investigation of the harvest or yield of an exploited species. An attempt is made to maximize catch while minimizing the cost of fishing on a sustained basis. In order to regulate maximized catches and minimized costs, the components of yield must be investigated. By some models these components are recruitment, growth, natural mortality, and fishing mortality. An additional factor, availability, is of utmost importance in considering yields of tropical tunas.

Fisheries oceanography attempts to relate the components of yield with features of the oceanic environment. Some of these features are currents, winds, temperature, salinity, and productivity.

Our studies of the skipjack tuna are at a stage where we are defining our units of study. These units are groups of skipjack which differ from one another in life history attributes. For example skipjack spawn mostly in the northern winter in Marquesan waters, but in Hawaiian waters these fish spawn mostly in the northern summer. Some of these groups may be genetically distinct and are called subpopulations.

In order to study these units we have developed a model which for the first time formulates a working hypothesis to evaluate the origin and movements of exploited groups of skipjack in the eastern and central Pacific Ocean.

The principal features of this model follow:

1. Skipjack exploited in the eastern Pacific fishery consist of large numbers of fish which originate in the equatorial central Pacific.
2. The exit of skipjack from the area of the eastern Pacific fishery is associated with a spawning movement toward the central Pacific.
3. Skipjack taken in the Hawaii fishery include fish of both Hawaiian and equatorial origins.

BRIAN J. ROTHSCHILD
U. S. Bureau of Commercial Fisheries

22. Studies of Ocean Currents Near the Hawaiian Islands

Currents near the Hawaiian Islands are being studied by several methods, for their intrinsic interest to the physical oceanographer, and also because they are a fundamental influence on the marine ecology.

Since 1961, the currents have been studied by means of drift bottles and cards which were released by the research ship "Charles H. Gilbert." The pattern of reported returns suggests a seasonal change in both the speed and direction of the offshore current system. In the first half of the year, the current carries the drift cards and bottles at speeds of about 6 miles per day or less, and the flow has a pronounced northern component; later in the year the speeds increase to about 10 miles per day or more, and the direction of flow shifts toward the west or southwest.

Direct measurements of currents have been made by means of surface floats attached to parachutes opened some distance below the sea surface. These floats have been used to examine details of eddy flow downstream of the Islands, in an attempt to study the generation, duration, and the dissipation of eddies, which are important elements of the current pattern near the Hawaiian Islands.

Finally, data collected by observations at sea are used to calibrate a scale hydrodynamic model of the Hawaiian Islands, in which patterns of current flow can be studied and photographed in the laboratory, under controlled conditions.

RICHARD A. BARKLEY
U. S. Bureau of Commercial Fisheries

23. Climatic Oceanography and its Application to the Hawaiian Skipjack Fishery

There are changes in the temperature and salinity of the ocean's waters which are analogous to changes in temperature and humidity in the atmosphere. Just as the latter can be explained in terms of movement of air masses, weather fronts, and circulatory systems, so the analogous changes in the ocean can be related to the movements of fronts which separate different water types or water masses. The boundary between the North Pacific Central water and the California Current Extension water moves seasonally through the region of the Hawaiian Islands. The time or northward movement of the boundary in late winter, as reflected in the time of initial warming of the sea near Oahu, and the presence of California Current Extension water around the Islands during the summer months have been shown to be related to the success of the Hawaiian skipjack fishery. Consequently, the time of initial warming early in the spring can be used to predict the relative success of the summer skipjack fishery.

GUNTER R. SECKEL
U. S. Bureau of Commercial Fisheries

24. Activity Patterns of Scombrids

Scombrid fishes are characterized by continuous swimming. This is associated in various degrees with search for food, gill ventilation, and maintenance of hydrostatic equilibrium. These three functional aspects of swimming are being investigated by studies of the activity patterns of scombrids in shoreside tanks (24 feet in diameter, and 3 feet deep) at Kewalo Basin.

Quantitative data on activity, measured as swimming speed, are obtained from an observation window in a tower overlooking the tanks. A Plexiglass board, parallel to the tank's surface, is inserted into the frame of the observation window. Sheets of clear plastic acetate paper are laid over the board and the path of the fish swimming in the tank is traced by an observer onto the acetate sheet with a wax pencil. While tracing, the observer views the tank from a fixed position through the acetate paper and Plexiglass. The length of the path, traced over a known time interval, is measured from the paper with a map measurer and converted to distance traveled by the fish and swimming speed. The distances between the window, the tank, and the observer's eye determine the conversion factor. In the present situation, 1 cm. on the acetate paper equals 24 cm. in the tank.

Wavyback skipjack, *Euthynnus yaito* Kishinouye, which have been in the tank for a month or so, swim at the same slow speed (about 0.9 m/sec for a 0.4 m. fork-length fish) throughout the day and night in the absence of food stimuli, If deprived of food for several days, speed decreases to about 0.6 m/sec, only to increase again following a meal. The average density of five intact *E. yaito* was 1.074 gm/cc, their food 1.071 gm/cc, and their sea water environment 1.024 gm/cc. Based on these density measurements, a 1 kg. *E. yaito* would weigh about 50 gm. in sea water and would tend to sink. Following a meal of 100 gm., its weight in water would increase by about 5 gm., because the food was also more dense than sea water. Since these fish swam faster when their stomachs were full and since they received lift while swimming from the planing action of their pectoral fins, it appears that the increase in speed following a meal results in part from the increase in weight.

Another adaptation to maintain hydrostatic equilibrium is the swim bladder. This organ is absent in *E. yaito* and in many other scombrids. All scombrids without swim bladders are relatively small species, less than 30 kg. in maximum recorded weight, whereas at least eight of those species with swim bladders attain sizes in excess of 30 kg.; some grow over 100 kg. A 100 kg. tuna without a swim bladder would weigh about 5,000 gm. in water if it had the same density as *E. yaito*. It can be speculated that the planing action of pectoral fins can be sufficient for the amount of lift required by smaller species, but that additional adaptations such as swim bladders are necessary for species with greater mass and heavier weights in water.

Analyses such as those presented in this abstract are being conducted on the activity patterns of scombrids to determine the effects of the functional components of locomotion on their behavior.

JOHN J. MAGNUSON
U. S. Bureau of Commercial Fisheries

25. A Method of Measuring Visual Acuity of Scombrids

Development of techniques for capturing tunas and maintaining them in captivity has progressed sufficiently to allow subjection of these pelagic scombrids to experimental procedures. Experiments designed to measure the visual acuity of tunas have been developed recently at the U. S. Bureau of Commercial Fisheries Biological Laboratory in Honolulu.

The method involves training a fish to respond in a desired manner when a visual stimulus is presented. The visual stimulus is an image of either vertical or horizontal stripes which is projected onto an opal glass plate placed against a window of the tank. When the stripes are vertical, the fish is trained to swim down the tank to a food-drop area where it is rewarded. When the stripes are horizontal, the fish is trained to turn before it reaches the food-drop area and return to the far end of the tank. If it fails to turn around when horizontal stripes are presented, the fish receives an electric shock. The image is projected onto the opal glass plate when the fish is at the far end of the tank. The projector is turned off when the fish reaches a marked distance from the window. Filters are used to reduce the illumination of the striped image until the fish is no longer able to discriminate between vertical and horizontal stripes.

Visual angles are computed from measurements of the width of the stripes and of the distance between the fish's eyes and the striped image. Visual acuity is calculated by taking the reciprocal of the visual angle and is then plotted against the logarithm of the luminance of the image.

The experimental tank is enclosed in a Quonset hut so that lighting can be controlled. The observer, conducting the experiment from a booth so that he cannot be seen by the fish, uses remote control buttons to operate the projector, slide changer, and electric shocker. Food is dropped from a feeding tube attached to the booth.

Preliminary analysis of the data indicates a greater visual acuity for aku, *Katsuwonus pelamis,* than for kawakawa, *Euthynnus yaito,* at higher luminances. At lower luminances, the visual acuities of the two species of tunas are similar.

EUGENE L. NAKAMURA
U. S. Bureau of Commercial Fisheries

26. Observations of Fish from a Floating Observation Raft at Sea

Pelagic fishes are frequently seen congregating around floating objects at sea. The ecology and behavior of fish accumulating around a drifting raft with a viewing chamber were observed near the island of Hawaii for a total of 85 daylight hours during five drifts of up to 50 hours' duration. A modified version of this raft was taken south to the Equator where two drifts of 8 and 9 days were made.

Nineteen identified species of fish and one species of porpoise were seen from the chamber near Hawaii. They were classified into three groups—transients, visitors and residents—on the basis of their reaction to the raft and the length of time they remained. Transients included *Decapterus* sp., *Euthynnus pelamis,* and istiophorids; they demonstrated no apparent attraction to the raft. Visitors included *Sphyraena barracuda, Pterolamiops longimanus, Manta alfredi,* and porpoise. They came to the raft and swam around for a few minutes before leaving. Residents included *Canthidermis maculatus, Coryphaena hippurus, Psenes cyanophrys, Acanthocybium solandri, Decapterus* sp., *Seriola* sp. and juvenile *Abudefduf abdominalis. P. cyanophrys* was the first to appear on all drifts and had the highest rate of increase.

Total numbers of residents increased three times faster when the raft was drifting than when it was anchored and ten times faster during daylight than at night. *Seriola* sp. was the only predator at the raft which successfully preyed on smaller fishes present. *C. maculatus, P. cyanophrys, A. abdominalis, and Caranx kalla* took shelter near the raft when they were frightened by other fish, approaching boats, or other disturbances. Observations of a *C. maculatus* picking a parasitic isopod from another and attempting to pick from *C. hippurus* and *Decapterus* indicate that apparently *C. maculatus* is a parasite picker and that floating objects may be pelagic cleaning stations.

On the two drifts near the Equator the following animals were seen from the observation chamber: adult and juvenile *E. pelamis,* small adult and juvenile *Neothunnus macropterus, A. solandri,* adult *C. hippurus,* adult and juvenile *Coryphaena equiselis, Decapterus pinnulatus, Elagatis bipinnulatus, Psenes cyanophrys, P. longimanus, Prionace glauca, Rhincodon typus, Manta* sp., *Naucrates ductor, Remora* sp., Exocoetidae, turtle and porpoise.

In general, accumulations at the raft had properties ascribed to a community with species playing different interwoven roles.

REGINALD M. GOODING
U. S. Bureau of Commercial Fisheries

NECROLOGY

The Academy records with sorrow the death of the following members during the year:

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†Member, American Association for the Advancement of Science.
‡Fellow, American Association for the Advancement of Science.

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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . .

FORTIETH ANNUAL MEETING 1964-1965

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THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

PRESIDENTIAL ADDRESS 1965

THE TEMPLE OF THE MUSES

Roland W. Force*

Originally the word *Museum* (Greek *museion)* designated a sanctuary or temple dedicated to the Muses of Greece. Later it came to mean a place for study and for intercourse among learned men, a place for concentration upon literature and philosophy. The most important museum in antiquity was founded at Alexandria by Ptolemy Philadelphus in the 3rd century B.C. for the promotion of learning and the support of students. It formed a part of the palace and contained cloisters, the library of Alexander the Great, a public lecture room, a common hall, and botanical and zoological gardens. Even at this early date support for a museum was given through a grant from the treasury, and the chief administrator was appointed by the king.

Perhaps the first natural history museum was Noah's Ark. King Solomon had a collection of curiosities. Aristotle's natural history was based on the great collection of animals made by Alexander the Great. As early as the 2nd century A.D. a portion of the Acropolis in Athens was devoted to a public exhibit of paintings. Precious stones were collected by wealthy Romans, according to Pliny; and Roman plunder in Greece resulted in the transport of many objects of art to Roman buildings and grounds, both public and private. Natural objects were preserved also in both Greek and Roman times. Rarity and peculiarity were emphasized. One can make a strong case for the human propensity toward acquisitiveness.

The Greek Muses were nine in number and were considered goddesses of song and poetry and of the arts and sciences generally. Theirs was the power to inspire both emotionally and intellectually. In *King Henry IV*, Shakespeare recognized this inspirational quality when he pleaded "O! for a Muse of fire, that would ascend the brightest heaven of invention." By extension, then, a museum, as a temple of the Muses, should be a place—a source—of inspiration and learning.

While this conception seems to have been eroded during the Hellenistic period, the Christian church revitalized it in the years that followed, principally through recognition of the spiritual inspiration inherent in certain works of art, relics, and natural phenomena both ordinary and extraordinary. From the earliest days of its existence the Christian church utilized visual aids to convey knowledge. Examples are the symbols drawn on catacomb walls and bas-relief carvings, stained glass windows, narrative mosaics, and tapestries which related the stories of the Scriptures graphically. Churches then were in a real sense museums.

Middle Ages monasteries had collections of curiosities, most of them gifts of travelers from foreign lands and pilgrims. Religious relics were widely collected and revered by ecclesiastics.

The acquisition of articles prompted by piety or superstition may be distinguished from collecting for purposes of instruction or study, but it stimulated the taste for collecting and secured the preservation of numerous interesting objects. The treasuries of many churches still contain some of the finest existing examples of ancient art, and many of the beautiful and valuable objects which now are found in the great museums of the world at one time belonged to churches.

During the Renaissance in the 16th century the Greek word *museion* was used in Italy in slightly different form. The Italianized form was *museo*. In this era the nobility, as it did earlier, took an interest in the arts and the pursuit of knowledge. Possession of peculiar or

*Director, Bernice P. Bishop Museum, Honolulu.

precious objects was a matter of prestige, then as now. This was the origin of the cabinet of curiosities.

The revival of learning can be said to have begun as early as the 15th century. Classical antiquity was greatly admired and treated generally as a great discovery. Florence became a center for scholarship. Popes, princes, and magistrates undertook excavation of ancient sites in search of objects of art which ultimately found their way into palaces and churches. Cosimo and Lorenzo de'Medici were patrons of learning. Petrarch collected coins, as did Pope Paul II.

By mid-16th century it is recorded that so-called "cabinets" or collections of coins and medals in Europe numbered nearly 1,000. Coins, gems, seals, transcriptions from epigraphic monuments, books, maps, mathematical instruments, fossils, and many other objects from nature were increasingly brought together in collections.

What these assemblages lacked in coherence and continuity was balanced by heterogeneity and breadth of subject matter. Works of art were intermingled with freaks of nature, botanical rarities, bones, stuffed animals, and oddments representative of numerous places and periods of history. In many instances order was lacking and scholarship was either unrelated to the collections or minimal. But in other cases order was imposed and the limits of collections were reasonably well defined. Bishop Paolo Giovio (1483-1552) collected only portraits of famous personalities. Others, such as Aldrovandi (1522-1605) and Settala (17th century), were noted for their extensive scientific collections.

Antiquarian research was exhaustive in the 16th and 17th centuries, and the monographs compiled then remain as monuments to the inspiration of the Muses of old. The vast treasures which were assembled during the Renaissance gradually were absorbed by institutional collections and became the foundation of the great museums of Rome, Florence, Vienna, Dresden, Munich, Paris, St. Petersburg, and London.

The imposition of order is the essential task of science, whatever the subject matter. Recognition of the need for systematizing motley collections of curiosities was a slow but steady process. One of the first to write about such matters was a Flemish doctor named Quiccheberg. In 1565 he wrote that the ideal museum should "represent the universe by means of a systematic classification of all subject matter." His was the first museum catalogue. It dealt with rocks and minerals.

The first handbook on collecting and museography was written two centuries later by C. F. Neickelius, a pseudonym for Caspar F. Einckel, a Hamburg merchant. Perhaps it was this influence which caused Sir Hans Sloane to give his house and collection to the British nation. It was opened to the public in 1759. This was the origin of the British Museum.

The pursuit of the unknown was accelerated by the many voyages of exploration in the 15th through the 17th centuries. The discoveries of new lands and new peoples, the ultimate development of missionary movements and the establishment of foreign missions in "heathen" lands caused Europeans to be concerned with remote and exotic peoples, customs, and objects. Costumes, tools, weapons, implements, and ornaments were collected. New biota were viewed with excitement, and the great wealth of terrestrial and marine flora and fauna, rocks, and minerals stimulated travelers and naturalists alike to a burgeoning collecting effort in an awesome task to record and understand, to probe and examine the world environment—an effort which still continues.

The museum as a public rather than a private entity owes its origin to the French Revolution. Only after this was there any broad recognition that the study of collections should be allowed to more than a privileged few. The museum then became identified for the first time as an institution of public education. The popularization of knowledge and the spread of the methods of experimental reasoning accounted for the appearance of encyclopedias in co-relation with the development of museums.

In the process of establishing museums with a public purpose, divisions of collections were begun. Art materials were separated from those relating to science or natural history; ethnological and historical materials were further distinguished. The separation of historical materials from art collections took some time, and it was not until about 1800 that the distinction became broadly recognized.

The development of museums as more than cabinets of curiosities was a slow one, and the conception—or misconception—has not been altogether overcome today. The idea of study in connection with collections is ancient, however. Often when the Latin word *musaeum* is translated into English, "study" is the equivalent term which is used. The association of learning with museums is noted in the writings of Samuel Johnson, who identified a museum as "a repository of learned. curiosities." From the end of the 16th century the word *museum* has been used in reference to both collections and the structure in which they are housed.

In recent time there has been a great burgeoning of interest in museums. The first edition of the *Museums Directory of the United States and Canada* was published in 1961. At that time nearly 5,000 museums were listed. The second edition, which is currently being distributed, includes many more listings. Not long ago the American Association of Museums noted that a new museum came into being in the United States and Canada on the average of one every four days. The Association tends to classify museums under the broad headings of art, history, science, and special museums. Included in its directory are art centers and associations, historic houses and historical societies, college and university museums, children's museums, aquariums, arboretums, botanical gardens, herbariums, planetariums, zoos, libraries with collections other than books (documents, manuscripts, etc.), preservation projects, government-sponsored parks, wildlife refuges, and historic sites.

The listing is diverse and broad, but always those entities considered as museums are concerned with man's heritage from his own past and from nature. This diversity was a natural outgrowth of the emergence of more sophisticated scholarship and specialization of interest in the sciences and the arts.

As scholarship in the various scientific disciplines has grown, there has been a correlated, yet lagging, recognition of museums as valuable sources of information. Professionalism in museums generally and especially in science museums has continued to grow through the years. The major natural history museums in this country and in several others, for example, consider their scientific staff a faculty. And, indeed, the qualifications for professionals on the staff of leading institutions are identical with those for research and teaching professionals in major universities.

Growing specialization in scholarship resulted in specialized museums. Around the turn of the century there were four basic types of museums: art, history, science, and industry. Science museums included those devoted to natural history, ethnology, and anthropology. The tendency during the preceding half century in such museums was to concentrate on scholarly research and to pay little attention to the public and to displays. Exhibits were essentially a form of open storage. Creative design and didactic technique left much to be desired.

By 1903, however, the British Museum Association was attempting to make that ancient institution more than a mere repository and to aim toward the stimulation of visitors. The interpretation of museum collections to the public is, in the case of the science museum, essentially a secondary function. The primary function of such an institution is scholarly research.

Community service in the form of improved exhibits was pioneered first in America by science museums in Boston, New York, Washington, and Chicago. Art museums, not traditionally oriented toward research, have generally been more concerned with public presentations. Among those supplying leadership, through improved approaches to exhibition in the early years of this century, were the Metropolitan Museum in New York and the Boston Museum of Fine Arts.

The development of college and university museums in America provided a valuable influence in utilizing collections for scientific purposes as well as for interpretive education. Smith and Oberlin were among the first colleges to develop campus museums. The University Museum of the University of Pennsylvania was founded in 1889 and soon earned a high reputation for research in ethnology and archaeology. The Oriental Institute of the University of Chicago provided a comparable influence which has continued to the present in field work, curatorship, and exhibition.

It is fair to say that a good bit of our popular education in natural history has stemmed from the Peabody Museum of Natural History at Yale, founded in 1802; from the mineralogical collection of the University Museum at Harvard, begun in 1784; the Dartmouth College collection, started about 1783; and the University of Ohio Museum, dating from 1823. The first generally credited museum in America was not, however, one connected with an institution of classroom instruction. It was the Charles-Town Library Society, at Charleston, South Carolina, founded in 1773.

Some museums today are outgrowths of academies of science and some are referred to by this designation. The New York Academy of Science is said to have fostered the American Museum of Natural History. The Academy of Natural Sciences in Philadelphia and the California Academy of Sciences are non-university museums of high reputation and sound contribution.

Privately endowed institutions, such as the Carnegie Museum in Pittsburgh, the Chicago Natural History Museum, and the Bishop Museum, though non-academic in the sense that they are not organizationally or fiscally related to universities, have through the years earned the respect of professional scientists and the public as well. In some cases privately endowed and also certain government-sponsored museums have been the outgrowth of national or international expositions. The Field Columbian Museum (today Chicago Natural History Museum) came into being during the World's Columbian Exposition of 1893. Both the Chicago Museum of Science and Industry and the Cleveland Health Museum stemmed from the Century of Progress Exposition of 1933.

The increasing number of government-sponsored museums (national, state, county, and city) is indicative of growing public interest in museums. The United States National Museum combines private endowment with government sponsorship. A gift by an Englishman, James Smithson, in 1826 began this remarkable and complex institution.

The great latter-day growth of science museums is in part the result of a general broadening of the educational base and a concern by the public in relatively complicated areas such as conservation, pollution, ecology, and general biological adaptation to environment both with and without man-made changes. Man's abiding interest in nature is the essential concern of the science museum. Museums of science and industry should be considered somewhat separate because their concern is primarily in applied science.

The importance of natural history museums to scientific investigation is to be found in their traditional concentration upon systematic collections. The ordering of objects in and from nature so greatly advanced by Linnaeus, de Buffon, Darwin, and many others has long been considered the special obligation of museum professionals.

As institutions, museums possess an immortality not typical of humans. The personnel in a given museum changes through time, of course. Through the replacement process, however, and the overlap in the tenure of individual staff members, continuity is achieved and primary purposes are adhered to.

Modern museums which possess collections can best be described as resource centers. Theirs is the task of storage and retrieval of both materials and information. They are storehouses of knowledge. They invite inquiry, stimulate and inspire visitor and scholar alike. They persevere and endure.

The museum is, in fact, an entity which is not to be finished. It will always be capable of expansion. Its purview in scope of natural phenomena extends from the depths of the earth to distant galaxies. Its perspective in time is as limited or limitless as time itself. And its treatment of materials ranges from the applied to the atomistic approach of basic science to the more broad and perhaps less well-defined areas of aesthetic response.

Whether a historic site, a restored structure, a planetarium, a botanical garden, a series of collections in bottles or boxes—whether private in sponsorship or public—whether academic or non-academic—whether large or small—the museum of today is a thing of value: a vastly altered sanctuary, more spacious, more complex, whose peristyle does not restrict. A temple still, but one in which we may imagine dwell many new daughters of Zeus.

ANNUAL REPORT 1964-65

HAWAIIAN ACADEMY OF SCIENCE

The fortieth year of the Academy ended with a total membership of 653. The Academy Council met three times during the year: June 3, 1964, March 23, 1965, and April 11, 1965. The minutes of these meetings are on file.

The Academy Council again approved presentation of a $25 award for a meritorius project entered in the Science Fair. This year $25 went to Priscilla Chow of Maryknoll High School for her project, Analysis of Some Relationships in Prime Modular Arithmetic.

Robert E. Coleman, *Secretary*

NOMINATIONS

The Nominating Committee presented the following slate of candidates for Academy offices during the year 1965-66:

President-Elect (one to be elected): Albert B. Carr, Jr., Louis G. Nickell
Secretary: Robert E. Coleman
Treasurer: Eleanor S. Anderson
Councilors: (2) (2 years): Judson L. Ihrig, Leonard E. Mason, Robert A. Nordyke, Morton M. Rosenberg, Martin J. Vitousek

Additional officers for the year will be:
President: Richard K. C. Lee
Councilors (1 year): John C. Marr, Toshiyuki Nishida, Roland Force (ex officio)

Alison Kay, *Chairman*

PUBLICATIONS

During 1964-65, the *Proceedings* for the Thirty-Ninth Annual Meetings were published and distributed to the membership.

O. A. Bushnell, *Chairman*

PUBLICITY

The activities of this committee consisted of obtaining publicity in connection with the Final Session which included two symposia: one on "Advancing Frontiers in Pacific Communications," and another on "Man and the Pacific Environment."

Hugh Lytle, *Chairman*

PROGRAM

The program committee, appointed in the spring, met several times and organized a program for the Final Session and Annual Meeting. The program was a departure from those of previous years in that it was an all-day session held on Saturday, May 22, 1965, with a luncheon in place of the traditional annual banquet. This arrangement seemed to meet with favor, attendance was greater than in previous years, and the thematic or symposium type of program received many favorable comments. In the morning three papers were presented centering around the theme "Advancing Frontiers in Pacific Communications Research."

After the luncheon, held in the East-West Center cafeteria, the Presidential Address was presented. Retiring President Roland Force spoke on "The Temple of the Muses." Science Fair winners Priscilla Chow and Michael Perry were guests of the Academy. Five students whose participation in the Westinghouse Science Talent Search was especially noteworthy were also honored. Ralph Miyashiro and Richard M. Perry were Honors winners, and Juanita Ching, James Harnly, and Stephen Okumura were state winners. Miss Iris Shinsaki was recognized for her selection to receive the Outstanding Biology Teacher Award of the National Association of Biology Teachers.

Three speakers participated in the afternoon meeting, presenting invitational papers on the theme "Man and the Pacific Environment."

George Gillett, *Chairman*

TREASURER'S REPORT

Balance April 1, 1964			$ 3,698.28
Receipts:			
Dues		$ 1,210.50	
Miscellaneous			
For supplies and contingencies re NSF grants	$269.80		
Annual Dinner (1964)	221.99		
Postage	.38	492.17	
NSF Grant Funds		13,882.15	
ISSEC Supplementary Funds		500.00	
First Federal Savings & Loan Association (Interest)		33.97	16,118.79
			19,817.07
Disbursements:			
Stationery & Mailing		368.87	
Printing			
Programs	38.50		
Proceedings (1963-64)	539.59	578.09	
Supplies & Incidentals		29.05	
Miscellaneous			
Annual Dinner (1964)	216.75		
Haskins & Sells 1963-64 audit	60.00		
HAS Hawaii Branch 1963-64	16.50		
AAAS	24.22		
ISSEC—8th Science Fair awards	35.00		
Flowers for Annual Dinner	8.00	360.47	
NSF grants		13,609.86	
ISSEC		480.61	15,426.95
Balance April 30, 1965			$ 4,390.12

Distribution of total cash balance:

Bank of Hawaii	3,648 30
First Federal Savings & Loan	741.82
	$ 4,390.12

Distribution of funds in Bank of Hawaii:

HAS operating funds	$ 1,366.48
NSF grant funds	1,743.50
ISSEC funds	538.32
	$ 3,648.30

Status of NSF grants

GE-1609—Students Science Seminar

Amount of grant		$ 4,220.00
Expended 1963-64		3,373.00
Balance on hand April 1, 1964		847.00
Disbursements:		
Program Director	$ 200.00	
Associate Directors	300.00	
Secretarial Assistance	94.00	
Office Supplies	50.00	
Postage & Telephone	10.00	
Travel & Per Diem	193.00	847.00
Balance April 30, 1965		—0—

GE—1849—Visiting Scientists Program

Amount of grant		$15,065.00
Expended 1963-64		8,551.15
Balance on hand April 1, 1964		6,513.85
Disbursements:		
Associate Director	$ 1,350.00	
Secretarial Assistance	607.05	
Visiting Scientists Honoraria	985.00	
Transportation & Per Diem	545.06	
TV Production Costs & Moderator	282.11	
Office Supplies	157.53	
Telephone	65.16	
Contingencies (FICA, overhead, etc.)	594.43	
Refund to NSF	1,927.51	$ 6,513.85
Balance April 30, 1965		—0—

GE-4293—Students Science Seminar

Amount of grant		$ 6,375.00
Cash received		5,270.52
Disbursements:		
Director	$ 400.00	
Associate Directors	900.00	
Secretarial Assistance	200.00	
Office supplies	4.50	
Expendable supplies	86.70	
Director's Travel & Per Diem	260.00	
Scientists' Travel & Per Diem	2,211.00	
Postage and Telephone	52.01	
Indirect Costs	47.95	4,162.16
Cash balance on hand April 30, 1965		1,108.36
Balance of grant		$ 2,212.84

GE-4302—Visiting Scientists Program

Amount of grant		$ 6,760.00
Cash received		4,650.00
Disbursements:		
Director	$ 700.00	
Scientists' Stipends	1,015.00	
Secretarial Assistance	1,651.00	
Transportation & Per Diem	113.03	
Office Supplies	353.45	
Telephone	100.00	
Indirect Costs	82.38	4,014.86
Cash balance on hand April 30, 1965		635.14
Balance of grant		$ 2,745.14

ISSEC Supplementary Funds

Cash on hand April 1, 1964	$ 518.93
Cash received	500.00
	1,018.93
Disbursements:	
Secretarial Assistance	480.61
Cash balance on hand April 30, 1965	$ 538.32

Status of Dues Payments:

	ADVANCE	ARREARS
As of March 31, 1964	$129.50	$318.00
As of April 30, 1965	144.00	102.00

Respectfully submitted,

Eleanor S. Anderson, *Treasurer*

OFFICERS

1964-65

Roland Force	*President*
Richard K. C. Lee	*President-Elect*
Robert E. Coleman	*Secretary*
Eleanor S. Anderson	*Treasurer*
D. Elmo Hardy	*Councilor*
E. Alison Kay	*Councilor*
John C. Marr	*Councilor*
Toshiyuki Nishida	*Councilor*
Donald P. Gowing	*Councilor (ex officio)*

INTER-SOCIETY SCIENCE EDUCATION COUNCIL

Annual Report for 1964-1965

On recommendation of the past president of the Academy, the president-elect was asked to serve as chairman of the Council. He felt that this division of labor of the Council's activities from those of the Academy would be a good practice to follow. After serving as the Council's chairman for the past year, I believe that this decision was a good one and will suggest that we follow this practice in the coming year.

The Council's activities were made easier with the appointment of Mrs. Lee C. Bowen as part-time secretary. Funds for her salary were made available through the Visiting Scientists Program. New and continuing committee chairmen assumed their roles and responsibilities. Attendance at the meetings of the Council was excellent, and committee chairmen and their alternates, as well as representatives of associated societies, all participated in the Council's decisions. There was some modification of the committee structure and several new chairmen joined the Council.

The Chairman acknowledges with appreciation the efforts of all the committee chairmen during the year. Their reports tell a small part of the story of their accomplishments. To the many scientists who participated in the ISSEC programs, I want to give my personal thanks.

Richard K. C. Lee, *Chairman*

ORGANIZATION

Officers

Chairman .... Dr. Richard K. C. Lee, UH
Vice-Chairman .... Dr. Jimmie B. Smith, PRI
Executive Secretary .... Mrs. Lee C. Bowen
Treasurer .... Mr. Dwight H. Lowrey, Cooke Trust

Committee Chairmen

Community Participation ...... Dr. John H. Payne, HSPA
Public Relations .... Mr. James W. Bernard and Mr. Richard K. Ekimoto, Van Waters & Rogers
Budget .... Dr. Walter Steiger, UH
Student Science Seminars .... Mr. Theodore Ozawa, University High School
Science Teacher Coordination .... Mr. Edwin Y. H. Chinn, Dept. of Education
Science Talent Search .... Mr. Edwin Y. H. Chinn, Dept. of Education
Science Teacher Workshop .... Mr. Byron K. Yoshina, Niu Valley Int. School
Science Fair .... Mr. Jules Fine, Plant Quar. Service
Dr. Laurence H. Snyder, UH
Science Film Service .... Dr. W. G. Sanford, PRI
Visiting Scientists Program .... Mr. Richard K. Coburn, Church College
Science Clubs Service .... Mr. Robert Morimoto, Kalakaua Int. School
Science Clubs Camps .... Mr. Walter Luke, Stevenson Int. School
Elementary Science Texts .... Sister St. Lawrence, Catholic Diocese

REPRESENTATIVES OF ASSOCIATED SOCIETIES

AAUW .... Dr. Doris R. Jasinski
Amer. Chem. Soc. .... Dr. Gerald G. Dull
Amer. Soc. Agron. .... Dr. James Silva
Amer. Soc. Mech. Eng. .... Mr. Joseph Bova
Amer. Stat. Assoc. .... Mr. Bernard D. Swenson
Anthrop. Soc. .... Mr. Robert N. Bowen
Eng. Soc. of Haw. .... Mr. Wallace Endo
Geophysical Soc. ....
Hawaii Med. Assoc. .... Dr. Robert A. Nordyke
Hawaii Astron. Soc. ....
Hawaii Dietetic Assoc. .... Mrs. Nao Wenkam
Hawaii St. Dental Assoc. .... Dr. Marilyn Bradshaw
Haw. Entom. Soc. .... Dr. L. W. Quate
Haw. Psychol. Assoc. .... Dr. H. Kelly Naylor
Haw. Bot. Soc. .... Mr. Jules Fine
Inst. Electric. & Electron. Eng..........Mr. Paul G. Williams
Inst. Food Tech. .... Dr. Lyle Allen
Soc. of Sigma Xi .... Dr. Herbert B. Weaver

FINANCIAL REPORT

As in the past the ISSEC funds were administered by the Cooke Trust Company.

Contributions

G. N. Wilcox Trust	500.00
Frear Eleemosynary Trust	250.00
McInerny Foundation	1000.00
Advertiser Publishing Co.	50.00
Central Pacific Bank	25.00
First Insurance Company of Hawaii	25.00
Hawaiian Electric Company	200.00
First National Bank of Hawaii	100.00
Juliette M. Atherton Trust	1500.00
Bank of Hawaii	100.00
Honolulu Gas Company	25.00
Lewers & Cooke	50.00
Earle M. Alexander, Ltd.	5.00
City Bank of Honolulu	10.00
Medical Group	25.00
Donald Wolbrink & Associates, Inc.	10.00
Hawaiian Telephone Company	200.00
Sears, Roebuck & Co.	50.00
The Liberty Bank of Honolulu	50.00
Oahu Transport Co.	50.00
Meadow Gold Dairies-Hawaii, Ltd.	100.00
Foster Equipment Co.	10.00
H C & D, Ltd.	100.00
Watumull Foundation	100.00
C. M. & Anna Cooke Trust	250.00
Castle & Cooke	200.00
Samuel N. & Mary Castle Foundation	1000.00
Hawaii Medical Association	100.00
F. C. Atherton Trust	500.00
*Hawaiian Sugar Planters' Association	1107.50
*Pineapple Research Institute	1107.50
*Hawaii State Dental Association	25.00
*Institute of Food Technologists (Hawaii)	10.00
*American Chemical Society (Hawaii)	50.00†
*Hawaiian Botanical Society	75.00†
*Institute of Electrical & Electronics Eng.	50.00

*Restricted to Science Fair.
†Includes 2 years donations.

*Hawaii Psychological Association	40.00†
*Society of the Sigma Xi	50.00†
*Hawaii Dietetic Association	45.00†
*Hawaii Heart Association	25.00
*Hawaiian Entomological Society	10.00
*American Society of Agronomy (Hawaii)	40.00†
*Police Officers Accommodation Fund	25.00
*Hawaii Medical Association	150.00
*Hawaii Weed Conference	10.00
*Hawaiian Orchid Societies	25.00
*Armed Forces Comm. & Electronics Assoc.	85.00†
American Factors	10.00
Coca Cola Company	25.00
Fred Simpich Sr.	4.00
James A. Glover	25.00
Anonymous donors	360.00
Total	$ 9939.00

Balance—March 31, 1964	$14,685.51

Receipts

Collections 7th Fair	420.00
Contributions	9,939.00
Visiting Scientist Program	103.00
Interest Savings & Loan	79.16
Sale typewriter & stand	75.00
	$10,616.16

Expenditures

Science Talent Search	73.50
Science Workshops	1,321.08
Science Film Service	1,207.09
Science Club Services	292.24
Science Club Camps	747.00
Public Relations Committee	140.59
Secretarial Service & Supplies	1,096.55
7th Science Fair closeout-adj.	5,298.45
8th Science Fair	3,410.81
	$13,587.31

Balance—April 30, 1965	$11,714.36

COMMUNITY PARTICIPATION

Contributions received total $6,585.00. In addition, the Pineapple Research Institute and the Hawaiian Sugar Planters' Association have pledged up to $1,500.00 each to pay for the travel expenses of our winners to the National Fair. This makes a grand total of $9,585.00.

The list of contributors remains almost the same from year to year, with the local trusts and foundations, the PRI, and HSPA providing the principal support. A small list of loyal businesses and groups contribute yearly in smaller amounts. This stability makes the task of the Community Participation Committee easy and satisfying.

John H. Payne, Chairman

PUBLIC RELATIONS

The activities of this committee consisted in the revision and publication of the ISSEC brochure. In addition, all Science Fair publicity was gathered and released by the Public Relations Committee.

James W. Bernard and
Richard K. Ekimoto, Co-Chairmen

BUDGET

As in the past, the ISSEC funds were administered by the Cooke Trust Company.

The Budget Committee and the Council accepted for 1964-65 the following budget:

8th Annual Science Fair	$ 6,120.00
Science Teacher Workshop	1,296.00
Science Club Camps	747.00
Science Club Services	500.00
Science Film Service	300.00
Science Talent Search Awards	70.00
Public Relations	250.00
ISSEC Secretarial Service & Supplies	500.00
Total	$ 9,783.00

ISSEC Account

Balance in Cooke Trust Co., Ltd., as of March 1, 1964	17,333.54
Expended March 1, 1964 to April 1, 1965	12,622.53
Receipts Sept. 1, 1964 to March 1, 1965	11,196.16
Deposited in First Federal Savings & Loan	10,000.00
Balance on hand as of April 1, 1965	5,907.17

7th Annual Science Fair Fund (1963-64)

Books closed December 14, 1964 Total Expenditures	6,206.62

8th Annual Science Fair Fund (1964-65)

Expended up to April 1, 1965	800.53

Walter R. Steiger, Chairman

STUDENT SCIENCE SEMINAR

The Student Science Seminar program operated during 1964-65 under a grant from the National Science Foundation to the Hawaiian Academy of Science (administered by ISSEC). Approximately 120 highly recommended and selected students (30 students each on Kauai, Oahu, Maui, and Hawaii) participated in this program. Associate directors were: Mr. Barton Nagata (Kauai), Mr. Clifford Kekauoha (Maui), and Mr. Allan Kondo (Hawaii).

This program, in operation since 1959, is designed to satisfactorily challenge the talents of the superior students by offering instruction in scientific concepts, methods, and applications at a more advanced, rigorous, and individualized level than can be given at present in the regular high school curriculum.

Scientists and mathematicians from a wide variety of disciplines have willingly given time and effort to meet with the students through evening seminar meetings. Twenty-five meetings were held on Oahu, and 15 on each of the other islands.

Reactions from parents, teachers, participating scientists, and from the students themselves have been favorable. Although the students received no inducements, such as extra advanced credits or stipends, the evening seminars were well attended.

Theodore Y. Ozawa, Director

SCIENCE TEACHER COORDINATION

Information on activities of ISSEC on the Visiting Scientists Program, Hawaiian Science Fair, and the State Talent Search was disseminated to schools to stimulate teacher interest and student participation.

Edwin Y. H. Chinn, Chairman

SCIENCE TALENT SEARCH

The Science Talent Search Committee was responsible for conducting the 24th Annual Science Talent Search for Westinghouse Science Awards and Scholarships worth $34,250 in conjunction with the 6th Hawaii Science Talent Search for grade 12 students in Hawaii.

Participation was excellent, with requests from 17 schools for a total of 78 sets of examination materials. Out of 27 completed entries, two students were selected for the Westinghouse Honors Group, earned by the top 10 per cent of those in competition. They were: Ralph T. Miyashiro, Punahou School, Oahu; and Richard M. Perry, Baldwin High School, Maui.

Entries were returned to Hawaii for state judging, and the following students were selected for local recognition: Juanita Ching, Kaimuki High School; James Harnly, Radford High School; and Stephen Okumura, University High School.

The judges for the State Talent Search were: Dr. John Payne, Principal Technologist, HSPA; Dr. Gerald Dull, Head of Biochemistry Department, PRI; and Dr. Leonora Bilger, Professor Emeritus of Chemistry, UH.

The students in the Westinghouse Honors Group and the three in the State Honors Group were recognized at the Annual Meeting of the Hawaiian Academy of Science on May 22, 1965. Handbooks of Chemistry and Physics were presented, and the students were guests of ISSEC at the luncheon held at the East-West Center.

To date Hawaii has qualified six students in the Westinghouse Honors Group and one student as a national winner.

Edwin Y. H. Chinn, Chairman

SCIENCE FAIR

The Eighth Hawaii Science Fair was held at the Hilton Hawaiian Village Dome from March 19 through 21, 1965. Approximately 12,000 people visited the Fair, a smaller number than during the last several years. The quality of the projects was relatively good, and there seems to be evidence of improvement year by year.

There were 92 projects, 33 in the Senior Division and 59 in the Intermediate Division. Eight came from Kauai, 13 from Maui, 20 from Hawaii, and 51 from Oahu. Seventy-nine awards were made to 42 individual projects. Oahu schools received 48, Maui 15, Hawaii 9, and Kauai 7.

The Annual Awards Banquet was held at the Hilton Hawaiian Village Long House on Saturday night. Two hundred and fifty people attended the banquet. The principal speaker of the evening was Dr. Roland W. Force, Director of Bishop Museum, and incumbent President of the Hawaiian Academy of Science. The topic of his address was: "Scientific Research as a Way of Life." The awards were presented at the conclusion of Dr. Force's talk.

Priscilla Y. C. Chow of Maryknoll High School received the PRI Award and Michael Perry of Baldwin High School, Wailuku, Maui, received the HSPA Award. These awards, as in the past, consisted of an expense-paid trip to the National Science Fair-International, held this year in St. Louis, Mo. from May 5-8. Miss Chow was awarded a second place in mathematics and computational science and Mr. Perry was first alternate for the U.S. Air Force Award in mathematics.

Dr. Laurence H. Snyder, Associate Director, accompanied the winners to St. Louis and will be director of the Ninth Hawaii Science Fair.

Jules Fine, Director

SCIENCE FILM SERVICE

More than a hundred science films, most in color, and several hundred filmstrips are available for free loan to intermediate and high schools throughout the Hawaiian Islands. The film library is located at the ISSEC office at Bishop Museum. Upon his resignation as director of the Visiting Scientists Program, Dr. W. G. Sanford agreed to serve as chairman of the newly established Science Film Committee. All requests for films were handled by Mrs. Lee C. Bowen.

The following statistics, compiled for the period September 1 through May 10, 1965, show how extensively this service was used: on Oahu, 19 public and 17 private and parochial schools ordered films and filmstrips. Requests were also received from 16 schools on Hawaii, Maui, Molokai, and Kauai.

A total of 1,275 bookings and about 165,750 viewers were counted for the period.

No new films or filmstrips were added to the library this year. However, the purchase of film racks considerably improved storage facilities and upkeep.

It is recommended that ISSEC provide funds for expansion of the film collection, as well as the purchase of up-to-date copies of several outdated space science films.

Wallace G. Sanford, Chairman

VISITING SCIENTISTS PROGRAM

The Visiting Scientists Program was started in 1963 and is supported by an annual grant from the National Science Foundation.

In October, 1964, Mr. Richard K. Coburn of the Church College of Hawaii took over the responsibility as director from Dr. W. G. Sanford, and during the same month Mrs. Lee C. Bowen was appointed executive secretary.

Because of changes in personnel, the program did not get under way until the beginning of 1965. In spite of the late start, it can be considered successful, as the following data show:

By the middle of May, scientists from the University of Hawaii, Bishop Museum, the Church College of Hawaii, and Straub Clinic had made a total of 107 visits to intermediate and high schools on Oahu and three of the outer islands. This figure includes 21 visits to the Senior Science Camp at Kaneohe in April. Three visits each to Hawaii, Kauai, and Maui were arranged with the assistance of the District Superintendents of the Department of Education on these islands. A total of 51 different schools took advantage of the program, 35 public and 16 private and parochial schools.

Visitation reports from teachers as well as from participating scientists were generally favorable. The students found the lectures both interesting and valuable.

Application for funds to continue the Visiting Scientists Program in 1965-66 has been made again to the National Science Foundation, and approval for another grant has been received.

Richard K. Coburn, Director

SCIENCE CLUBS SERVICE

A questionnaire to determine the number of science clubs throughout the state of Hawaii was sent to each school. The report indicated that there are over 50 organized science clubs throughout the state.

These science clubs are now operating independently and an effort is in progress to organize a central council to coordinate all the science clubs. This was initiated by Miss Iris Shinseki, a science club advisor at Waianae High School.

Robert A. Morimoto, Chairman

SCIENCE CLUBS CAMP

On April 2, 3, and 4, 1965 the 5th Annual Senior Science Camp was held at Camp Kokokahi, Kaneohe. A total of 146 students from 24 private and public high schools attended the camp. Because of the size of the camp, the Hawaii Conference Church Camp was also utilized.

Twenty-one university professors and science resource people conducted classes at the camp. Each class lasted one hour and averaged between 20 to 30 students. Speakers were selected from the Visiting Scientists Program. Seventeen counselors at the camp helped with planning and running of the camp.

Walter Luke, Chairman

ELEMENTARY SCIENCE TEXTS

Exploring Nature In Hawaii, by Sister Mary St. Lawrence, O.P., is a series of elementary science texts illustrated in color, extending from Books I through VIII published between the years 1955 and 1962 by the Catholic School Department of Hawaii under the direction of Rev. Daniel J. Dever, Superintendent of Catholic Schools. Initially 10,000 copies of each book were printed at Tongg Publishing Co. The Academy undertook the scientific advisory service for the manuscripts beginning with Book IV and the title pages of Books IV through VIII carry the endorsement of ISSEC. When Books I and II ran out of print, they were revised and 10,000 copies of each were printed with the ISSEC endorsement on the title page. Book III ran out of supply without revision. Present stocks stand at approximately 4,000 to 6,000 copies per book.

The series has been very well received and is used in public, private, and parochial schools with few exceptions. Sales to tourists continue at an even, good pace.

From time to time requests are made by teachers, both public and parochial, to have the series indexed (each book has its own table of contents only); to complete the teachers' manuals (these are available only for Books III through VII); to reproduce the illustrations for bulletin board use or as colored slides. These suggestions are not being seriously entertained at the moment because of financial outlay involved. The Catholic School Department which carries the financial responsibility for the series on a non-profit basis still stands considerably in debt for the initial printing color work, which debt is counterbalanced by the number of books in stock.

Sister Mary St. Lawrence, Chairman

SCIENCE TEACHER'S WORKSHOP

The Science Teacher's Workshop held in conjunction with the Annual Science Fair was handled this year by the Hawaii Science Teachers Association. John Kay, Biology teacher at Iolani School, acted as general chairman for this project.

The theme for the workshop, "Current Trends in Science Research and Implications for Science Teaching" was set at the committee's organizational meeting in December. It was decided at this time that the workshop should continue to stress the investigation and inquiry aspects of science, as has been the theme of past workshops. To this end, it was decided that the workshop should involve scientists discussing their current research problems and problems that they encounter in their investigations, so that the teachers would have an opportunity to gain insight into investigative techniques.

The following scientists were invited to participate in the workshop:

Dr. Ernst Reese, Zoology; Dr. John Holmes, Physics; Dr. Paul J. Scheuer, Chemistry; Dr. Malvern Gilmartin, Oceanography; Dr. George Woollard, Geophysics; and Dr. Gregory Bateson, Animal Psychology.

Dr. Jimmie B. Smith of the Pineapple Research Institute was invited to deliver the opening remarks and to comment on the Science Fair program.

There were 11 participants from Hawaii, 8 from Maui, and 11 from Kauai. There were 66 participants from Oahu, including 7 teachers who were on leave and participating in the NSF Academic Year Institute. In addition, there were 2 East-West Center Grantees. Also, Mr. Mike Donahoe, Western Region Representative of NASA, attended as a special guest.

The teachers represented all levels of science education from grades 7 to 12.

The workshop affords teachers a rare opportunity to discuss and ask about research problems with researchers and it also affords the opportunity for discussion of common problems. This opportunity for communication is one of the stronger points in a workshop of this nature.

Byron Yoshina, Chairman

The 40th ANNUAL MEETING 1964-65

Program

FINAL SESSION

May 22, 1965, Hawaii Institute of Geophysics Auditorium, University of Hawaii, Honolulu.

ADVANCING FRONTIERS IN PACIFIC COMMUNICATIONS RESEARCH

1. Satellite Communications.

   Gerald F. Payne........Vice President for Operations
   Hawaiian Telephone Company

2. Linguistic Research in the Pacific.

   Howard McKaughan............................Acting Director
   Pacific Lexicography Center
   University of Hawaii

3. Communication in the Higher Vertebrates.

   Gregory Bateson........Associate Director for Research
   The Oceanics Institute
   Makapuu Point, Oahu

Luncheon: East-West Center Cafeteria, Garden Room
Presentation of Awards

PRESIDENTIAL ADDRESS

The Temple of the Muses.

Roland W. Force, Director
Bernice P. Bishop Museum

BUSINESS MEETING

MAN AND THE PACIFIC ENVIRONMENT

4. New Horizons in Biomedical Research in the Pacific.

   Windsor Cutting..............Director, Pacific Biomedical Research Center, University of Hawaii

5. Current and Future Challenges of Tropical Agriculture.

   Harry F. Clements......College of Tropical Agriculture
   University of Hawaii

6. Geophysical Studies in the Hawaii Area.

   George Woollard............Director, Hawaii Institute of Geophysics, University of Hawaii

Papers Presented at Final Session

NEW HORIZONS IN SPACE COMMUNICATIONS

Gerald F. Payne*

One day late next year, a television signal will leave a station on the mainland. It will be received, amplified, and retransmitted by a satellite over the Pacific, and in a small fraction of a second it will arrive at a terminal station here in Hawaii, and then on a television screen in your home. Thus, Hawaii will become more intimately tied to the rest of the world through satellites in the sky. And so, when the next inauguration of the President of the United States takes place, you will be there, and when the umpire calls "Play ball" to open the World Series, you will be there!

The great appeal and impact of live international television has been and is being dramatically demonstrated. On May 2, 1965, we in Hawaii for the first time were able to enjoy an event on the day it occurred in Europe. Through the Early Bird satellite and the delivery of TV films to Hawaii by jet aircraft, viewers here were able to see scenes ranging from a heart-valve operation in Houston to a coordinated five-band musical presentation from five different countries.

And, last Monday the first transatlantic television program in color was transmitted by Early Bird. Other demonstrations planned for the future include transmission via Early Bird of telephone calls, photos, data, teletype messages, and other communications. These demonstrations herald the beginning of a new pattern in world communications.

President Johnson, who already has made two broadcasts from Washington to Europe via Early Bird, has stated that, through communications satellites, time and space will be telescoped, as voices, messages, and pictures leap the former barriers of distance with the speed of light.

What has brought about this new era in communications? The age of modern invention dawned with the 19th century, and distance began to disappear. Developments came quickly: the telegraph in 1844; the telephone in 1876; radio-telegraphy in 1896; the radio-telephone in 1900. As we entered the 20th century, the stage was set for trans-oceanic voice communications.

The first voice was sent overseas in 1915. In that year the Bell System, in cooperation with the United States Navy, demonstrated a voice-radio hookup between Honolulu, Washington, and Paris.

During the years that followed, refinements were made in the art of long-distance radio telephony, and consideration was given to the bottom of the sea as a pathway for the human voice.

In 1956, high-quality voice communication via undersea cable was offered with the installation of the first transatlantic telephone cable. Other cables quickly followed. Today, Hawaii is the hub of a cable network connecting the U. S. mainland, Canada, Australia, New Zealand, Japan and the Philippines.

Arthur G. Clarke, an ingenious and inventive individual, in 1945 proposed a global system of communications consisting of three satellites in synchronous orbit deployed around the globe.

In November 1957 the Soviet Union placed Sputnik I in orbit, and the fantasy of Clarke became a distinct possibility as Sputnik beeped its message around the world that the space age was really here.

The United States, a year later, placed a complete Atlas missile in orbit about the earth. It carried simple signal repetition equipment with a pre-recorded tape of President Eisenhower's Christmas message. It was the world's first device that could be called a communications satellite.

Then, in July 1962, Telstar, designed and built by the American Telephone and Telegraph Company, was placed in orbit and, through the drama of transatlantic television, the full impact of the potential and imminence of satellite communications was sensed for the first time.

In her traditional Christmas broadcast to the British Commonwealth in 1962, Queen Elizabeth said: "The wise men of old followed a star. Modern man has built one. But, unless the message of this new star is the same as theirs, our wisdom will count for naught."

The charter for the Communications Satellite Corporation was drafted by the Congress through the Communications Satellite Act of 1962. Early in 1963 the Corporation formally came into being and, in less than two years, the idea of Congress in 1962 has been transformed into a $200 million Corporation, owned by 164 communications carriers and more than 140,000 public stockholders distributed throughout the country. An international joint venture has been successfully launched, and today it includes the telecommunications entities of 45 countries. Within the group now assembled is represented more than 80 per cent of the communications traffic of the world. The Corporation, as manager for the international enterprise, has the responsibility of bringing into being a system to meet the needs of the world as expeditiously as possible.

But what are the needs and demands for an international communications capability, and how can satellites meet them? International telephone traffic

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*Operations Vice-President, Hawaiian Telephone Company, Honolulu.

has been growing at a rather impressive rate. During the past seven years the growth in Hawaii-Mainland telephone messages has been about 22 per cent per year, which means that traffic has been doubling every three and a half years. Actual demands have consistently exceeded estimated requirements. In 1960 Hawaiian Telephone Company estimated that 175 voice channels would be required for Hawaii-Mainland communications in 1966. Subsequent revisions have brought this figure to a present estimate in excess of 295 channels. This underestimation of actual demands is typical. The stimulus of the advent of a high-quality service has always produced a major impact on the demand for increased capacity.

It is clear that revenues from telephone traffic will provide the main source of income to the Communications Satellite Corporation in its early years. Although data and television traffic will undoubtedly be of growing importance, it will be the telephone business that will form the base for growth. It is, therefore, of some interest to look at the growth of the telephone industry on an international basis.

During 1963 more telephones were added throughout the world than in any previous year. The increase was close to 10 million telephones, an impressive number. The United States ranks far ahead of any other country in the number of telephones, having in excess of 84 million telephones in service. Japan is in second place, with a number in excess of 10 million. Thus, transpacific communications assume an even greater importance in the total international picture.

What can communications satellites do about the booming demands and how do they compare with other modes of communications?

The structure of a communications satellite system in its simplest form consists of three parts: a ground station to boost a signal to a satellite; the satellite itself which receives, amplifies, and then thrusts the signal forward; and a second ground station that picks up the signal.

To give a satellite signal its initial boost from the ground, thousands of watts of power are necessary. But the power of the signal that the Early Bird satellite sends back to earth may be something like six watts. At the second ground station, accordingly, a super-sensitive receiver is necessary to snare the remnants of the relayed signal. No home TV set could possibly do that job.

Since communications satellites are deployed at very high altitudes, from perhaps 6,000 miles to as high as 22,300 miles, a single satellite can be seen simultaneously over large areas of the earth's surface. Thus, any two points commonly visible to a satellite, and equipped with suitable ground terminal facilities, can communicate with each other through this satellite. Through the use of relay stations and multiple satellites, all points on the earth's surface can be connected. This multi-lateral aspect affords to most countries, for the first time, the possibility of global communications on a high-quality basis without reliance on ground links through other countries.

An intriguing thing is that, once the satellites themselves are deployed, a terminal station is the entry to a global communications capability. Very significantly, the cost of such a terminal station is not unduly high. Depending upon the type of station constructed, the cost might run somewhere between $2 million and $6½ million.

As you know, the only American commercial ground station now in operation is at Andover, Maine. Construction is expected to begin this year for a ground station in Hawaii. The Hawaiian station will probably be constructed on Oahu between Waialua and Kahuku, according to Douglas S. Guild, president of Hawaiian Telephone Company and also a director of the Communications Satellite Corporation.

The satellite system, of course, is a much more expensive proposition. Here the cost depends upon the number of satellites required to provide global coverage, the unit satellite cost, the cost of the boosters required to place the satellites in orbit, the launch reliability of these boosters, and finally, the most important factor, the lifetime of the satellites themselves in orbit. This in turn depends upon the types of components that are used, the numbers of components, and their lifetime cycle. The key to the economics of satellite communications systems lies in the building, selection, and integration of hundreds of components into an integrated assembly that will continue to operate without failure of any of its elements for a period of years. This imposing problem in reliability is the key to Communications Satellite Corporation's future.

In an address to the Eleventh National Symposium on Reliability and Quality Control in Miami Beach a few months ago, Dr. Joseph V. Charyk, president of Comsat, noted that the economic future of his corporation is more sensitively tied to reliability than any corporate venture of which he was aware. He said, "In our corporation we seek *not* to classify *reliability* as a separate function or discipline, but to make it an *essential* element of everything we do. We are in a field where technology is limited; where there are major unknowns. We are highly dependent upon related fields, also in a development phase, and all of these elements are locked together in single packages bearing huge price tags. No wonder, then, that in our corporation, we live and breathe reliability."

The impact of satellite lifetime and launch reliability can easily be appreciated if we compare an assumption of 90 per cent launch reliability and a five-year life on the one hand, with an assumption of 60 per cent reliability and three-year lifetime on the other hand. The costs of service in these two cases could vary over a range of two to one. This, perhaps, explains in part why the average person hears from one source at one time a rather gloomy prediction of when the Corporation will be in a profit position, while at another time, from another source, a glowing report is forthcoming. In reality, no one can truly predict the satellite lifetimes that may be achievable.

Even figures as high as ten years do not appear to be out of the question, although most predictions are based on the assumption that satellites of the simplest types might be expected to have a lifetime of three years, with the more complicated types initially limited to 12 to 18 months.

Satellites themselves are not unduly expensive, although the boosters that are required to place them in orbit may range from $3½ million to $7 million, or even higher if one contemplates the possible use of the very large boosters now in development. Even so, the initial investment required to deploy a global system of satellites to provide a global service is far lower than the investment that would be required to provide similar global capability by means of cable systems. However, in cable technology, all indications point to very long life systems with comparatively modest operating and maintenance costs, whereas in satellites, as I have pointed out, there is today no accurate picture of what satellite lifetimes will be achieved and, hence, what the operating expenses of the system will be and, therefore, what the relative economics will be.

As far as initial hardware costs are concerned, it may be noted that to lay a modern cable across the Atlantic requires an investment of about $45 million and from Hawaii to the Mainland about $33 million. Such a modern cable has a capacity of 138 basic voice circuits. With the use of TASI (Time Assignment Speech Interpolation) equipment, this number can be doubled for use in voice communications.

Today, Early Bird, and its appropriate translation into many different languages, has become a synonym for the herald of a new era in international communications. So perhaps it is appropriate to dwell for a few minutes on Early Bird and on what it may portend.

Early Bird was launched from Cape Kennedy aboard a thrust-augmented Thor-Delta rocket on April 6, 1965. The first two stages performed perfectly and, after the programmed coast phase, the third stage was fired over South Africa to place the satellite into an almost perfect transfer orbit. The initial inclination to the equator was about 18° and in this orbit the satellite travelled out to a distance of 22,680 statute miles above the earth and down to 910 miles.

During the next few days, appropriate altitude and velocity changes were effected through commands generated in the Communications Satellite Corporation's command and control center in Washington and sent to the satellite via the earth station at Andover, Maine. Then on April 9, with the satellite at its farthest point from the earth's surface, the final apogee rocket motor was fired to place the satellite into a stationary orbit above the equator and the Atlantic Ocean. The accuracy of this operation was such that the satellite was placed within 9/100 of a degree of the equator.

Even while the satellite was in its transfer orbit, test television transmissions were sent from Andover to the satellite and back to Andover, and the signals confirmed that the communications equipment was working perfectly. During the first 10 days after Early Bird was launched, 55 commands were transmitted to the satellite and nearly 3,000 valve operations took place in the two hydrogen peroxide systems during 25 orientation and positioning maneuvers.

The Early Bird satellite has a capacity of 240 voice circuits, or a capacity approaching the total of all the telephone cables laid across the Atlantic. The hardware costs for the satellite itself is of the order of $1.2 million, while the Thor-Delta rocket that placed the satellite in orbit was launched for about $3½ million.

In size and appearance, Early Bird is similar to the Syncom satellites. It is a spin-stabilized synchronous satellite 28.4 inches in diameter and 23.25 inches high, exclusive of antennas and apogee motor.

Weight of Early Bird in orbit is *only* 85 pounds. The outer surface of the satellite is covered with 6,000 silicon-coated solar cells. The spacecraft is built around an aluminum and magnesium riveted structure. The outer structure supports the solar cell panels and contains the hydrogen peroxide gas system tanks, the axial and radial jets of the control system and most of the spacecraft electronics. The inner structure supports the apogee motor and the remainder of the electronics. Antennas consist of collinear slot dipoles for transmitting and receiving, and four whip antennas in a turnstile arrangement for VHF telemetry and command.

The electrical power system consists of the 6,000 silicon solar cells arrayed on four individual panels that provide a total area of 1,968 square inches, two 21-cell nickel cadmium batteries, and voltage regulators. The solar cells supply 45 watts without drain on the batteries when the satellite is not shadowed by the earth. During its 24-hour orbit, the satellite will be in full sunlight for most of its orbital life. However, during an eclipse, the satellite will be in a shadow for periods up to 70 minutes. During these periods, electrical power will be supplied by the batteries for operation of the receivers and decoders.

The Early Bird electronics includes communications, command, and telemetry. The communications system is a redundant, frequency-translation, active repeater. Ground station signals are received by redundant receivers which are interconnected in such a way that they can drive either one of the satellite's two traveling wave tube transmitters. Either tube may be selected on command, but only one may be activated at a time. The output of each is six watts.

Dramatic and successful as the Early Bird has been, this satellite is only the first step. To determine the type of satellite system that will best meet the requirements for global service, the Communications Satellite Corporation has embarked on a far-reaching research and development effort including design and development work on several types of satellites. Off hand, one might tend to conclude that the optimum satellite system would be the one requiring the fewest number of satellites to provide global coverage. This, however, may not be the case. In order to focus on this point, let me discuss briefly the different types of possible satellite systems and some of the advantages and disadvantages of each.

The one that would appear to be the simplest and most economical is one that we call a sychronous system. This system draws its name from the fact that the satellites are positioned above the equator at an altitude of the order of 22,300 statute miles. At this altitude the velocity of the satellite is such that it is, in effect, synchronized with the earth's rotational speed. To an observer on the earth, the satellite appears to maintain a fixed position in space above a particular point on the earth's surface.

The synchronous satellite involves no real paradox. The farther from earth a satellite gets, the less the pull of gravity; and the less the pull of gravity, the less speed is required to keep the satellite in orbit.

Therefore, it takes progressively longer to make one complete revolution; and at a certain height—which happens to be 22,300 miles—one trip around the earth takes exactly 24 hours. Since this is the earth's own period of rotation, the satellite is able to hover over one spot as though defying the law of gravity. Of course it is not really motionless, for it is moving along in its own orbit at about 6,900 miles an hour. But at this speed it just keeps up with a point on the earth's spinning equator far below.

A single synchronous satellite would be commonly visible to points over an area comprising more than 43 per cent of the earth's surface. Three such satellites properly positioned would provide communications on a global basis with the exception of two relatively minor areas in the vicinity of the poles. Since rather small disturbing forces are present, however, satellites of this type require a small propulsion unit on board to provide the control forces which are necessary to keep it in position and which must be initiated by commands from the ground. Three successful synchronous satellites have been launched: Syncom II (July 1963); Syncom III (August 1964); and the Early Bird satellite launched last month, which is an improved version of the first two.

For all its obvious advantages, the fixed synchronous satellite has one unavoidable defect. Because it is 22,300 miles above the earth, even radio waves—traveling at 186,000 miles a second—take an appreciable time to reach it and return to earth. This introduces a time lag in conversations. When you ask a question, there will be a delay of over half a second before you can receive a reply. Fast-speaking individuals who insist on interrupting each other may find it hard to adjust to the half-second delay.

Although this time delay in itself may not prove objectionable to any significant percentage of users, a related factor may aggravate the problem, namely, that of echoes. Echoes arise from the impedance mismatch that occurs when long-distance transmission facilities connect with local facilities. The former are four-wire systems, in which transmission in the two directions are carried on separate circuits or pairs of wires. In the latter systems, one circuit or pair of wires carries transmission in both directions. The eerie echoes noticed on some of the first Early Bird broadcasts were good illustrations of an impedance mismatch. Echo suppressors are available, but there is no such thing as a perfect echo suppressor. Much encouragement is received, however, from the results of tests with the latest echo suppressors being built by Western Electric Co.

A second kind of satellite system studied is one generally referred to as the medium altitude random type. This system envisions a relatively large number of satellites, perhaps of the order of 18 to 24, orbiting the earth at altitudes of about 6,000 to 8,000 miles.

These satellites are of the simplest type, very similar to Telstar or Relay. They contain no devices that might be used to alter the orbit of the satellite and no attempt is made to space the satellites relative to each other. Not less than 18 such satellites would permit communications between major points on the earth's surface on practically a full-time basis. However, there may be brief periods during a month when no satellite would be commonly visible between two points of major interest and, hence, during such periods, communications by satellite would be impossible. This latter factor is one of the disadvantages of this type of system.

Another major disadvantage is, of course, the large number of satellites required to achieve global service. This system would also require more sophisticated ground stations since they would have to track the orbiting satellites. The ground station's antennas must be movable, locking onto a satellite and tracking it across the sky. A second antenna is also needed to pick up the next satellite as it comes over the horizon.

Advantage of the medium altitude random system is that the satellites are of the simplest type and, hence, can be expected to have a relatively long lifetime. Also, several satellites of this type can be placed into orbit with a single rocket, or booster, and time delay is minimal.

An intermediate type is the so-called medium altitude phased system. Here the satellites are again at altitudes of the order of 6,000 to 8,000 miles. However, the satellites contain a positioning device which is used to properly space the satellites relative to each other during the first few weeks after launch. The satellites are arranged so that as one satellite disappears over the horizon, another satellite appears. Thus continuous communication between major points of interest on a global basis can be provided with as few as twelve satellites. Although a positioning control device is needed, it must function only during the first few weeks after launch, unlike the synchronous case, where it must function throughout the lifetime of the satellite. Fewer satellites are required than in the random type, and launching of a number of satellites with a single booster is simply accomplished.

On the basis of the Early Bird satellite experience and the results from research and design contracts on the medium altitude random and medium altitude phase systems, the Communications Satellite Corporation plans to make a decision not later than the latter part of 1965 as to which type of system will be deployed on a global basis.

It now appears that a satellite design can be evolved which can be used either in a synchronous orbit or in a phased system at any altitude between 6,000 miles and synchronous altitudes. Accordingly, the Communications Satellite Corporation is now planning to invite proposals for the development of such a satellite and hopes to initiate active development in the coming months on a schedule that would permit global deployment by the latter part of 1967. It is expected that this satellite would have a capacity of at least 1,000 two-way telephone circuits and that a number of such satellites could be launched by a single booster rocket.

The fundamental accomplishment of a satellite communication system is to leap-frog over the limitation of earlier equipment. In effect, the launching of Early Bird is the equivalent of installing virtually overnight a communications network connecting North America, South America, Europe, and Africa.

Among communications specialists, there is a widespread belief that communications satellites will end the geographic remoteness for many lands that might be years in gaining the national advantages of up-to-date communications. Even now, the global television audience is increasing at a rate of two million homes a month.

Our perception of the future, however, must be dim, but history teaches us that we are probably unable to foresee with accuracy the full potential that communications satellites may yield. Suffice it to say that we stand on the threshold of an exciting new age.

One of the most useful bits of information that communications satellites will distribute to the world will be weather bulletins, assembled from photographs taken from meteorological satellites. The best weather satellite cannot stop the weather or change its effects. Yet weather satellites can provide two vital weapons in fighting the elements: forewarning and understanding. Photographs taken by the Tiros satellites already have saved lives and property. Understanding will come in time. Years and years of analysis and study of the weather will expose its moving forces. When they are exposed and understood, perhaps then they *can* be controlled.

Already the idea has been advanced that the oceans could be sown with transmitting buoys that would flash up to a satellite detailed weather conditions. Possibly the height of a wave generated by an earthquake could be reported by these buoys.

Another application of communications satellites that may have great potential is their use for communications between stations on the ground and aircraft flying the commercial air routes of the world.

A milestone in aviation history was reached on November 21, 1964, when the first successful ground-to-air communication using a satellite was received aboard a Pan American 707 jet enroute from San Francisco to Honolulu. Printed messages were sent from a ground facility in California to the Syncom III satellite stationed over the equator and the International Date Line. The Syncom III then re-transmitted the message to the aircraft. It is amazing to realize that the total communications distance from the ground facility to the aircraft via the satellite was about 45,000 miles, equivalent to nearly twice the distance around the earth.

The possibility is now being explored of incorporating in a future Early Bird a VHF capability to permit two-way experimental communications between ground facilities and regular commercial aircraft.

Other communications possibilities are equally exotic. For example, in computer storage systems there is the opportunity for establishing an electronic reference bureau. Tomorrow's student may be able to insert into a machine an inquiry as to where he can learn about a given topic. In seconds, back would come any appropriate material that may be available in the libraries of the world.

We often hear that technological developments seem to be outpacing political and sociological developments and that man has failed to develop satisfactory non-technical tools needed for their control. We are hopeful that the expansion of communications attributable to satellite development may help to improve understanding among peoples of the world and provide a new aid to growth in international trade and commerce and cultural interchange.

Conservative individuals have little doubt that communications satellites, at least, will add a new dimension to international communications. More visionary souls such as Arthur Clarke, who in 1945 proposed global communications via satellites, have forecast as follows: "Comsats will end ages of isolation, making us all members of a single family, teaching us to read and speak, however, imperfectly, a single language. Thanks to some electronic gear 20,000 miles above the equator, ours will be the last century of the savage and for all mankind the Stone Age will be over."

LINGUISTIC RESEARCH IN THE PACIFIC

Howard McKaughan*

Linguistic research in the Pacific has received real impetus in the last few years. General surveys for the state of such research in the area were made in connection with the Tenth Pacific Science Congress and the Ninth International Congress of Linguistics in 1961 and 1962 respectively. Capell's two surveys in 1962, together with comments by various linguists on one of the papers, give current information on our knowledge of the languages, their classification, and structures.

The Congresses mentioned and a Conference on Linguistic Problems of the Indo-Pacific Area held in January, 1965 at the School of Oriental and African Studies, University of London, have been attended by linguists from many parts of the world.

One of the points of discussion at the Pacific Science Congress held at the University of Hawaii was the problem of focusing this widely scattered interest and creating some means of centralizing information as well as disseminating it. The outcome was the establishment of the journal *Oceanic Linguistics,* edited by Professor George Grace. This journal attempts to keep abreast of linguistic research in the Pacific, report on the people working on such research, and their projects, and generally act as a center for information concerning these activities. The journal is now published by the department of linguistics of the University of Hawaii where Dr. Grace is a professor.

Interest in linguistic research grows and is encouraging. Fortunately also, the number of linguists actually

*Department of Linguistics, University of Hawaii, Honolulu.

doing research on Pacific problems increases each year. The prospects ahead are excellent, though not to be assumed apart from a continued pressure to encourage linguistic research in many almost completely neglected areas.

It should be remembered that almost one-quarter of the languages of the world are spoken in the Pacific and bordering areas. It is estimated that between 500 and 1,000 languages are spoken in New Guinea alone, and that apart from these some 500 languages are spoken by members of the Austronesian family.

Through the efforts of Stephen Wurm of the Australian National University and through those of linguistic researchers of the Summer Institute of Linguistics, we are gradually getting something of a picture of the languages in the Territory of New Guinea, especially in the Highlands. Some of the Austronesian languages have been studied in even more detail. But in both areas much more intensive work is needed in straight descriptive statements concerning the phonologies and grammars of the languages, and in comparative studies within the families.

Polynesian is one of our more clearly defined subgroups of Austronesian, but even in this subgroup there are many gaps to our knowledge. The linguistic picture in the areas of Micronesia and Melanesia needs even more attention, the linguistic structure in Melanesia being very complex.

The outlook for linguistic research in the Pacific is now better than ever. A statement concerning some of the more important research projects and agencies known to the author will indicate both the direction and the type of research envisioned for the next few years. Statements dealing with actual languages, their relationships, structures, and so forth may be noted in the references cited at the end of the paper. Time permits only the briefest of summaries.

One of the most productive organizations primarily interested in research is the Summer Institute of Linguistics. This organization is a private corporation devoted to analysis and description of lesser-known languages which have previously been unstudied. The group applies its research to the preparation of literacy materials, to giving aid to the governments of the countries where they work especially for educational purposes, and to serving mission organizations by translating the Scriptures into the languages being studied.

The corporation has research teams in 16 countries in both hemispheres studying over 360 languages. In the Pacific area, SIL has teams studying 17 languages in South Vietnam, over 40 in the Philippines, 65 in the Territory of New Guinea, and 7 in Australia. Reports of the work in the Philippines and New Guinea appeared in *Oceanic Linguistics* in 1962 and 1963. The last number of this journal published a number of data-oriented papers by the Philippine Branch of SIL, and a monograph on *Verb Studies in Five New Guinea Languages* appeared in 1964 as a publication of the SIL University of Oklahoma. Articles on languages of South Vietnam have been published in *Mon-Khmer Studies I and II* put out by the Linguistic Circle of Saigon. A number of papers by members of this organization have also appeared in *Oceanic Linguistic Monographs*, and others will appear shortly in a new monograph series by the Linguistic Circle of Canberra. The linguistic production by this organization is excellent and should be highly commended. It is hoped that they will expand their work out from New Guinea to some of the Melanesian languages, and even further into the Pacific as well as into other countries of Southeast Asia.

An example of a project involving both cultural and linguistic research is the Micro-Evolution Studies Project under the leadership of Prof. James B. Watson of the University of Washington. This project is concentrating on four languages of the Eastern Highlands of New Guinea (Awa, Auyana, Gadsup, and Tairora). It is hoped that correlations will be found between language behavior and culture, perhaps along the lines of divergence in both systems. Project studies on linguistic divergence by the author appear in a special New Guinea issue of the *American Anthropologist*, which also contains a number of other articles of interest to both anthropologists and linguists. Such interdisciplinary projects are of importance because of the basic knowledge gained, and because of the possible impact of the disciplines on each other. Current trends in the development of models in linguistics and their application to the study of culture are proving to be exciting indeed, and the Pacific is in the vanguard of such research.

Various techniques to measure language divergence and also to help in the classification of languages have been applied in Pacific linguistics. The most extensive application of lexicostatistics anywhere in the world has just been completed by Professor Dyen of Yale. His work is titled *A Lexicostatistical Classification of Austronesian Languages.* He did his research primarily under the auspices of the Tri-Institutional Pacific Program (TRIPP) sponsored by Yale University, the University of Hawaii, and the Bernice P. Bishop Museum. Three hundred and seventy one lists were used, with at least one hundred items per list to be compard. This implies 68,635 pairs of lists with the calculation of the percentages of cognates for each pair yielding more than 7,000,000 pairs of words. A machine program was written for the calculation of the percentages of cognates of each list with each other list. Two things should be noted: (1) the importance of the computer in handling such masses of data, and (2) the availability of these results for testing in specific instances. The latter will no doubt help in our conclusions as to the usefulness of lexicostatistics as well as its validity.

Another important proposal for research in the Pacific is one submitted to the National Science Foundation by the Bishop Museum entitled: "Polynesian Culture History." This is another interdisciplinary approach, in this case applied to the problem of Oceanic culture history. The disciplines eventually to participate include archaeology, cultural anthropology, ethnobotany, human geography, and linguistics.

The linguistic phase of the proposal envisions a focus on Polynesian. It is hoped that specific neglected areas will receive attention and that current materials can be updated and made available to other linguists. Major descriptive work is proposed for the Ellice Islands. Comparative studies in both lexicon and grammar are proposed, with the use of the computer as an aid in analysis as well as storage and retrieval for the data. Field trips augmented by work with informants available in Hawaii and New Zealand will be another major part of the project. Prospects of receiving grant aid from the National Science Foundation, especially for the archaeology and linguistic phases, seem bright.

The Bishop Museum is cooperating in this project with linguists of the University of Hawaii and the University of Auckland (as well as other institutions in New Zealand and Fiji). Cooperative research efforts such as this are to be encouraged in every way possible. Such cooperation, we feel, will lead to better and more thorough coverage of the languages in the area.

An important factor in linguistic research in the Pacific is the new department of linguistics at the University of Hawaii. This department was initiated in the fall of 1963, and has grown from a faculty of three members to nine in fall of 1965. Administrative and legislative support at the University for this emphasis on linguistic research is to be highly commended.

Specialists have been appointed with the Pacific and border areas in mind. This is in line with the natural responsibilities of the only University in the Central Pacific. Programs leading to the M.A. and Ph. D. degrees in linguistics are available, with special focus on descriptive and comparative research. Although the area interests are not limited to the Pacific, the department does encourage research by its graduate students in this particular area of the world.

A newly approved Pacific Lexicography Center at the University of Hawaii will also have an important impact on linguistic research in the Pacific. The objectives of the Lexicography Center are: (1) to gather and disseminate linguistic research information for the Pacific and bordering areas, (2) to collect and store lexical materials of all descriptions, and (3) to prepare, produce, and publish a new variety of lexicographic tools for students and scholars. The use of the computer in realizing these objectives is an important factor in the Lexicography Center plans.

Research is under way on new systems for storing, and retrieving all kinds of linguistic information through utilization of the University of Hawaii's Statistical and Computing Center. Excluding certain military installations, this Computer Center is the largest in the Pacific. With the IBM 360 on order, the Computer Center will have available a total configuration including the IBM 7040 and 1401 now in operation.

Assuming the availability of adequate buffering equipment to allow "on-line" or "real-time" access to core and secondary storage, consoles are now being designed to utilize IBM's 1050 terminals and/or 2250 display units in such a manner that the working linguist can store, retrieve, edit, and relocate linguistic information in quantities and at speeds never before achieved. Experimental programs are now under study which will allow not only instantaneous access to a variety of types of stored information, but will also allow the first practical application of recent discoveries in lexical association patterns to dictionary production. Eventually it is hoped that materials available at the Pacific Lexicography Center will contribute significantly to the machine analysis of specific languages and to machine translation in general.

The experimentation with storage and retrieval techniques envisioned by the Lexicography Center will give due attention to problems and desiderata of historical linguistics. It should be possible to retrieve not only complete vocabularies for particular languages, but comparative vocabularies of the following types: (1) lexicostatistical test-lists, (2) longer comparative lists, matched by gloss, and eventually (3) comparative lists matched by etymon. The last would require experimentation with computer techniques for phonological comparison.

Many individuals other than those connected with the projects or agencies mentioned are doing linguistic research in the Pacific. *Oceanic Linguistics* reports on these activities as they are brought to our attention. This journal will no doubt be an important outlet for research results in the Pacific and may be able to initiate a monograph series to handle longer data-oriented materials such as dictionaries, texts, and descriptive analyses, as well as comparative results.

Perhaps this is the place to express strong hopes that foundations will not only support the research envisioned in the Pacific, but will also strongly support the publication of the results thereof. We view with much concern the tendency to publish only articles of theoretical orientation. Data in the form of dictionaries, word lists, texts, data-oriented analyses, and general descriptions are important to the science and its future.

We are much encouraged by the outlook for linguistic research in the Pacific. It is possible to clarify the linguistic picture in this area of the world within a reasonable length of time. We believe that the variety of languages represented, their numbers, and the work already done all go together to make this area important for such a focus long neglected. Centers such as the Bishop Museum and the University of Hawaii have taken on this challenge with every reason to believe that success is assured.

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COMMUNICATION AMONG THE HIGHER VERTEBRATES

(Abstract)

Gregory Bateson*

From the protozoa to man, creatures receive information about each other's presence and state; and, as we go higher on the scale, the information which can be received becomes more and more varied and complex.

A first task, then, is to grade the orders of complexity that have evolved.

Perhaps the most important single step in the whole evolution occurred when some species became able to use the information that *"this movement or sound which I now make is a signal."* Of course, movements and sounds carried meaning long before that critical moment, but those signals were emitted without awareness of their nature and were responded to, we may say, automatically.

With the evolution of awareness of the nature of the signal, it became possible for the animal to monitor or correct his signals; it became possible to communicate about communication; and, last but not least, it became possible to deceive and to distrust the signals of others.

Let us call the creatures who have taken this step the "Higher Vertebrates." But at what stage, then, did evolution achieve this decisive step?

We cannot identify these "higher" creatures until we know what is the subject matter of mammalian communication.

This latter question I would answer by saying that they communicate about styles of relationship. When you go to the refrigerator and the cat comes up and makes certain sounds, I would suggest that she is saying "Dependency! Dependency!" She is not saying "milk," nor does it help to say that she is expressing her feelings. She is telling you what sort of relationship she expects or assumes, and you are supposed to deduce from this that your next behavior is to provide milk.

In other words, the language of mammals is rather abstract.

Probably the human ability to make indicative statements about concrete objects is unique to that species—and is, at that, imperfectly developed, even among males.

But does the cat use the information that her message is a message?

The question is difficult to answer in regard to the sort of signal which we are considering here. It is possible, however, to answer in other types of cases. In the training of porpoises at Sea Life Park it is clear that the animals are very well able to use the information that the *actions* which they are asked to perform on cue are also signals about their relationship to the trainer. The porpoise who is annoyed with the trainer will refuse the act. The act is therefore not at all the automatic matter which simple learning theory might suggest.

For research in learning and discrimination, this can be a troublesome matter. It is difficult to tell whether the animal does not know what he should do, or whether, knowing very well, he still chooses to do what he should not.

The capacity to be *naughty* becomes an indication of high evolutionary status.

*Associate Director for Research, Oceanic Institute, Waimanalo.

NEW HORIZONS IN BIOMEDICAL RESEARCH IN THE PACIFIC

Windsor C. Cutting*

My story this afternoon has two parts. Part one concerns what we have. Part two concerns what we almost have. God willing, the Legislature acting, we'll be on our way to it soon.

The part we do have is the Pacific Biomedical Research Center. The PBRC arose as a concept five years ago when a task force from the National Institutes of Health came here to see whether they might make a branch in Hawaii. They were impressed by what I call a three-adjective lure: the marine, tropical, and ethnic aspects of Hawaii. They thought that these three adjectival lures offered unique features and that they should, in fact, have a new branch here to do new medical-biomedical research along these lines particularly. They went back to Washington. Congress did not fund the venture. The State of Hawaii thought the idea was good, did fund it, and constructed the building. (I call it the "House with the Golden Shutters," which seems to please some people.) In that house, then, finished about two years ago, are a number of departments, and I thought that first, since we're sort of giving a status of things here, I might tell you what those departments are and what they are doing—not everything they're doing, because they're doing everything, but picking out a few things which can be done only in Hawaii.

On the ground floor is the department of genetics. Genetics deals with genes and heredity, and where you came from, and why you're this way (because your grandfather was that way). Geneticists study thyroid glands, blood groups, twinning, a number of things, and they make use of this adjective "ethnic." We found Hawaii a delightful place to be. We found the people of Hawaii delightful, and one of their delights is their diversity—their ethnic diversity. What better subject could a department of genetics have than the people of Hawaii to work on and with? So they're very happy.

Next is the department of microbiology. Microbiology is a large field, ranging from immunology to bacteriology to virology, and so forth. Many of these things can be done as well in San Francisco as in Honolulu, but a few, perhaps, are best done here. One is the study of schistosomiasis, a disease caused by a little worm which is very troublesome in Egypt, also in Japan, southeast Asia, and other places. So here is the door to Asia, where this can be well studied. Also there is, on the beaches, a toxic alga that sometimes gets inside swimmers' shorts, apparently. It gives the swimmer an itch, but what is it that does that? This is grist for the mill of microbiology. The last one is the use of poi as a microbiological medium. I was talking to the Regents of the University a couple of days ago, running over these things with them, and when I spoke the word "poi" they all perked up and wondered if there was enough poi for microbiology to use. We thought there probably would be.

Biochemistry, on the top floor, deals with nucleic acids, proteins, and polypeptides, in other words, with the things of which cells are made. And their Hawaiian element, exists more in the people here than in the actual subject because these matters are studied all over the world. The language of deoxyribonucleic acid is universal, but if you walk along the corridor up there, you'll see people in saris, and people in white pants, and people in black pants, and people in practically no pants at all. That's Hawaii for you, in biochemistry.

The psychologists have a portion of their interests in the PBRC. They're studying the effects on babies of what happened to the mothers beforehand: if the mothers are given certain drugs before delivery, are the babies better or worse for it?

In physiology, the emphasis is on environmental physiology. Of course, Hawaii does have the kind of environment which does have unique qualities, particularly in comparison with Alaska, so that some of the things studied under the heading of environment are comparing stress or reaction to stress in Hawaii and in Alaska. Those of you who have been bothered during the last two years by barking dogs will be glad to know that those dogs have been moved to Alaska, where litter mates are now running with them, and we are going to see who runs better, Alaska dogs or Hawaii dogs. I don't know the answer yet.

Then at pharmacology, which is also on the top floor of the building, we have a group interested in chemotherapy, which is the treatment of diseases with drugs. Our long-term interest has been in trying to find drugs which would affect virus diseases and, because cancer may be caused by viruses, drugs which might affect cancer. And, because, interestingly enough, the process of fertilization has something in common with both virus infections and cancer in trying to find drugs which would be useful as anti-fertility agents. When we started out here we had transposed compounds, some synthetic, some from nature, some actually bacterial products, and suddenly we realized that there were a lot of other things in this area that we never thought about before. The phrase I love to say is "Indo-Australian biota," because *this* is what is present in Hawaii and is not present in San Francisco. It means everything that is living—from here to the southern part of Africa: plants, trees, flowers, bushes, animals, fish, and so forth. It also means the microscopic correlates to the macroscopic things. So there's an infinity of possibilities here for natural products. This was by no means a new discovery. Everybody here, people in many departments, had already had this idea, and now we're trying to gather them together to bring this into a group action. Since I'm particularly interested in this phase I want to go over it a little with you.

Suppose the indigenous people in some South Pacific island have a plant which they think is good for something, and that you would like to find out about

*Director, Pacific Biomedical Research Center, University of Hawaii.

it. But if you go down there and ask them, they won't tell you about it. If, however, your anthropologist can go down there and live among them a couple of years and woo them, then perhaps they will tell you what the secrets are. If you're a public health man, perhaps you can get their confidence. Then, however, it's outside of the capacity of the anthropologist to know whether this plant is the same as that favored plant. How to collect it, what condition to get it back in, and so on. Here's where botanists and zoologists come into the picture. And, when we do get the material here, a mass of leaves or stems or roots of something, how do you get the actual active principle out of it? Our thought is that, first the pharmacologist would make a crude extract of it, and if this showed any promise, he'd turn it over to the chemist because what the organic chemist would rather have than anything else in the world is a beautiful Erlenmeyer flask with some white crystals in it, newly isolated, of an unknown substance. This would make any chemist happy, and we hope to provide them with plenty of happiness. Then the chemist would give the isolated compounds back to the pharmacologist who would try to find out if they are still active (because sometimes the period of activity has been lost along the way). So how does it act, what's the mechanism, what's the toxicity for laboratory animals, if this substance really looks interesting? And in this the pathologist is involved. Finally, if this happens to be a ten-strike, and it does look as though the substance is good for something, then a clinician is needed to test it on human patients. So here is a long series of tests involving entirely different departments, which are now getting together on this kind of a project.

Now to go to extramural things. We have tried to be useful for the city of Honolulu along scientific lines. But when you have a building already completely full of people, two to a foot, practically, you can't invite everybody to come in and work there. But we have tried to be hospitable, especially if people have interests along the lines of some workers in the building. So now eight doctors from the community are having some kind of contact with the PBRC: six physicians, one veterinarian, and one dentist. In these projects, one way or another, we're able to have, we hope, some usefulness outside of our own building. We're also engaged in a cooperative venture with the State Department of Health on pesticides. Washington asked the Department of Health if Hawaii would be one of nine states to assess the danger from pesticides. Hawaii will do it. The research is being done physically here at the University.

We're trying to organize a hormone conference here, an international conference, to bring people from all over the world. And this for a rather interesting idea. The animal hormone people know everything about each other's work, the plant hormone people know about their's, but the animal people have no idea what indoleacetic acid (which is a plant hormone) would do to animals, and so forth. We thought that perhaps here, where a lot of agricultural science is present, might be an ideal place for such a joint meeting.

A computer is now being installed, a satellite computer to the big one in the University, so that the geneticists, particularly, can be happy. There is a venture in Kewalo Basin to build a sea-side laboratory, so that marine forms can be used for medical-biomedical research. If you want to work on the nerves of a squid and it needs fresh salt water, it's easier to do this at the edge of the ocean than even 10 minutes inland, particularly if the sea-water pump doesn't work very well where you happen to be 10 minutes inland. So some day we hope to have a Kewalo Basin Branch, and to this Branch attract scientists from everywhere who want to come and work by the sea in a delightful place, in other words, the whole mid-Pacific. Just the other day I got a letter from a man in Michigan. This looks pretty good to him: he'd like to come here and spend six months. Trouble is, the building isn't built yet.

One word on finances before I finish with the PBRC. Everything costs money, and everybody or nearly everybody likes to know how much it costs and who's paying for it. The state's budget for the PBRC (this is the research budget and not the teaching budget of the department there) is about $100,000 a year. The Federal budget—in other words, the total of PBRC's Federal research grants—is 15 times that, or a million and a half dollars a year. So, with that relatively small amount, scientifically speaking, Hawaii is able to attract 15 times as much Federal money, which we think is pretty good, too.

Now that's what we have. If we go on to what we almost have, this is the two-year medical school. This is something that keeps Dr. Lee and me busy—three times a day, as it were. The history of this does not go back as far as that of the PBRC. In 1962, WICHE, the Western Interstate Commission for Higher Education, sent a group here to see whether Hawaii might have anything to contribute toward the nation's needs for physicians and saw that, yes indeed, Hawaii could, and Hawaii should, and that its contribution probably lies along the lines of a two-year medical school. So the Regents of the University authorized a study, and the Commonwealth Foundation gave a grant which has now run through two years to support study of this problem and to try to develop it in its early stages if it were warranted. Also, the Association of American Medical Colleges sent out a group. (It's amazing how many groups come out here. If you apply for a few dollars from Washington, 13 people come out here. They arrive on the next plane to see if you deserve it or not. We have no flights scheduled for tomorrow, but Monday we're back on schedule again). Well, last year, 1964, the Governor strongly supported this thesis, the Legislature approved it in concept, and this brings us up to the current time when the Legislature is now considering it in detail and in actuality. I hope that they find the money, find the words, in the course of the next few days, before they adjourn.

You may be interested in knowing what the story of the two-year medical school is. In this context are the thoughts of three years ago, when they started planning here. There are, actually in being or in planning, eight two-year medical schools in the United States, out of about 85 or 90 altogether. This is counting Hawaii as one. The President in Washington has recently had a Commission study many needs in medicine. This is the Commission that has come out with the recommendation that cancer, stroke, heart disease, and so forth, be studied intensively. Their answer is that the United States needs 1,000 more physicians a year than it now produces, and that the best source for these lies in two-year schools. The reason is that in all medical schools the first two years are tight because they require laboratories. The last two years are not nearly as tight because then the laboratories are likely to be hospital rooms or wards, and then there are usually plenty of patients. These "clinical years" are not limited by physical equipment. The purpose of the school here —some people ask, why do we need a school here anyhow?—is threefold: One, the youth of Hawaii don't have quite the same chances that the youth of California do to go to medical school. If a boy or girl is eager, mature, venturesome, has plenty of money, there's no problem. He can go anywhere he wants to—even to medical school, if he's smart enough. If he's not quite so well-heeled, or not quite so venturesome, or a little bit later in maturing, he may say, well, I'd better do something that isn't quite so demanding, and he doesn't consider medicine seriously. So, unless there's a chance to start him in medicine here, some of Hawaii's children don't have an even break.

Number two, which actually, in the long run, is equally important, if not almost more important, is research. In every medical school you have a faculty, and the faculty by and large divides its time half and half between teaching and research. The research product, in terms of faculty, and really in all other ways of assessment, is equally as important as the student product. And if you have a research organization in a community studying medical problems, then the city or the community becomes a much more lively, interesting place, medically, and has much more a chance of having something practical done for it in the long run.

Third, this is one way in which Hawaii can play an international role. (I'm going to come back to this in a moment.) The curriculum of the school we have in mind is interesting, in that it will let the students continue to take arts and sciences courses while they're in medicine. I don't want to go into this now in detail, but we do think we have some curricular niceties. The building is planned on a hexagonal motif, which will be interesting too, because most buildings are rectangular in scheme. This will be a large base with a rising tower, the units being hexagons (the arguments for those in favor are that the bees know best, and the arguments for others is how can you do any better than a square? I don't know, I'm not an architect, but we're building it in the hexagon style). The time-table for this is three or four years. A big building takes about a year to plan in detail and about two years to build, so about three years from now, more or less, will be the earliest time to start the medical school.

Now I want to speak about two other units in the health area. One is the School of Public Health and the other is the School of Nursing. With Dr. Lee here, I have the feeling that some day he'll tell you the Public Health story more in detail, so I want to mention just one thing about it. This is that if you belong to a state which is so wealthy that it can waste money, it can have a Public Health School in Berkeley and a Medical School in San Francisco: nobody worries about a little duplication here and there. If you're not quite in that status, it behooves you to feel you can economize by having the two schools near together, in fact almost integral parts of each other. We planned things this way, and then we found that we had some unearned increments coming along too: the experts in the School of Public Health would be available in the medical school without any maneuvering, or manipulation, or getting of appointments, or so forth, and vice versa. So I think both Dr. Lee and I are extremely happy with the thought of this coordination between the two schools.

The Nursing School, an excellent school, is older than either of these two.

These four units, the PBRC, the School of Medicine, the School of Public Health, and the School of Nursing, are all in the health field. The intention is that these be combined, at least on paper, into a College of Health Sciences, and we think that this will be a fairly important and strong college on the campus in the long run.

Now I want to end on the international theme. Different people in and out of the units I've been talking about are pretty involved in international health. Last summer a group went to a Pacific island to teach medical technicians there the latest ways to count blood cells, hunt bacteria, and so on. This sort of thing is good. It prefaces the day when both professional and sub-professional educational problems will probably be parts of the programs here, because in some places a highly trained professional may not be quite as relevant to the issue as somebody who is trained in more practical things and who can refer more complicated things to some place away.

Another international element, of course, is the East-West Center students, some of whom find their way over to the PBRC. As a rather amusing aside: we're consultants to the FAA, the Federal Aviation Agency, in an unofficial way about Wake Island. Now on Wake Island there's a doctor, who is on duty seven days a week, 24 hours a day, and he doesn't even dare drink a martini, because if something might happen he has to be on duty. This is an impossible status, so they're going to get another doctor. But there isn't enough work for two doctors, so what's the other fellow going to do? That's our problem: to think up some good research for Wake Island. (I'll receive suggestions from you on the way out.) More seriously, Okinawa is a problem. The United States is a predominant instrument in Okinawa, and they are eager that the University of Hawaii take over a good deal of the health education, if not health service, too, on Okinawa. The University of the Ryukyus has 2,000 students. It hopes to grow to 4,000. It really isn't ready for a medical school yet, but it is ready to have some education carried on in the few hospitals there. It's ready to have the undergraduate curriculum strengthened a bit, so that some day, when the medical school is possible, one can be started there. So we're going to be pretty involved in this, and I think that it's not unlikely that this may be a model for a number of other connections with islands which are obviously beginning to look to this mid-Pacific spot as a sort of intellectual center where they can find some answers to their problems.

The last international thing is Senator Inouye's plan, now a proposal in Congress that you've seen in the papers in the last few days for a Pacific Medical Center which would train people from the Pacific and Southeast Asia and do research in connection with those areas. Exactly what this is going to be and where we fit into it, we don't know, but I must say it is a magnificent idea and we're all for it.

This brings me up to the finale about the international university. Universities promote learning all over the world. A few universities are international, and they promote something besides learning: I call this harmony, and this is familiarity with other people, realization that other people from somewhere else are really just like the people from wherever you came from, and that the world is one. So an international university, then, to me is a tremendous dream. I think the United States probably should have an international university here, and another one, say, in Puerto Rico, thinking about the other side of the Atlantic, perhaps one somewhere in Texas or in the South, thinking about South America. In other words, not very many, but a few especially directed toward this international element.

Universities, traditionally medieval universities, had three faculties: law, religion, and medicine. Medicine is the one we're closest to here, and I hope, if we become a really great international university, we will have a really great College of Health Sciences to go with it—with medicine, and public health, and nursing playing their important parts.

CURRENT AND FUTURE CHALLENGES IN TROPICAL AGRICULTURE*

Harry F. Clements†

Much thought these days is being given the proposition that at some future date the world's population will exceed agriculture's maximum ability to provide adequate food. The world's population, estimated at 2.7 billion today, has at its disposal one and a quarter arable acres per person, and some 2.25 acres in meadows and pastures. By 2000 A.D., the expected population of 6.3 billion would have available about a half acre of arable land per person. Whether any of these projections result in valid estimates is beside the point because, despite all famine, pestilence, wars, as well as planned birth rates, the population will continue to increase and, as it does so, it will occupy more of the area on which it ought to be growing food. It seems to be a truism that the finest, flattest, and most productive lands are the ones first lost by agriculture to the realtor, the politician, or the military for conversion to building sites, playgrounds, roads and airports, warehouse areas, and other similar construction projects, which, though perhaps essential, become waste areas so far as food production is concerned.

The essentials for food production are these: solar energy, temperatures above freezing for at least part of the year, water, mineral nutrients, carbon dioxide, and organisms capable of photosynthesis. Obviously, for maximum production there must be maximum absorption of the radiant energy and conversion of it to food energy which can then be stored. It should be kept in mind that, in this sense, light falling upon barren spaces—water or land—is dissipated and lost for all time. The total global surface receiving solar energy at some time during the year is 126 billion acres, of which 36 billion acres are land. In arable use today is about one-tenth of this latter area. If we include pastures and similar areas, the total area available is about one-fourth of the whole land mass.

The attack on the problem can be along several routes, converging toward the central goal of greater food production. We can increase the number of arable acres; we can increase the productivity of each acre; we can undertake to change man's food habits; we can concentrate on the production of only those crops with the highest food value per acre for humans and gradually eliminate the others; and we can, in keeping with the trend of the times, train him to eat less—although if we are to believe the medical and insurance people, this will just make him live longer and therefore confound the solution of the problem.

Increasing the number of acres. I have chosen to include as tropical and subtropical the area between the 35° latitudes, north and south. Within this belt are some of the most populous lands (south and southeast Asia), as well as some of the least populous (nearly all of Africa and South America). The great jungles of all three of these continents are begging for development. Here, with year-'round sun and heat and a very great abundance of water, lie millions of acres of the earth's surface with unbelievable potential and yet with very little use. The reasons for the scant population lie in the scourges of disease, the miseries of the humid heat, the generally primitive poverty, the failure of technology to reach these areas, and, of course, the simple fact that these lands are not yet needed.

In my travels throughout the tropical world I am continually distressed at the poverty which I see on all sides—whether it be a small child in an Indian vil-

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†Senior Plant Physiologist, Hawaii Agricultural Experiment Station, and Consulting Plant Physiologist, C. Brewer and Company, Ltd.

lage within the shadows of Delhi, his face and eyes covered with flies and sores; or the little girl in Dezful, with the drawn face of an old woman, collecting the dung of the water buffalo; or the children, sometimes naked and begging and stealing in Central and South America, the Orient, India, and the Arab world. It is, I believe, a simple fact that the greatest areas of human poverty are to be found in the tropical areas of the world; and yet, without question, the first step in converting the huge jungles and Asian wastes into productive agricultural lands is the freeing of their inhabitants from disease, malnutrition, the enervating effect of the climate, and, above all else, from ignorance.

A second great area for new acres is in the Middle East and south Asia and much of Africa, where lie huge desert and semi-desert areas asking only for water—water which usually may be found running through the areas themselves. The Khuzestan area in south Iran is now being converted into something like a TVA by the same David Lilienthal who had so much to do with the original Tennessee Valley Authority. Damming the Dez river for power has provided the water catchment for great irrigation projects on the plains where once flourished the ancient agriculture of the Persians under Darius and his successors. The areas in Iraq on either side of the great rivers Euphrates and Tigris are similarly waiting for the application of modern equipment, human knowledge, and effort to return them to their ancient glory much in the manner already accomplished in the Imperial Valley of southern California.

Many of these areas include fertile soils which in times past were destroyed by salinity. For some time it was believed that the Khuzestan was once the land of a half million people with a highly developed irrigated agriculture, and that the people, agriculture and all, were destroyed by the conquering Genghis Khan. The population estimates were based on the number and size of villages seen in ruins throughout the area. What seems more likely, however, is that the population probably was never more than one-tenth that assumed. People lived in the villages until, because of the irrigation practices used, salinity increased to destroy their agriculture and this forced them to abandon their lands and move on to build new villages and new farms. Today, Hawaiian Agronomics Company, the international subsidiary of C. Brewer and Company, Limited, has successfully established for the Government of Iran a sugar plantation provided with a drainage system which is undoing the damage of the past by removing from the land as much as one-half a ton of salt per hectare per day. It is interesting that the main canal leading the water onto the plantation parallels the ancient canal of Darius. This same company is now installing a similar plantation and irrigation and drainage system for the Government of Iraq in salinity-damaged lands near what was once the luxuriant garden of Eden.

Tremendous areas for exploitation are the vast water surfaces, including the off-shore flats, where plant succession could be started which would build up a land mass, as well as the ocean surfaces themselves, particularly in the tropical belts. Here the primary essentials for food production exist: sunlight intensity is great; temperatures are always favorable; and water, carbon dioxide, and inorganic nutrients are all available. The deliberate cultivation of salt water species, both plant and animal, useful to man is being done only experimentally—yet only a very narrow band of sea surface around each of these Hawaiian islands, for example, would be needed to double the present area used for plant production. Proteins produced by sea algae are digestible by many animals and can, with chemical processing, be made digestible by humans. The surfaces of the fresh water inland lakes again provide a vast expanse receiving a steady influx of radiant energy, where fresh water algae such as *Chlorella* can be grown with amazing photosynthetic efficiency, far greater than that of our most efficient land crops. The dense growth found in lakes such as those in Kashmir can be made useful by proper development, breeding, and plant selection.

Other areas receiving solar energy are the hilly slopes of land where water is adequate and where terracing is feasible. Thus, in Ceylon, China, and parts of India, many valuable acres are carved out of the hills and put to paddy and other food crops, but millions more acres of such slopes could be put to concentrated use.

Increasing the productivity of each acre. Turning now to increasing the productiveness of each acre, we again have an enormous potential. In Uttar Pradesh in North India, the average yield of cane per acre in 1957 was about 10 tons. With reasonable irrigation, fertilization, and crop control this could be increased sixfold. Yields of other crops in the same rotation could also be similarly increased. Not only could the actual yields be increased, but much time on the crop rotation could be saved. For example, crop rotations in India are commonly followed, employing cereal crops, legumes, fodder crops, and sugar cane. I calculated that in one four-year rotation, 17 months were unproductive. This period included 14½ months of actual time wasted, when nothing was in the field. The explanation was that the soil "needed a rest." "A rest from what?" I ask. Whenever a fallow has shown itself to be helpful, it usually means that nitrification has produced a small amount of nitrate, which causes some expression of plant response, but which could much more profitably be provided as fertilizer while growing a useful crop. Then five months are given over to growth and decomposition of a leguminous green-manuring crop—another practice which needs critical evaluation, for it would be much more profitable to buy the fertilizer so gained and keep the land in production of useful crops. Another practice in India is the use as fertilizer of the residue of peanuts from which the oil had been extracted. I thought this a terrible waste of high quality protein—protein which could be used directly as human food and protein which is so desperately needed in that country. In one state alone 16,000 tons of oil cake were thrown away for fertilizer, yet experiments had shown that, where phosphate and nitrogen fertilizers were used properly, the ground nut cake contributed nothing more. Had the cake been fed to animals or to humans, and the manures applied to the field, the benefits to the crops would have been about the same, but another feeding cycle would have been gained. Thus, by better cultural practices and eliminating wasted time, existing lands in parts of India could be made to increase by ten times their present yields.

In contrast to this waste are the practices in Japan where, immediately following the rice harvest, winter vegetable crops are planted. Winter cropping in other subtropical areas, with frost-resisting crops, can be a very profitable business. Winter truck crops in the Imperial Valley of California, in Florida, and elsewhere are other illustrations.

Were we to provide water for all the currently unproductive lands where rainfall is less than adequate, again we could realize enormous production increases. For example, here in the islands, where the sugar industry privately developed its own water, some very simple points were established. The dry areas of Maui, Oahu, and Kauai would be nearly deserts without water. To the early pioneers, the idea occurred to collect the runoff waters from the very wet and steep high-rainfall areas and, by means of canals, tunnels, and pumps, allow these waters to flow into the dry, sunny areas, thereby transforming these latter into very productive farms. Similar developments on Hawaii could put thousands of acres in Kau into production far more lucrative than ranching.

Damming rivers results not only in the partial control of flooding but also provides water for the dry months. In India, for example, crops in certain states are constantly suffering—from drought for part of the year, then from flooding for the rest. Damming the great rivers from the Himalayas is providing a control of water which promises well indeed for the future of that area.

Recently, studies by the Ralph M. Parsons Company of Los Angeles have estimated that a hundred billion dollars would bring to the arid western farm lands of the United States and Canada the clear waters of the Canadian and Alaskan lakes and river systems. Another scheme, by Kierans of Ontario, would divert to the south and into the Great Lakes system, the waters now going north into James Bay. Such proposals in this day of power equipment are probably much less visionary than were the plans of Hawaii's early sugar men. It might also be recalled that in the first century A.D. the city of Rome was supplied with some 300 million gallons of water daily by 14 aqueducts totaling a length of 1,300 miles. Throughout the mountainous areas of the frozen arctic are great store houses of ice and snow, parts of which thaw each year; the resulting waters could be moved toward the tropics and the deserts to provide for needed crop growth. Perhaps the intense sun rays on mountain tops could be harnessed to melt even more of the ice masses each year.

Much work is being done to increase the water supply by various methods of purifying the limitless ocean water. Although Israel is very active in this work, countries in both Europe and America are busy trying to solve the economics of this effort. The methods are of several general sorts, and one is the capturing of the sun's rays for use in the evaporation of water from a saline solution. In the remote areas of the world which have access to the salt waters of seas and oceans, such a proposition has merit. Power is needed to keep condensing surfaces cool enough for the purpose, or, where the air is already cool enough, then only the installation costs need financing, there being no operating costs other than maintenance. Such a plant, using radiant energy, is operating in a mountain mining town in Chile and produces 23 M^3 of water a day. Total installation cost was \$2500/M^3 of capacity.

Costs of the most efficient multi-flash evaporation setups run to about 30 cents per thousand gallons—which, for drinking water, is not unreasonable.

A second general method calls for the freezing-out of water from brine. Freezing has an advantage since the latent heat for freezing is about one-seventh that for evaporation, though usually the heat is cheaper than the mechanical energy needed for freezing.

A third general method calls for dissolving out the water with a solvent in which the salt is not soluble, and then separating the immiscible layers, leaving behind the concentrated salt brine. Certain substituted amines are used here.

Finally, the fourth general method calls for the use of ion-exchange resins and membranes, some of which remove the cations and others the anions, leaving the pure water free to flow on. Another variation of this calls for membranes which are permeable to water under pressure but not to the solutes.

There is little doubt in my mind that one day, perhaps soon, sea water can be purified, and for a cost that would permit irrigation, at least for the more profitable truck crops.

What can be done to take advantage of what little water is available is nicely being pointed out by Israel. Of its 5 million acres, only 75,000 were under irrigation when the country was established. Within 12 years, 340,000 acres have been irrigated. By using all of its resources, 650,000 acres can be irrigated, and yet its rainfall, coming mostly in winter, is 40 inches in the north, 8 inches in the midsection, and about 1½ inches in the south.

As one travels through this country, he sees every effort bent towards the capture not only of every drop of water, but also of every possible bit of solar energy. Trees are planted wherever the land is not otherwise in use. As one approaches the Negev desert, where rainfall may be even less than an inch a year, small dams are seen across the main gulch runways to capture and retain the small runoff from the occasional freshet. Xerophytic trees are planted and are actually alive. The long-range view is that such plantings will increase the rainfall—even perhaps by another inch per decade or century.

Enormous areas exist not only in the tropics but elsewhere throughout the farming world where beautiful, clear water flows wastefully past fields which are suffering variously from drought and where yields could be substantially increased. Perhaps even higher percentage increases could be realized on some of our best lands were best practices always followed. For example, in many agricultural areas fertilizers are not used at all; or the nutritional needs of the growing crops are guessed at or are determined by very outdated methods. A case in point is the progress which has been made on the local plantations of C. Brewer and Company. In 1950, the last year prior to the use of crop logging, the area harvested produced 215,000 tons of 96° sugar. In 1964, with somewhat fewer acres but after a decade of improved cultural practices—including crop feeding and soil toxicity elimination based on the foliar diagnosis of each crop in each field—the total crop was 308,500 tons, an increase of more than 40 percent. It is a known fact that some years are much better crop years than others, and to take advantage of this requires fertilizer and irrigation practices adjusted to the welfare of each particular crop as it grows in the particular field under the particular climate. Throughout the world yields could be similarly increased, but the prevalent addiction to the old ways blocks progress.

Multiple cropping is another example of increasing the productivity of each acre. In Ceylon, rubber trees are grown for their latex but, in addition, they provide shade for the cacao crop and support for the black pepper vines. In Japan and China fish are grown as a second crop in the rice paddies.

Such, then, are the possibilities for increasing the yield of crops on existing lands. So real are these that recently a South American country which was trying to double its sugar output, but which needed capital for the new land, began to realize that the whole objective could be realized on the land already planted in cane if modern methods were employed.

It should be evident that there need be no real worry about agriculture's ability to feed a growing population for many years to come. The great oceans which make up almost three-fourths of the surface area of the world, or some 90 billion acres of surface receiving solar energy, have not been called upon to produce anything like what is possible. In 1950, the global catch was estimated at 20 million tons of marine flesh; in 1962, 45 million tons were brought in. By 1980, it is estimated that the annual take will be of the order of 70 million tons. Competent officials estimate that, were the oceans properly managed, they could produce an annual crop of more than 200 million tons—of which about 18 per cent is protein, 85-95 per cent digestible protein. Thus, in 1961, 115 million tons of water- and land-animal flesh were consumed, of which 41 million tons came from the sea. Obviously, the sea could provide almost twice as much animal protein as the total now being consumed from both land and sea.

Inland ponds under scientific breeding and cultivation have considerable potential. Average yields of fish in ponds in China, Indonesia, and the Congo reach 900-1800 pounds/acre/year. Maximum yields under best management reach 8,000 pounds/acre/year, which is considerably higher than the yield of land animal meat/acre/year. Yields of fish grown as a second crop in the rice fields of Japan run as high as 1800 pounds/acre/year.

Changing the food habits of man is another point of attack and has great potential. The protein we consume need not come from animals—although plant proteins are not all equally digestible by man, at least not without some prior processing. Thus, the protein of soybean as well as of many other seeds is digestible. On good land one acre of soybeans can yield 700 pounds of protein. Alfalfa, however, will produce 1,200-1,400 pounds of protein, most of which, indigestible by man, is digestible by animals, but at a substantial total loss. Thus, man would get about one-half as much protein in milk from the acre of alfalfa fed to cows as he could by eating the soybean protein.

If we prefer lamb chops—and who wouldn't—we'd get only one-seventh as much protein per acre as from the soybean. In other words, whenever the plant crop grown is eaten by animals whose meat is then eaten by humans, there is a very great loss of the valuable protein. One pound of milk protein is made from about four pounds of feed protein. One pound of beef or lamb protein requires from 10-12 pounds of feed protein. Also, there is considerable variation in the efficiency of animals. For example, one pound of live weight broiler requires 2.3 pounds of feed; eggs, turkey, and pork require about 3.0-3.5 pounds; beef, 8.0 pounds; and lamb, 8.7 pounds.

Great progress is being made by agencies of the United Nations, the United States, and various foundations in providing talent and information to the underdeveloped countries. The Rockefeller Foundation has developed some very high yielding forage crops in Mexico and Columbia. Eighty-five different and useful legumes from 20 different genera have been introduced into Mexico.

The Ford Foundation, which works more in the Asiatic countries, is similarly affecting their economies. In Israel, agronomists have discovered a very high-protein Bermuda grass capable of growing in high-salinity soils.

I believe, too, that American business companies such as my own are serving very well when they undertake to sell their management and technical skills to underdeveloped countries. Contracts to set up plantations or other enterprises provide for no cash investment by the American company, but provide for the actual starting of a large plantation-size business, the on-the-job training of the natives for each and every position, and then the gradual withdrawal of the American company when the enterprise is well started. For this work during President Kennedy's administration C. Brewer won the Presidential "E" Award for excellence in export. As I see it, the great need in these poverty-stricken lands is for patient training on the job by people who know the business themselves. The natives are usually very eager to learn and are very apt pupils once they see someone doing the job correctly. The fact, too, that the work is done by an American seems to add dignity to it. The fact that our people, even those with Ph.D. degrees, are seen in the fields, has been a good example to the elite of those countries who are reluctant to get themselves dirty.

As time goes on, the biochemist and geneticist may be able to create plants with a greater photosynthetic efficiency—for this is the fundamental process, creating food from inorganic materials. Possibly there can be greater development of crops which can grow submerged in water, where, as in the case of the algae, more of the radiant energy can go into carbohydrate and protein synthesis and less into the transpiration needed to protect the delicate synthetic mechanisms from the excessive heat of radiation when the leaf is projected into the atmosphere.

It should be evident that, because until now he has not *had* to do so, man has done very little about developing the maximum food production potential. Since the need for greater productivity will gradually be intensified, man's efforts will also gradually intensify. Research in all the areas surveyed is well established. I am inclined to conclude by saying that, if man is destroyed, it will more likely be by violence of his own making rather than by starvation.

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GEOPHYSICAL INVESTIGATIONS OF CRUSTAL STRUCTURE IN THE HAWAIIAN ISLANDS*

G. P. Woollard†

Background

Under a National Science Foundation grant, a program of seismic refraction measurements was initiated on and adjacent to the island of Oahu, Hawaii, with the primary objectives of determining (a) the depth and seismic nature of the inferred volcanic plug in the Koolau caldera on Oahu which is characterized by a local gravity anomaly of about +115 mgal; and (b) the depth of the mantle and the velocity structure of the overlying crust in the adjacent area beneath the Hawaiian Ridge. Both objectives were realized. In addition, under another NSF grant, gravity and magnetic data covering all of the adjacent area were obtained. These data, plus other gravity, magnetic, and seismic refraction data taken elsewhere on and adjacent to the Hawaiian Ridge by various groups, permit a composite picture of regional relations to be obtained against which the results obtained on Oahu can be compared.

Regional Relations

That the regional relations as regards crustal structure on and adjacent to the Hawaiian Ridge are complex is evident from existing seismic data and from the magnetic studies conducted to date, in particular. The entire Hawaiian area, both on and off the islands, which is characterized by large magnetic anomalies, can be related to (a) rift (fracture) zones in the crust, and (b) centers of volcanism. It is probable that the cause of these anomalies is the intrusion of mantle material into the overlying crust. The fact that, on the islands at least, these areas are also characterized by marked local gravity anomalies that exceed +100 mgal over the major volcanic peaks and calderas, and average +50 mgal along many of the rifts defined magnetically, tends to substantiate this conclusion. Seismic data as to the nature of these intrusives, however, are not too abundant. The most conspicuous example that existed prior to our work on Oahu was the subnormal Moho depth of 5.8 km below sea level found by Shor and Pollard (1964) just north of Maui. This had been interpreted by Shor and Pollard as a fault displacement of the crust and mantle, but, the magnetic data clearly indicate that this subnormal depth is probably related to an intrusion of mantle material along an extensive east-west trending rift. Similarly, on the island of Oahu, our studies indicate mantle material at a depth of only 4 km below sea level adjacent to the Koolau caldera and at a depth of only 1.6 km in the caldera itself.

The normal depth of the mantle away from the Hawaiian Ridge, on the basis of the seismic refraction studies of Shor and Pollard (1964) and the unpublished studies of Western Geophysical Company, range from 9 km on the Hawaiian Rise about 150 miles north of the Ridge to 13 km below sea level in the bathymetric trench area adjacent to the Ridge. On the Ridge itself, the only published results indicate a depth of about 15 km near Gardner's Pinnacle (Shor, 1960)

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†Director, Hawaii Institute of Geophysics, University of Hawaii.

and a depth of about 15 km just north of Maui (Shor and Pollard, 1964) and of 13 to 15 km on the island of Hawaii (Eaton, 1962). Unpublished refraction seismic studies on the island of Hawaii by Ryall and Hill of the U.S. Geological Survey (personal communication) appear to confirm Eaton's estimate which was based on earthquake travel time data. However, our studies between Oahu, Lanai, and Molokai using two independent traverses indicate a depth of 20-23 km to the M discontinuity beneath this portion of the Ridge. Similarly, an as yet uncompleted traverse from Kahoolawe island across the island of Maui using the first two of three scheduled 500-ton high explosive surface blasts under project SAILOR HAT indicates that the mantle will be at least 18 km below sea level in this area.

The regional pattern suggested by existing data, therefore, is one which implies thickening of the crust along the axis of the Ridge northwest from the island of Hawaii towards Oahu, as evidenced by an increase of some 6 km in the depth to the M discontinuity below sea level. The difference of about 2 km in the surface elevation of Hawaii and Oahu, therefore, is not all due to the more advanced surface erosion on Oahu, but in part is attributable to a higher degree of crustal subsidence beneath the older island.

If crustal subsidence has progressed to a greater extent beneath Oahu than beneath Hawaii, because of the greater time since the first island was formed, presumably the mantle may be even deeper at the Midway end of the Ridge, where the volcanics now all lie below sea level and are capped with 580 to 1240 feet of coral (Harry Ladd: personal communication).

In cross section, existing data are confined to a section running north from Maui some 175 miles across the adjacent Hawaiian Trench and Hawaiian Rise. A composite section based on our results on the axis of the Ridge off Oahu, and on those of Shor and Pollard (1964) over the Trench and Rise area north of Maui, shows approximately 3 km of downward displacement as indicated by the internal structure of the crust beneath the Ridge, with the large increase in crustal thickness resulting from thickening of the basal crustal layer. The subnormal depth of 9-10 km below sea level for the M discontinuity on the Hawaiian Rise, as compared with normal oceanic values of 11-12 km elsewhere in the Pacific Ocean, could be related to elastic flexure of the crust in response to the subsidence beneath the Ridge. If this is the case, a similar crustal flexure is to be expected to the south of the Ridge. Also one might anticipate a more pronounced upbowing of the crust beneath the Rise further along towards Midway, since the northwestern end of the Ridge appears to have undergone greater subsidence than that evident in the area of the Hawaiian Islands. However, there is little indication in the bathymetric data that such a condition might actually exist, and as yet there are no geophysical measurements that might help resolve this problem.

However, this picture of crustal tectonics could be present and partially or totally disrupted by other tectonic factors. This is suggested by the abrupt change in bathymetry where the Molokai Fracture Zone intersects the Hawaiian Rise at its eastern terminus north of the island of Hawaii. Not only does the Molokai Fracture Zone define the eastern end of the Hawaiian Rise, but apparently it is associated with a local deepening of the Hawaiian Trench north of Hawaii and Maui. Whether this is related to the greater depth to the Moho noted beneath the axis of the Ridge between Oahu and Molokai which lie on the north side of the extension of Molokai Fracture Zone across the Ridge as defined magnetically is not known, but there does appear to be a possible correlation.

To summarize, a review of available data suggests:

(a) There is differential crustal subsidence along the axis of the Hawaiian Ridge from the island of Hawaii to Midway Island.

(b) The Hawaiian Trench appears to be a subsidence feature adjacent to the Ridge that is pronounced at the eastern (young) end of the Ridge, and probably silted in at the western (old) end, so that it is no longer a distinct bathymetric feature.

(c) The Hawaiian Rise may be a crustal flexure induced by the subsidence of the Ridge. If so, the mantle conceivably might be shallower than 9 km to the northwest, towards the older end of the Ridge where subsidence has been greatest. Also, one would expect a similar crustal flexure south of the Ridge.

(d) The cross-cutting Molokai and Murray Fracture Zones might have locally disrupted the above basic tectonic pattern or resulted in crustal segments being offset, possibly laterally and vertically relative to each other.

From a consideration of the above, it goes without saying that the site selected for drilling the Moho hole, about 150 miles north of Maui, may not be the optimum site, and that actually a shallower site might exist in the Rise area adjacent to Midway. Therefore, until the nature of the basic regional crustal pattern is established, it will not be known whether or not the proposed site represents optimum conditions.

Local Relations on Oahu

Although various attempts have been made to seismically investigate the internal structure of a volcano [Raitt on Bikini and Kwajalein (1952), Gaskell and Swallow on Funafutu (1953), Officer, Ewing, and Wuenschel on Bermuda (1952)], our study of the Koolau caldera on Oahu is the first to ever define the depth of the mantle within and adjacent to the vent area as well as beneath the lava pile as a whole.

The Koolau caldera itself lies at the foot of the Pali escarpment on the windward side of Oahu, and is marked by an extensive swamp lying essentially at sea level, out of which rises Olomana Mt., a conspicuous volcanic peak some 2,000 feet in height. The gravity survey of the area shows the center of the gravity high of about +115 mgal to be located in the center of the swamp area near the Mackay Radio Station. The geologic boundaries as defined by Gordon Macdonald (personal communication) indicate an original caldera some 5 to 6 km in diameter.

As preliminary computations to explain the gravity high (Woollard, 1951) indicated that material with a density of about 3.2 gm/cc must rise very close to the surface in the caldera, it was originally planned to shoot a series of fan traverses across the caldera to locate the point of nearest approach to the surface of this high density intrusive material and then to shoot a reversed seismic refraction spread across this location to determine its depth and true velocity.

Unanticipated operational difficulties in working in the swamp, plus the cultural development of the surrounding area and a greater depth than anticipated, made it necessary to modify this straight-forward approach. In all, 15 short seismic refraction lines varying from 6 to 10 km in length were shot in the swamp area over the center of the gravity high. Although none of these provided definitive data on the intrusive body, they did define the following near-surface structure:

(a) A surficial layer 100 meters thick having a velocity of 1.7 km/sec, which was identified from well data as being coral and beach sand.

(b) A second layer 400 meters thick having a velocity of 2.8 km/sec, which could be in part coral, but more probably is weathered volcanic cinder material, on the basis of outcrop material surrounding the caldera.

(c) A third layer of unknown thickness having a velocity of 4.63 km/sec, which is representative of the massive lavas occurring away from the caldera and making up the Pali escarpment.

Failure to define the thickness of the third layer can be attributed to the high slopes of the boundary faults ringing the caldera, which gave fourth layer velocities exceeding that of the mantle, and in places even gave velocities reaching infinity.

The technique finally adopted for determining the depth to the intrusive diapir responsible for the large gravity anomaly was one based on time leads and lags for paths penetrating to progressively greater depths and passing ultimately through the intrusive body on a long reversed profile. Interpretation is based on both the velocities defined and a comparison of the observed travel times with those for theoretical models incorporating the same velocities. This is a procedure that has been used in the study of salt domes where it has not been possible to obtain usable reflection data.

Prior to shooting this long profile, a rigorous quantitative analysis was made of the gravity data in which the results from the short seismic spreads were incorporated into the mass distribution model along with results of other seismic measurements and laboratory studies of density equivalents for seismic velocities associated with igneous and volcanic rocks. The resulting theoretical model that would satisfy the gravity data indicated a central plug of material with a minimum density of 2.9 gm/cc grading into a density of 3.2 gm/cc at a depth of no more than 1.7 km, rising from what might best be described as a secondary magma chamber of considerably broader extent at a depth of about 3 km.

Using this model and equivalent velocities for the densities required to satisfy the gravity data, theoretical travel times were computed for the proposed long seismic traverse to obtain a synthetic travel time plot that would not only define adequately the boundaries of the plug but its true velocity. It was on the basis of this theoretical study that shot and recording locations were laid out along a 20 km line extending from Chinaman's Hat, an island in Kaneohe Bay, to Waimanalo.

The resulting travel time graph corroborated the synthetic travel time plot and defined a rock mass at a depth of about 1.6 km, with a surface width of about 6 km, and having velocity greater than 7.0 km/sec (which could be as high as 7.7 km/sec), and which was flanked and overlain by material having a velocity of 4.63 km/sec.

A surprising result, in view of the failure to obtain reflections on the short spreads within the caldera, was the recording of reflected arrivals from a depth of about 3.5 km *outside* the area of the central mass. As these corroborated the indications of the gravity analysis, an extended series of refraction spreads was carried northward along the windward coast of Oahu to Kahuku Point, over what gravitationally and magnetically appeared to be an associated rift zone fracture that had been invaded by mantle material. The refraction data indicate material with a velocity of 7.6 to 7.7 km/sec rising from about 5.5 km to 4.2 km as the Koolau caldera is approached.

All of the data, therefore, are in substantial agreement and suggest that the Koolau vent is located at one end of an extensive rift extending along the coast of Oahu that has been invaded by mantle material having a velocity of 7.6-7.7 km/sec in its present, presumably recrystallized, form. Whether this rift intrusion should be regarded as a secondary magma chamber for the pipe-fed intrusion in the Koolau caldera, or as an independent feature, is of secondary importance; but it does appear from the analysis of the magnetic data that each pipe-fed intrusion now marked by a volcanic peak or caldera is located on a rift fracture. Thus, there appears to be a genetic relationship between the two, and it is probable that the rift fracture represents the primary tectonic control governing intrusion from the mantle, and that venting of lava to the surface through a pipe has been a secondary feature possibly localized by a cross-cutting fracture that was closed at depth at the time of intrusion because of the prevailing regional crustal stress pattern. The fact that the orientation of the crustal fractures as defined magnetically strike essentially east-west on all the islands east of Molokai, rather than along the axis of the Ridge, whereas west of Molokai, the fractures as defined magnetically strike northwest-southeast and more or less parallel to the axis of the Ridge, certainly suggest two fracture systems and a change in regional stress pattern with time. It certainly is not in agreement with the idea advanced by Wilson (1964), that the Hawaiian Ridge developed from crustal migration whereby material was removed progressively away from a single center of volcanism located beneath the present island of Hawaii.

Away from the two primary calderas on Oahu, located near Kailua on the windward side and near Waianae on the leeward side of the island, but adjacent to the island along its southern coast in an area showing normal magnetic relations (no marked anomalies), a reversed refraction traverse was shot to determine the normal depth of the Moho beneath the Ridge.

This traverse, designated BRAVO indicates a crust having a thickness of about 21 km with a structure as follows:

Layer 1	Water		0.5 km	
2	3.0 km/sec		1.8 km	
3	4.97	"	7.3 km	dipping 1.1° to the East
4	6.75	"	11.4 km	
5	8.4	"	21.0 km	Total depth to Moho

In addition to these refraction results, there appeared to be reflection arrivals in the range from 25 to 42 km which, if real, indicate a depth of about 23 km to the Moho.

To check the reality of this apparently abnormal depth to the mantle below the axis of the Ridge, and also to evaluate the effect of the Molokai Fracture Zone and the implied intrusives indicated by the magnetic measurements on seismic results, three traverses in the form of a triangle were shot in the area between Oahu, Lanai, and a point due south of Oahu. These traverses are designated HOTEL, JULIET, and INDIA. Although final results are not available as yet for these measurements which were made in April, the preliminary results on line HOTEL which closely parallel traverse BRAVO from Oahu to Molokai substantiate the results from BRAVO. The cross-over distance for mantle arrivals having a velocity of about 8.28 km/sec is 96 km, indicating a depth to the Moho somewhat in excess of 21 km. However, on the Lanai end of the traverse, material with a velocity of 7.6 km/sec occurs at a shallow depth of about 10 km. Similarly, mantle-like material with a velocity of about 7.75 km/sec at a depth of about 10.3 km is indicated on traverse JULIET, running south from Lanai. As both traverses are located in the shallow water area of the crest of the Ridge, these shallow depths to the mantle and somewhat subnormal mantle velocity values rather conclusively substantiate the magnetic results which indicate intrusive rock into the crust here on an extension of the Molokai Fracture Zone beneath the Ridge. Although reduction of the results for traverse INDIA has not been started as yet, it appears fairly definite that the results for this traverse will also be complicated by the presence of intrusions.

These measurements, therefore, demonstrate a significant point, namely that care has to be exercised in selecting sites for seismic measurements if a true picture of crustal structure is to be obtained. On the basis of our studies to date in the area, the only significant criterion that can be used in selecting a site that represents "normal" conditions are the observed magnetic anomalies. As a magnetic survey of the entire Ridge and adjacent area from Hawaii to Midway is now being conducted, the proposed seismic study should produce definitive results.

Proposed Future Work

We propose to continue the program of seismic refraction measurements as part of the Institute's program of inter-disciplinary geophysical and geological studies of the Hawaiian Ridge from Hawaii to Midway. The objectives of this program are: (a) to define the lateral change in crustal structure and the depth of the mantle both beneath and adjacent to the Hawaiian Ridge as one progresses from the young (Hawaii) end of the Ridge to its older (Midway) end, and (b) to determine the effect, if any, of the cross-cutting Molokai and Murray Fracture Zones on crustal structure. The significance of this study is manifold: it should (a) give data on the degree of crustal subsidence and change in crustal structure that has accompanied the differential surface subsidence between Midway, which is defined entirely by sub-sea-level volcanoes marked now by coral atolls, and Hawaii, where volcanic mountains rise to 13,500 feet above sea level; (b) provide evidence pertaining to the origin of the Ridge, particularly as to whether it was formed by intrusions along a progressively developing fracture system in the crust, or is a result of crustal migration away from a single center of volcanism located at Hawaii, as proposed by Wilson (1964); (c) provide evidence as to the cause of the subnormal Moho depths noted on the Hawaiian Rise north of Maui, and in particular clarify whether these are due to elastic flexure of the crust induced by the subsidence of the Ridge, with a possible companion flexure on the south side of the Ridge; (d) provide evidence on stress-strain relations in the central Pacific and changes in stress pattern with time; (e) provide evidence bearing on the problem of how isostasy is achieved with a loaded subsiding crust, and whether the M discontinuity is governed by pressure-temperature relations and polymorphic changes of rock material or by some other phenomenon, such as serpentinization; (f) clarify the relation of the Hawaiian Ridge to the cross-cutting fracture systems both in terms of age relations, the genesis of the Ridge, and of whether there has been lateral displacement of one system by the other.

NECROLOGY

The Academy records with sorrow the death of the following members during the year:

David T. Fullaway   Christos P. Sideris

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Abbott, Agatin T.
Abramovitz, Melvin
Ai, Raphael A. C.
‡Akamine, Ernest K.
Akamine, Ralph N.
Akau, Thelma I.
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†Alexander, William P.
‡Alicata, J. E.
‡Allison, Samuel D.
Amioka, Shiro
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‡Arnold, H. L. Sr.
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†Hylin, John W.

Ihara, Violet K.
Ihrig, Judson L.
Iida, Kumizi

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*Member, Hawaii Division, Hawaii Academy of Science.
†Member, American Association for the Advancement of Science.
‡Fellow, American Association for the Advancement of Science.

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*Ikeda, Warren
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Ishii, Mamoru
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PROCEEDINGS OF THE HAWAIIAN ACADEMY OF SCIENCE . . . .

FORTY-FIRST ANNUAL MEETING 1965-1966
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CONTENTS

THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

PRESIDENTIAL ADDRESS 1966

SCHOOLS OF PUBLIC HEALTH AND INTERNATIONAL EDUCATION

Richard K. C. Lee*

UNTIL ABOUT 1910, there were no facilities in the United States for specialized training and education in public health. The first degree in public health was awarded in 1910 at the University of Michigan. Beginning in 1912, a program of study was organized at the Massachusetts Institute of Technology by Prof. William Sedgwick, whose strong influence subsequently sent forth a long procession of outstanding disciples in the new profession. After a few years, a joint Massachusetts Institute of Technology—Harvard University School of Public Health was formed because it was recognized that the environmental phases represented only a part of the total public health picture. Later, the schools separated when Harvard established its own School of Public Health.[1]

In 1936, following the passage of the Social Security Act, there were some forty-odd schools which offered degrees in public health. They sprang up across the country, largely as a result of the availability of federal funds for training in public health. There were no criteria for judging the competence of these schools or courses, but it was known that many were quite inadequate.[2] The leading schools in 1941 formed the Association of Schools of Public Health. This stimulated a study by the American Public Health Association's Committee on Professional Education, which led to the development in 1946 of a procedure leading to the accreditation of degrees in public health. The Committee in 1965 began accrediting the schools of public health instead of recognizing degrees, and today there are thirteen accredited schools in the United States and two in Canada.

Banks and Troupin[3] reported that there are about 60 schools of public health in the world today, all with different goals, methods, resources, and attitudes. They proposed a system of international recognition of schools of public health and degrees in public health. The idea was that an international system of recognition would encourage the schools to meet similar minimum standards, and assure that all graduates of schools of public health would have certain minimum qualifications.

Definition

The World Health Organization's working definition for a school of public health is "an institution with adequate resources which, in addition to research in public health and service to the community, provides a full-time course lasting not less than one academic year, or its equivalent, covering the subjects essential to the understanding of the various problems of public health and the concepts, organization and techniques required for dealing with them, and which is open to members of the medical and allied professions seeking qualifications in public health."[4]

In the proposed new "Criteria and Guidelines for Accrediting Schools of Public Health,"[5] the following statement is used to describe the responsibilities of schools of public health:

> In their role of intellectual leadership in the broad field of public health, it is reasonable to expect that schools of public health will consciously endeavor to meet the expectations of society by preparing competent, imaginative workers for careers in preventing

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*Dean, School of Public Health, University of Hawaii.

NOTE: References to numbers are listed at the end of this article.

disease and disability, and analyzing, improving, promoting, and maintaining the optimum health of the public. It is likewise expected that, in the light of continuing or periodic evaluation of the results in their activities, the individual schools will maintain sufficient flexibility to conduct educational experiments and to introduce periodic innovations in educational policy and methodology, as well as to make changes in curriculum content and emphasis, in order to remain responsive to the constantly changing requirements of society. In carrying out a complex and expanding program of teaching, research and service, it is necessary for each school of public health not only to be an integral part of an accredited university—with a faculty representing competence in the areas of knowledge related to public health, the physical and biological sciences, and the humanities—but also to have access to field situations, through field service and community laboratories, and a wide range of physical facilities and technical equipment for continuous use in its educational enterprises. It should have a faculty and staff of sufficient stature, diversity of professional training, appropriate community focused and oriented experience and numbers adequate to accomplish the stated mission of the school.

Objectives

The main objective of a school of public health is to provide graduate education of physicians, dentists, nurses, and other health personnel for careers as administrators, research investigators, teachers, and practitioners in agencies or institutions primarily concerned with community health. Traditionally, the schools have tended to emphasize career development of individuals in the health profession who have had previous experience working in health agencies. The Joint Committee on Education for Public Health, a report of which is included in the *Report of the 2nd National Conference on Public Health Training,* believes that "there is a body of knowledge, skills and abilities which, when possessed by an individual, makes it much easier to understand, appraise and help resolve community health problems. These attributes need not and cannot logically be introduced into the curriculum of all disciplines, but it is apparent that those who are to have supervisory or program planning roles should be given the opportunity to learn these skills, preferably in an interdisciplinary environment." The bringing together of various groups during the training period leads to mutual understandings of the role of each participant in the public health program, and to the promotion of the "term" approach in public health.

The faculty of all schools are also deeply involved in research and community services at local, national, and international levels. They actively participate in continuing education programs. Many schools have the additional responsibility of serving as regional or international training centers. The number of out-of-state and foreign students in the schools extends up to 75 per cent of the student body. On the average, however, about 25 per cent of the students are graduates of foreign universities.

Many factors influence the programs of a school, such as the university tradition of the school, the particular regional public health setting, the concept of health care, the organization of health services, the socio-economic conditions of the state, and the level of previous education and training of potential candidates. For example, the objectives of the School of Public Health at the University of Hawaii are (1) to provide instruction in the health sciences, (2) to encourage, develop, and conduct health research in Hawaii and the Asian-Pacific area, and (3) to render community health services in the state, the Pacific, and Asian areas. The development of the School's programs is in accordance with these objectives and with the established University and state policy to encourage programs which build upon Hawaii's special characteristics relative to its geographical location, its physical environment, and its multi-cultural society.

Manpower Needs in Health

One of the most critical health problems facing the nation today, constituting an extremely challenging task for the schools of public health, is that of training adequate numbers of public health personnel to keep pace with the population growth in the United States. It is estimated that public health is faced with the need for training about 17,000 additional personnel by 1970 for state and local health departments, merely to keep pace with projected population growth and an attrition rate of 4 per cent per annum.[2] There are no estimates for world-wide needs of similarly trained workers.

Dr. William H. Stewart, Surgeon General of the United States Public Health Service, in his paper at the White House Conference on Health on Education for the Health Professions,[6] emphasized that "health manpower will shape and limit the health care we provide and the health protection we afford to the American people in the years ahead. All of us who have a hand in shaping education for the health professions take pride in the axiom that the training we provide today shapes the medical care pattern of tomorrow. But if we are to make good on this claim, we must also accept the corollary—that the medical care needs of tomorrow must shape the training of today. Moreover, our influence and clientele are world-wide. What do our schools offer for meeting the health needs of Southeast Asia? How long can the United States continue to support the position as an importer of physicians, an importer of nurses?"

Dr. Ernest Stebbins, Dean of Johns Hopkins School of Public Health, in his prepared statement before the Congress of the United States,[7] emphasized the shortages of health manpower and suggested that "any member who wishes to gain a keener sense of this critical situation need only to telephone the health officers in his state capital or home district. I know the answer will come back loud and clear and in specific terms. The shortage of adequately trained public health personnel is nationwide."

The enactment of federal legislation supporting schools of public health is evidence that the United States Congress recognizes the problems of health manpower needs. The Hill-Rhodes Act expresses Congressional findings and policy as follows: (1) an adequate supply of professional public health personnel is necessary to promote the health, welfare, and security of the nation; (2) the number of these adequately trained persons and the rate at which they are being trained are grossly inadequate to meet the current needs of local, state, federal, and international health programs; (3) modern technological and social development requires even larger numbers of trained public health personnel whose professional education must be augmented by specific training in these fields of increasing public health concern; (4) major obstacles to accelerating the rate and broadening the scope of such training are inadequate public health training facilities, the high cost of training programs, and the shortage of scholarship funds to attract an adequate number of trainees; and (5) that therefore it shall be the policy of Congress to provide the funds necessary to overcome these obstacles and thus increase the opportunities and scope of public health training.

International Education and Training

Schools of public health in the United States are concerned primarily with the training of Americans and secondarily with the training of foreign nationals who attend their schools. This is not to say, however, that interest in international experience among the schools is diminishing. Rather, an increasing awareness of the need to re-examine the schools' appropriate roles in teaching international students prompted the Association of Schools of Public Health in 1962 to sponsor a six-month pilot study[8] which attempted to evaluate the contributions of its member schools in the United States and Canada toward international programs. The purpose of the study was to enable the member schools to identify areas which needed strengthening in order to increase their effectiveness in international programs.

International public health began more than a century ago, when twelve countries held the International Sanitary Conference in Paris in July 1851, at which time the extensive spread of cholera was a deep concern of many countries. The international sanitary conferences, irregularly held throughout the following fifty years, were concerned primarily with epidemic diseases but, after the turn of the century, international public health began to embrace much of its present broad humanitarian objectives. Between the two world wars, international public health education received its initial impetus from the International Health Division of the Rockefeller Foundation. The Foundation's field staff screened promising foreign candidates and sent them to the United States for basic public health courses. During World War II, the few foreign students in the American schools of public health were mostly Latin American; after the war, however, the enrollment of international students increased rapidly. By this time, many public and private organizations with international health interests were contributing toward and thereby enlarging international health work and education. These organizations included the United Nations Relief and Rehabilitation Administration, World Health Organization, Food and Agriculture Organization, United Nations International Children's Educational Fund, the United Nations Refugees Relief and Works Agency for Palestine, the Rockefeller Foundation, the W. K. Kellogg Foundation, and the China Medical Board. Among the several Federal agencies actively involved in providing public health fellowships to foreign students were the Institute of Inter-American Affairs and the Agency for International Development.

The Center for Cultural and Technical Interchange between East and West at the University of Hawaii, an agency of the Federal government founded in 1960, provides public health fellowships to qualified students applying to the School of Public Health at the University of Hawaii. The objective of the East-West Center is "to promote mutual understanding among the countries of Asia, the Pacific Area and the United States." In addition to graduate students, the Center brings together senior scholars and technicians of American, Asian, and Pacific countries for mutual interchange of ideas and knowledge.[9]

Dr. Myron Wegman, Dean of the School of Public Health, University of Michigan, in his statement to Congress[10] in 1962, pointed out that professional education in public health has served a unique function in developing close ties with similar schools in other countries. This has served to strengthen professional contacts and to facilitate interchange of ideas in a number of fields of science as well as in public health. Public health advances have constantly brought with them the necessity of always thinking in broad terms. The schools of public health are particularly important because their relatively recent development has facilitated mutual understanding and working interrelationships to a high degree. He pointed out that schools of public health in the United States are constantly being asked to play a more active role in collaborating with schools of public health in other countries. This sharing of ideas often leads to considerable interchange of personnel. He pointed out that the School of Public Health of Puerto Rico performs a unique function internationally since it carries on instruction in Spanish. In this way, it is able to serve Spanish-speaking countries of the Americas and attracts increasing numbers of qualified students. He also observed that "our schools of public health, state supported and private, are in the broadest sense of the words, truly national and international. Their service to the country and the world, the need for maintaining standards of education of which the nation can be proud, make it essential that legislation be enacted to provide these education activities."

Recent Trends in International Education and Training

More and more in recent years, schools are including in their formal organizations units which recognize international health education. For example, beginning with the 1965-66 academic year, Harvard University appointed a new assistant dean for international programs to coordinate and administer the various international research activities (many of them based abroad) and programs which offer education for those planning international health service. Johns Hopkins University established in 1961 a special division of international health in response to the needs of the Public Health Service, the International Cooperation Administration (now the Agency for International Development), and the World Health Organization.

Tulane University's division of tropical medicine and hygiene, which functions also as a division of graduate public health, for many years has been active in programs throughout Latin America.[11] Tulane has an overseas center for medical research and training in Colombia. In 1961, in cooperation with the Universidad del Valle, Tulane established its International Center for Medical Research and Training at Cali, Colombia. Four other such centers are supported in Pakistan by the National Institutes of Health and the University of Maryland, in Malaysia by the University of California, in Costa Rica by the Louisiana State University, and in Calcutta by the Johns Hopkins University.

The School of Public Health at the University of Hawaii is developing a program in international health to serve as an academic center of regional significance for training and research in the public health problems of Pacific and Asian countries. It is in an unusual position to offer further training of professional qualified personnel in the various fields of health, with special emphasis upon international health, allowing them to pursue or continue a career of health work related to the newly developing countries of Asia and the Pacific.

The new criteria for accreditation[5] include the expectation that schools of public health will be concerned with the relative pertinence and applicability or organized community health service programs in different regions of the world. Moreover, the admission of students from other countries is recognized both as an opportunity and a special problem. First, there should be assurance of a minimum competence of such students in the language of instruction, as well as of a basic knowledge in the major areas. Secondly, provision should be made for these students to meet deficiencies in language and in other important content subjects before formal admission to graduate degree programs. In addition, students from abroad should be admitted to a given school only when there is clear indication that the specific school is particularly suitable to meet the candidate's needs in assuming a position of high-level responsibility upon his return to his home country. Once undertaken, however, every reasonable effort should be made to enrich the individual's experience and knowledge without affecting the school's orientation to its own country and cultural region.

Summary

Schools of public health in our nation are an important national resource for the training of manpower to fulfill the nation's needs as well as those of international education and research. The 1965 Congress recognized the great national deficit in health personnel and enacted much important and far-reaching legislation affecting the future health of the nation. The decade ahead will challenge all schools to increase their training and research efforts. In 1965, there were about 85,000 foreign students in the United States. The number is expected to increase to more than 100,000 or 150,000 during the next 5 years, and to increase even more in succeeding years.[11] The Congress of the United States presently is considering HR 12453, a bill to amend the Public Health Service Act so as to help train and otherwise provide professional health personnel for health work abroad. This International Health Act of 1966 provides grants to schools of public health for training in international health work. These grants may be used to pay all or part of the cost of establishment, expansion, and operation of programs for the specialized training of persons who are or intend to enter any one of the health professions for health work in foreign countries.

Dr. Philip Lee, Assistant Secretary for Health and Scientific Affairs of the Department of Health, Education, and Welfare, states[12] that the role of universities in world affairs, particularly in relation to the foreign aid program of the United States, has received increasingly thoughtful attention in recent years. The number of American universities in AID-supported programs has increased from 87 to 169 in less than 3 years and the cost from $121 to $230 million during this period. The U. S. Office of Education's publication, *A New International Dimension,*[13] emphasizes that Office's chief international function as fostering the development of our educational institutions so that they meet the needs of American society in a rapidly changing world. This requires a concern for the broad general education of all Americans, for the future supply of intellectual leaders in international affairs, and for the training of overseas specialists. Schools of public health have already demonstrated this concern, and they can be expected to render valuable assistance to our Federal agencies charged with accomplishing the nation's goals in international education.

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ANNUAL REPORT 1965-1966

At the end of its forty-first year, the Academy had a total membership of 1,315. The Academy Council met eight times during the year: May 26, July 15, September 7, and November 18, 1965; January 5, January 31, March 9, and April 12, 1966. Minutes of these meetings are on file.

The Academy Council again approved presentation of $25 in awards for meritorious projects entered in the Hawaii Science Fair. This year $15 went to Jeff Nakamura of Punahou School for his project, "The Isolation and Characterization of the Deoxyribonucleoprotein of a Protozoan, *Tetrahymena* sp.," and $10 went to Victoria Higa and Susan Oshiro for their project, "Which Way Does Your Hair Swirl?"

Robert E. Coleman, *Secretary*

NOMINATIONS

The Nominating Committee presented the following slate of candidates for Academy offices during the year 1966-67:

President-elect (one to be elected): John C. Marr, Jimmie B. Smith
Secretary: Robert E. Coleman
Treasurer: Eleanor S. Anderson
Councilors (2 years) (2): George Felton, Shosuke Goto, George Gillett, Gunter Seckel
Additional officers for the year will be:
President Louis G. Nickell
Councilors (1 year): Martin J. Vitousek, Robert A. Nordyke, Richard K. C. Lee (ex officio)

Paul C. Ekern, *Chairman*

PUBLICATIONS

During 1965-66, *Proceedings* for the fortieth annual meeting of the Academy were published and distributed to the membership.

O. A. Bushnell, *Chairman*

MEMBERSHIP

After the expansion of many scientific activities in Hawaii during the past few years, an effort was made to enroll many of these new scientists in the Academy.

Brochures explaining the Academy's purposes and activities were circulated among the scientific community. As a result of these efforts, 687 new members were elected since May 1965, bringing the total membership to 1,315.

John C. Marr, *Chairman*

PROGRAM

Early in the year a questionnaire was sent to the membership asking for information on types and subjects of programs desired most. In keeping with the results of this survey, a program of contributed papers was arranged for the fall session on the evenings of November 18 and 19, 1965. All of the papers for the first night's meeting were on marine biology. Three speakers reported on different aspects of the Bureau of Commercial Fisheries' operations with the submarine, *Asherah*. The second night's program presented seven papers on a variety of subjects.

The final session of the Academy was again held as an all day meeting on Saturday, April 16, with luncheon. The morning session was concerned with the physical sciences, presenting invitational papers on astronomical research, tsunamis, lasers, and ionizing radiation. After a short business meeting, a luncheon was held in the East-West Center cafeteria, and the presidential address was presented. Retiring President Richard K. C. Lee spoke on "Schools of Public Health and International Education." Five students, whose participation in the Westinghouse Science Talent Search was especially noteworthy, were honored. Thomas Ho, Ruby Ibaraki, Deborah Cotton, and Jefferie Nakamura were honors winners, and Gail Hamaoka was an additional participant. Mrs. Dorothy Wendt was recognized for the Outstanding Biology Teacher Award of the National Association of Biology Teachers. Miss Iris Fukui was recognized for the Outstanding Chemistry Teacher Award of the Hawaii Chapter of the American Chemical Society. Four invitational papers on medical research were presented during the afternoon meeting.

Louis G. Nickell, *Chairman*

AAAS REPRESENTATION AND FELLOWS

The Academy did not find it possible to obtain representation at the AAAS annual meeting in Berkeley. Some AAAS council business has been conducted by correspondence.

The fellowship committee, composed of Walter Carter, Harry Arnold, Jr., Elmo Hardy, Estel Cobb, and myself as chairman, met to consider nominees. In view of the increased membership of the Academy and scientific community in Hawaii, twenty-seven members were approved by the Academy Council and their names were submitted to the AAAS on May 6, 1966.

The nominees were: J. W. Beardsley, Robert E. Coleman, David Crowell, Robert Cushing, Robert Cutting, Kazuo Fujino, Philip Helfrich, John W. Hylin, Alan J. Kohn, Charles Lamoureux, Richard K. C. Lee, James F. Lenney, Ira Lichton, John J. Magnuson, Marion O. Mapes, John J. Naughton, Pete T. Okumoto, Daniel E. Palmer, Ernst S. Reese, Leon Rosen, Paul J. Scheuer, Lucian M. Sprague, John R. Stephenson, Frank L. Tabrah, Sidney J. Townsley, Minoru Tamashiro, and W. Y. Whang.

Gerald G. Dull, *Chairman*

OFFICERS

1965-66

Richard K. C. Lee	*President*
Louis G. Nickell	*President-elect*
Robert E. Coleman	*Secretary*
Eleanor S. Anderson	*Treasurer*
John C. Marr	*Councilor*
Toshiyuki Nishida	*Councilor*
Robert A. Nordyke	*Councilor*
Martin J. Vitousek	*Councilor*
Roland Force	*Councilor (ex officio)*

FINANCES

Balance April 1, 1965			$ 5,656.67
Receipts:			
Dues		$ 2,217.00	
Miscellaneous			
For supplies, contingencies, & clerical assistance re NSF grants	$ 2,178.24		
Annual dinner (1965)	215.00		
Donations	40.00	2,433.24	
NSF grant funds		11,645.49	
ISSEC		500.00	
First Federal Savings & Loan Association Interest	35.61		
Marie C. Neal Estate	500.00	535.61	17,331.34
			22,988.01

Disbursements:

Stationery & mailing		682.44	
Printing		1,407.43	
Supplies & incidentals		185.26	
Miscellaneous			
Telephone	33.11		
Annual dinner	266.44		
P. O. Box	12.00		
Haskins & Sells (1964/65 audit)	75.00		
AAAS	23.06		
Refreshments for fall meeting	8.38		
9th Annual Hawaii Science Fair Wish Award	15.00	432.99	
NSF grants		13,752.54	
ISSEC		359.22	16,819.88
			$ 6,168.13

Distribution of total cash balance:

Bank of Hawaii	4,882.70
First Federal Savings & Loan Association	1,277.43
Cash on hand	8.00
	$ 6,168.13

Distribution of funds in Bank of Hawaii:

HAS operating funds	3,792.21
NSF grant funds	411.39
ISSEC funds	679.10
	$ 4,882.70

Status of NSF Grants (Visiting Scientists' Program)

GE-4293

Amount of grant		$ 6,375.00
Expended 1964-65		4,162.16
Balance on hand April 1, 1965		2,212.84
Disbursements:		
Program director	$ 200.00	
Associate director	300.00	
Secretarial assistance	100.00	
Office supplies	3.49	
Expendible supplies	240.30	
Directors' travel & per diem	97.00	
Scientists' travel & per diem	490.00	
Indirect costs	782.05	2,212.84
Balance March 31, 1966		—0—

GE-4302

Amount of grant		6,760.00
Expended 1964-65		3,239.92
Balance of grant April 1, 1965		3,520.08
Disbursements:		
Director	200.00	
Scientists' stipends	1,255.00	
Secretarial assistance	149.00	
Transportation & per diem	749.94	
Office supplies	246.55	
Telephone	100.00	
Indirect costs	666.91	
Refund to NSF	152.68	$ 3,520.08
Balance March 31, 1966		—0—

GE-7983

Amount of grant		$ 6,375.00
Cash received		6,083.69
Disbursements:		
Director	$ 1,820.00	
Secretarial assistance	275.00	
Travel & per diem	2,410.00	
Office supplies & communications	40.00	
Expendible instructional supplies	95.00	
Honoraria	480.00	
Indirect costs	768.00	5,888.00
Cash balance on hand March 31, 1966		195.69
Balance of grant		487.00

GE-9586

Amount of grant		$ 6,670.00
Cash received		2,500.00
Disbursements:		
Director	800.00	
Secretarial assistance	450.00	
Honoraria	255.00	
Scientists' per diem	54.00	
Director's travel	144.00	
Publicity	293.13	
Indirect costs	288.17	2,284.30
Cash balance on hand March 31, 1966		215.70
Balance of grant		4,385.70

ISSEC supplementary funds

Cash on hand April 1, 1965	538.32
Cash received	500.00
	1,038.32
Disbursements:	
Secretarial assistance	359.22
Cash balance on hand March 31, 1966	679.10

Status of dues payments:
As of March 31, 1966
Advance ....$ 716.00
Arrears ....$ 158.00

Eleanor S. Anderson, *Treasurer*

ACTIVITIES OF THE INTER-SOCIETY SCIENCE EDUCATION COUNCIL

1965-66

Elsewhere in this issue of the *Proceedings,* Doak Cox, formerly President of the Hawaiian Academy of Science and a pioneering spirit in the evolution of the educational activities of the Academy, details the genesis of the Inter-Society Science Education Council. Although there had been previous organizational efforts, he notes that the year of 1957-58 produced the First Annual Hawaiian Science Fair in the spring of 1958, followed some weeks later by the organization of ISSEC. Thus 1968 will mark the tenth anniversary of the founding of ISSEC, and the Tenth Annual Science Fair will be held in the spring of 1967.

These years have seen the Academy become one of the most active in the United States in the support of science education. Operated almost entirely with a voluntary force of scientists from the Academy rolls, the various programs have been imaginative and have been praised by professional educators in Hawaii and elsewhere. Some programs have been formalized and now are supported by direct grants from federal agencies. The "spin-off" effects on science educational processes in Hawaii has helped to lift Hawaii to a position of leadership in science education in the United States.

What of the future? To discuss this question, representatives of the various scientific societies and community sponsoring organizations were asked to meet with ISSEC officers on April 4, 1966, at Agee Hall, HSPA Experiment Station. Although the attendance was small, the discussion was good, and a report of the findings will be filed with the Academy president by the fall of 1966.

Meantime I am happy to present the Annual Report of ISSEC for 1965-66 to the Academy. I have been assisted by Mr. Albert Nagy, Mathematics Department, University of Hawaii, as Vice-Chairman. He will succeed me for 1966-67. Mrs. Rhea Lucas of the Bishop Museum has served as Secretary of ISSEC on a part-time basis and Mr. Dwight Lowery of the Cooke Trust Co. has continued to serve as Treasurer. Representatives of the affiliated scientific societies, not listed here, have met in council with us as was necessary throughout the year. The various program directors will be listed below with abstracts of their reports to me for the year. To all these people, and to many other Academy members, as well as our loyal supporters in the community, I express my deepest gratitude for their efforts on behalf of science education.

COMMUNITY PARTICIPATION: Dr. John Payne, HSPA Experiment Station.

From the beginning of ISSEC various trusts and foundations in Honolulu have been loyal donors. In addition, the Pineapple Research Institute and HSPA Experiment Station have provided up to $1,500 each to sponsor trips to the mainland for the two top winners of the State Fair. Dr. Payne reports a collection of $6,020 for this year, to which must be added a committment of $1,500 for one fair winner provided by PRI. However, HSPA discontinued its major support, reducing its contribution to $100. Hence, total collections are less than in previous years.

TREASURER'S REPORT: Mrs. Dwight Lowery, Cooke Trust Co.

Fiscal Year—June 1, 1965-May 31, 1966

Opening Balances—June 1, 1965			
ISSEC Account			$ 4,943.52
8th Fair			(5,174.39)
Savings & Loan Account			10,000.00
			9,769.13
Receipts			
Collections: '64-'65 year	$2,215.00		
Collections: '65-'66 year	8,886.00		
Interest	498.75		
Refund: '64'-65 year	433.20		
Refund: 8th Fair	3.30		12,036.25
Disbursements		*Budget*	
Science Camp (1)	1,103.00	803.00	
Science Talent Search	0	70.00	
Science Workshop	307.39	1,366.00	
Science Clubs	421.85	337.44	
Film Service	121.50	300.00	
Clerical Expense & Public Relations	709.84	700.00	
8th Fair: Balance	49.81		
9th Fair:	6,102.90	6,495.00	(8,816.29)
			12,989.09
Closing Balances—May 31, 1966			
ISSEC Account			7,547.69
9th Fair			(6,582.35)
Savings and Loan Accounts		(2)	12,023.75
			12,989.09

(1) $300 Honorarium re Junior Science Camp.

(2) Additional $2,000 transferred to Savings & Loan. $23.75 was the interest on this sum to year end. (Pass Book Account.)

SCIENCE FAIR: Dr. Laurence Snyder, University of Hawaii.

The Ninth Annual Hawaiian Science Fair was held March 11-13, 1966, at the Hilton Dome. Ninety-two exhibits were selected for judging at the Fair, twenty-nine of which were in the Senior Division. Francis Aona of St. Louis High and Wrenwick Lee of Farrington High were selected as top winners of the Senior Division, with projects entitled "Iorad III" and "An Investigation into Barnacle Fouling" respectively. Francis Aona was given the PRI award, and Wrenrick Lee was given an ISSEC award in place of the HSPA award of previous years. They were accompanied to the International Fair in Dallas, Texas, by Dr. and Mrs. Ira Lichton; Dr. Lichton will serve as next year's Fair Director. Francis Aona won a fourth place award for his project.

PUBLIC RELATIONS: Messrs. Richard Ekimoto and Richard Okamoto, Van Waters & Rogers Co.

Primary public relations efforts have been associated with an ISSEC brochure, updated annually, and the Science Fair. Space acquisition for the latter has become increasingly difficult in the local media but recognition of the Fair and top winners was given. Perhaps some different approaches need to be made for 1966-67.

VISITING SCIENTISTS PROGRAM: Mr. Richard Coburn, Church College.

This program evolved from a lecture series for teachers on Oahu begun in 1957 and extended to the neighbor islands in about 1960. Funded independently by the National Science Foundation through the Academy for the last several years, it continued in 1965-66 to offer 119 presentations with 43 participating scientists. Included were three visits each to Hawaii, Kauai, and Maui, with an average of four presentations for each island visit. Funds have been received from NSF for continuance of the program in 1966-67.

STUDENT SCIENCE SEMINARS: Dr. Albert Carr, University of Hawaii.

Started under ISSEC auspices by Dr. Carr in 1959, this program is now also funded through the Academy with a grant from NSF. Thirty specially selected high school students formed four seminar groups, one each on Oahu, Kauai, Maui, and Hawaii. Twenty-five sessions were held on Oahu, about sixteen each on the other islands. The seminars afford these students the opportunity of additional science instruction together with interchange with professional scientists. Funds have been granted by NSF for continuance in 1966-67.

SCIENCE CLUBS SERVICES: Iris Shinseki, Waianae High School.

Since their inception some years ago ISSEC has worked closely with high school science clubs. In 1964-65 the clubs were organized into a statewide association, under the leadership of Miss Shinseki. The association arranges student workshops and field trips, as well as publishing the bi-monthly Ke Akeakamai. Miss Deborah Cotton, Maryknoll School, served as association President in 1965-66.

SCIENCE CLUBS CAMPS: Gerald Sato, Kaimuki Intermediate School and Robert Morimoto, Kalakaua Intermediate School.

For several years science club members have encamped for a weekend of science instruction and field work, which has also provided an opportunity for exchange between clubs. With joint sponsorship by the Hawaii Science Teachers Association, Walter Luke, President, two camps were held at the Kokokahi YWCA facility—a senior camp on March 18-20 and a junior camp shortly thereafter. Approximately 140 students attended the senior camp. Some 23 professional scientists, physicians, and other science-oriented persons were present for the senior camp.

SCIENCE FILM SERVICE: Mrs. Rhea Lucas, Bishop Museum.

Using films and film strips obtained by ISSEC from the former Science Clubs Service at the University of Hawaii, ISSEC has operated a service to private and parochial schools through the ISSEC office at the Bishop Museum. By April of 1966, there had been 896 reservations of motion picture films for the school year, and 125 of film strips by 31 public and 24 private schools. At the request of the Chairman, Mr. John Kay of Iolani School did a quick usage-study which suggests our use rate does not compare favorably with that of the Library of Hawaii, for example. This, together with increasing maintenance costs and obsolescence of titles, suggests a thorough review of this activity, as a part of the overall ISSEC review, and prior to further operation of this service in 1966-67.

ELEMENTARY SCIENCE TEXTS: Sister Mary St. Lawrence, Catholic School Office.

Some discussion of the mechanism for developing a new elementary science series, in addition to the very popular "Exploring Nature in Hawaii," was undertaken by the officers of ISSEC and representatives of the Catholic School Office. Results of this discussion continue with decisions to be reported later.

SCIENCE TEACHER WORKSHOP: Harold Lee, Punahou School.

This workshop was first held in conjunction with the Third Annual Fair in 1960 and continued, with varied programming, each year. This year the invited teachers met at Punahou School on Saturday, March 12, from 8:30-3:00, with lunch provided by ISSEC. Various scientists were asked to speak and the reception was reported as good.

SCIENCE TALENT SEARCH: Mr. Edward Chinn, State Department of Education.

In continuance of previous practice, students were selected to participate in the nationwide Westinghouse talent search. Four were given honors at the State level: They were Thomas Ho and Ruby Ibaraki of Kaimuki High; Deborah Jean Cotton of Maryknoll; and Jeffrey Nakamura of Punahou.

In addition to the above activities, two teachers were recognized by small monetary awards by ISSEC at the annual Academy meeting in May. Recognized as the outstanding biology teacher for 1965-66 was Mrs. Dorothy Wendt of Waipahu High School, as selected by the Hawaii Biology Teachers Association. Mrs. Iris Fukui, Kalani High School, was selected as the outstanding chemistry teacher by the National Association of Chemistry Teachers, local chapter.

Respectfully submitted,
Jimmie B. Smith
Chairman, ISSEC, 1965-66

JBS:hh
July 19, 1966

GENESIS OF THE INTER-SOCIETY EDUCATION COUNCIL*

Doak C. Cox

The establishment of the Inter-Society Science Education Council, as in its subsequent highly successful operations, involved the ideas and work of many persons focussed through the several organizations. Doubtless each of us involved would describe the process a little differently. I trust I can avoid significant distortion in my description, but I hope I will be forgiven if I inadvertently slight the contributions of some individuals or organizations.

The Council, originally the Inter-Society Science Education Committee, was established in the spring of 1958 following the First Annual Hawaiian Science Fair. No doubt the rapid development of public interest and support was significantly conditioned by the launching of Sputnik I in October 1957. However, it is clear that the scientific committee in Hawaii was already concerned about science training before the Sputnik flap, and I am inclined to place the inception of the science education effort in the reorganization and reorientation of the Hawaiian Academy of Science in early 1953.

Interest in the problems of science education had not been shown earlier by the Academy and, in fact, was specifically excluded from the field of the Academy as described by its first President in his retiring address in 1926. "The pedagogical side of science," he said, "is already looked after by teachers' organizations; and while the Academy might, at some time, wish to inquire into the adequacy of the equipment for teaching science, the methods, and so forth, would probably be best left to the teachers themselves" (Newcombe, 1926).

As sometimes happens, the interest finally was aroused by a triviality. With the advice of the American Association for the Advancement of Science, the Academy had originally been organized with the intent that it would become an affiliate of the AAAS. Somehow the affiliation was not consumated for more than a quarter century, but the Academy was finally accepted by the AAAS in 1952, and as a result, became entitled to award annually a couple of honorary junior AAAS memberships to high school students. Early in 1953, in considering how to handle these awards, the Academy's Council realized abruptly what insignificant contact it had with science education, science teachers, and science students.

To quote from another Presidential review (Cox, 1959): "An attempt was immediately launched to invite science teachers to membership in the Academy, and before the spring meetings, 36 responded. From this group a Science Teachers Committee was appointed the next year, and instructed not only to administer the AAAS awards, but to investigate the formation of a science teacher society, that might become associated with the Academy, and the formation of science clubs.

"This Committee was maintained for four successive years. The work of the first two years was largely exploratory, but a break-through seemed to be scored in the third year when a Science and Mathematics Teachers Organization was launched at a meeting of 100 teachers and guests at Coconut Island in November 1955. The success was only temporary; in spite of the continuing support of the Committee, the organization foundered.

"In the meantime, however, the concern of the Academy in the field of science education had born fruit in a number of other ways. Members of the Academy began to be called with increasing frequency for service as Career Day Councilors

*Prepared at the request of the Chairman of ISSEC for a review meeting held on April 4, 1966, Agee Hall, HSPA Experiment Station.

in the high schools, as participants in meetings organized by the Department of Public Instruction to acquaint elementary and intermediate teachers with the features of Hawaiian natural history, and as members of curriculum advisory groups.

"In 1954-55, a program subcommittee headed by John Warner arranged two popular symposia intended especially to acquaint teachers with the activities and facilities of the research institutions in Honolulu.

"Two years later, Sterling Wortman, then head of the Program Committee, arranged, in cooperation with the Department of Public Instruction, a series of six lectures by Academy members for the science teachers of Honolulu. So enthusiastic was the reception that the DPI insisted on a repeat performance the next year. Again Wortman handled the arrangements for the Academy, this time as Secretary and ex officio member of the Science Teachers Committee.

"In 1956, the AAAS suggested strongly that the annual funds (it provided), formerly used for postgraduate research grants, be diverted to the support of high school science projects. The administration of these funds was transferred to the Science Teachers Committee, which arranged for a grant to the students of Radford High School for the construction of a botanical garden."

In the 1953 reorganization of the Academy, provision had been made for the formal association with the Academy of Hawaiian societies representing the various scientific disciplines, and for the creation of an Affiliation Committee composed of the representatives of these Associated Societies.

"Through the stimulus of the Hawaii Chapter of the American Chemical Society, the Affiliation Committee in 1956-57 undertook serious consideration of a Science Fair. A special Science Fair Executive Committee was set up representing 8 of the 10 societies (then associated) with the aim of organizing a fair for the spring of 1957. This timing proved too ambitious, but in the spring of 1958, under the leadership of Leon Rhodes, the First Annual Hawaiian Science Fair was held in Honolulu. About 2,000 students participated in schools throughout the Islands. Of the exhibits prepared, 157 were shown at the central fair and the top boy and girl winners were sent to the National Science Fair in Flint, Michigan. This activity required a budget far beyond the Academy's norm, but the community responded well to an appeal for financial and material support and assistance. To receive the monetary contributions, the Academy filed as a tax-exempt institution and established a Special Science Fair Fund."

The Inter-Society Science Education Committee was established in accordance with a recommendation by the Science Fair Committee at a joint meeting of the Council of the Academy with the presiding officers of its ten associated societies held on May 29, 1958. Its objectives were "to assume the holding of annual science fairs in Hawaii and to coordinate and undertake such other activities in the field of science education as the Academy and its associated societies might deem desirable." Each associated society was entitled to appoint a member of the committee and the Academy was to appoint its chairman. The Academy Council transferred to the new committee all of its efforts in the science education field and changed its Science Fair Fund to a Science Education Fund to be administered by the new Committee.

Albert J. Mangelsdorf was appointed the first Chairman of ISSEC. The members appointed by the Associated Societies were:

Amer. Chem. Soc., Hawaii Sec., L. J. Rhodes (J. H. Payne, alt.)
Amer. Soc. Agron., Hawaii Sec., E. J. Britten (W. E. Holmes, alt.)
Amer. Statis. Soc., Hawaii Sec., Gordon Frazier (R. Takasaki, alt.)
Anthropol. Soc. Hawaii, Dorothy Rainwater
Geophysical Soc. Hawaii, Saul Price (Thos. Austin, alt.)
Hawaii Medical Assn., Harold Civin
Hawaii Psychol. Assn., Leonard Diamond (Edgar Vinacke, alt.)
Hawaiian Botanical Soc., Gerald Dull
Hawaiian Entomol. Soc., Wallace C. Mitchell
Soc. Sigma Xi, Hawaii Chapt., John H. Payne.

It would be difficult to imagine a more ambitious precedent than that set in the first year of this Committee. To add to the Science Fair, a number of new programs were begun. Some stemmed from needs seen by the Committee on which the Committee had to find people to work. Some were concerns brought to the attention of the Committee by persons offering their services if the Committee would provide encouragement and support. In all, the Committee established ten subcommittees to carry on the work (Mangelsdorf, 1959).

The Second Annual Hawaiian Science Fair was held under the direction of Saul Price, Director, and Wayne Hilton, Associate Director. This time 5,000 students at 75 schools throughout the Islands were involved.

The Science Library Resources Subcommittee, Robert Clopton, Chairman, arranged for the circulation of a 200-volume AAAS travelling High School Science Library among the smaller high schools on four islands.

The Teachers' Science Seminar Series was continued under the chairmanship of Sterling Wortman.

A Subcommittee on Counseling and Scholarships was set up under the chairmanship of Shosuke Goto.

A Subcommittee on Science Teaching Aids under the chairmanship of Baron Goto assembled materials of interest to high school teachers and arranged a spring vacation field trip.

A Subcommittee on Science Clubs under the chairmanship of Donald McGuire laid plans for the ambitious program of advisers, guest speakers, field trips, and television programs serving high school science clubs that was to begin the next year.

A series of Student Science Seminars was begun under the chairmanship of Albert Carr.

Community participation was sought and organized under the chairmanship of Nils Larsen, bringing in a total of contributions of $9,785.

The handling of the funds was placed in the hands of a Budget Subcommittee under the chairmanship of John Payne.

A Legislation Subcommittee under the chairmanship of Wilfred Greenwell kept track of legislation and legislators concerned with science education.

In addition, plans were laid for the Museums in Miniature to be prepared in cooperation with the Bishop Museum Association and the Exploring Nature in Hawaii series of elementary science texts to be prepared in cooperation with the Catholic School Department.

The Committee was enlarged by the addition of the subcommittee chairman, ex officio, and, as associate members, Kenneth Chapson representing the Engineering Association of Hawaii, Teruo Masatsugu representing the Department of Public Instruction, John Naughton representing the University of Hawaii, Col. C. K. Warren representing the Armed Forces (with Lt. Col. T. A. Gerells as alternate), D. C. Cox, Ralph Heinicke, E. H. Bryan, and its invaluable Secretary, Dorothy Rainwater.

With the passage of years, of course, some ISSEC programs have been dropped and others added, as some individuals moved out and others have taken their places, and as some sources of support dried up and others have been discovered. Along with the continuous search for funds and particularly for the dedicated manpower needed, I sense that there has been a continuing concern with the basic ISSEC orientation. The overall program has repeatedly been examined with the aim of increasing its effectiveness in instilling in the young people of the Islands a sense of the nature of science and the value of its methods rather than just a knowledge of scientific facts and an acquaintance with scientific equipment.

In the light of this history, the objectives originally set forth for ISSEC seem curiously narrow, curiously insistent on one activity, the Science Fair, and curiously cautious about any other activities, in the requirement that they be subject to the desire of the Academy and its Associated Societies. The fact that, at time of ISSEC's establishment, there was some unease about the powers of this new joint endeavor is made additionally clear from the ruling that, though the Committee was established on a continuing basis, its organization and functions were made explicitly subject to review at the end of the first year.

So far as I can recall, the success of the first year was so great that the value of the joint enterprise was beyond question, and I should think that the successes of the intervening years have been sufficient to permit recognition that the actual objectives of ISSEC have been more broadly expressible. Let me suggest that, paralleling more or less the objectives of the Academy itself, they are: the promotion of the understanding of scientific knowledge, and the appreciation of the scientific method particularly among the young people of Hawaii.

If we believe in the value of scientific endeavor as an intellectual activity and as a component of technological advance, we cannot doubt the value of these objectives. Its own history stakes out for the Inter-Society Science Education Council its place in their accomplishment.

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The 41st
ANNUAL MEETING 1965-1966

Programs

FIRST SESSION

November 18, 1965, Agee Auditorium, HSPA Honolulu

1. Donald W. Strasburg: Bureau of Commercial Fisheries Operations with the Submarine *Asherah* and Icthyological Results of These Operations
2. Everet C. Jones: The Use of a Submarine to Survey Populations of Planktonic and Demersal Invertebrates
3. Robert T. B. Iversen: The Use of a Submarine to Record Marine Biological Sounds
4. E. Alison Kay: The Opihi: Hawaiian Limpets
5. P. B. van Weel & J. P. Christofferson: Electrophysical Responses to Various Stimuli in the Antennulae of Certain Crabs

November 19, 1965, Agee Auditorium, HSPA Honolulu

6. J. Linsley Gressitt: Plants Growing on Living Insects in New Guinea
7. R. M. Heinicke: Why Do Pineapple Plants Make Bromelain?
8. Sidney C. Hsiao: Kinetic Studies on Echinoplutean Alkaline Phosphatase
9. Raymond Yang & David H. Crowell: The Effect of Repetitive Stimulation of the "Law of Initial Values" in the Human Neonate
10. Richard A. Haag, William T. Woodard, and, John M. Digman: A Factor Analysis of Various Measures of Response Speed, Memory Span, and Physiological Indices of Activation Level
11. Andrew W. Lind: Indices of Integration Among Orientals in Hawaii and the U.S. Mainland
12. David P. Hill: Crustal Structure of Hawaii from Seismic Refraction Studies

SECOND SESSION

April 16, 1966, Hawaii Institute of Geophysics Auditorium, University of Hawaii

13. John T. Jefferies: Astronomical Research at the University of Hawaii
14. Wm. Mansfield Adams: Prediction and Prevention of Large Earthquakes and Tsunamis
15. John R. Holmes: Lasers: Characteristics and Potential Application
16. James L. Brewbaker: Ionizing Radiation in Bioagricultural Research and Tropical Food Preservation

Business Meeting

Luncheon

East-West Center Cafeteria Garden Room

Presentation of Awards

PRESIDENTIAL ADDRESS

Schools of Public Health and International Education
Richard K. C. Lee, Dean
School of Public Health
University of Hawaii

17. Robert W. Noyes: Studies in Spermatozoan Transport
18. George Goto: Fertility Control in Humans
19. Oliver Wayman: Infertility in Hawaiian Farm Animals
20. Robert A. Nordyke: Medical Uses of Radioisotopes: Current Practice and a 5-Year Prediction

Abstracts

FIRST SESSION

1. Bureau of Commercial Fisheries Operations with the Submarine Asherah and Ichthyological Results of These Operations

The Honolulu Laboratory of the Bureau of Commercial Fisheries operated the two-man submarine *Asherah* off Barber's Point, Oahu, during September and October, 1965. The craft was leased from General Dynamics/Electric Boat to gain experience with a submarine as a research tool. The research vessel *Townsend Cromwell* and the raft *Nenue II* provided support facilities for *Asherah.*

Asherah is 17 ft long, weighs 8,500 lbs, has an operational depth of 600 ft, and a speed of 2.5 knots. Research facilities include six portholes, two floodlights, an externally-mounted still camera and stroboscopic flash, a closed-circuit television camera and monitor, a depth gauge, and a fathometer. In addition, a hydrophone and plaques bearing materials of known reflectance were mounted on the hull.

The Bureau's research missions undertaken with *Asherah* included surveys of the midwater and bottom faunas, studies of the plankton community, patrols around submerged lights, evaluation of plankton nets and expendable bathythermographs, measurement of currents, observations at the thermocline, and measurements of light attenuation and biological sound. A total of 50 dives was made.

The survey area consisted of a gently shelving sandy plain extending from the shore to a depth of about 350 ft. At the 350-ft point the plain gave way to a precipitous limestone cliff, which dropped away to depths of several thousand feet. The submarine explored the plain from a depth of 80 ft to its brink and investigated the cliff face down to a depth of 630 ft.

The fish fauna of the plain was concentrated over ledges, isolated rocks, or patches of coral offering shelter. Only a few species, mostly triggerfish, were regularly encountered over the bare sand. This was in great contrast to the hordes of colorful species seen over rocks and coral. Prominent in these assemblages were butterflyfish, surgeonfish, damselfish, and goatfish. Many isolated rocky patches were cleaning stations for the wrasse *Labroides phtirophagus.* Swimming pelagically above the plain were large schools of mackerel scad, big-eye scad, and surgeonfish (*Naso hexacanthus*).

The steep cliff was rather featureless, and the more demersal fish were again concentrated in whatever ledges and crevices occurred. They included squirrelfish, eels, and butterflyfish. Enormous schools of 1-3 in. fish ranged along the cliff face; two captured specimens were juvenile *Holocentris lacteoguttatus.* Preying on these small fish were schools or small groups of skipjack, little tunny, wahoo, jacks, amberjack, and red and gray snappers. The cliff face served as a deep-water nursery ground as well as a rich forage area.

DONALD W. STRASBURG
Bureau of Commercial Fisheries
Biological Laboratory

2. Use of a Submarine to Survey Populations of Planktonic and Demersal Invertebrates

Observations were made of planktonic and demersal invertebrates in waters off Barber's Point, Oahu, in September and October 1965, from the portholes of the submarine *Asherah.*

From visual observations of particle sizes and frequencies, an estimate of 1,000 mg of plankton per cubic meter of water was made; this is about 50 times the average volume of zooplankton obtained in net tows around Hawaii. Most of the particles were organic debris or non-swimming forms such as radiolarians. Little change in the amount of plankton was seen between the surface and 630 ft or from day to day. By way of contrast, observations from the bow chamber of the research vessel *Townsend Cromwell* in November 1964, in the area between Hawaii and lat. 10° N, resulted in estimated volumes of planktonic radiolarian colonies and ctenophores up to 250,000 mg and 30,000 mg, respectively, per cubic meter of water viewed. The larger portholes and 12-knot speed of the *Townsend Cromwell,* which allowed the viewing of an enormous volume of water per hr, and the depth-range of the *Asherah* are attributes which, if combined, would give a valuable tool for plankton research.

From observations of demersal invertebrates, general distribution patterns were determined. On the steep cliff face, at depths from 350-630 ft, the urchin *Chondreocidarus gigantea* was common, and the starfish *Linckia* sp. and unidentified hydroids were rare. At the top of the cliff, several thousand large spatangoid urchins were seen in densities up to 6 or 8 per square meter. At depths from 200-400 ft, large beds of pen shells, *Atrina vexillum,* were seen in densities up to 400 per square meter. Other invertebrates seen in or on the sandy flats were sponges, brittle stars (at night), tube worms, and cone shells. Trails and diggings of buried forms were common.

In depths from 100-200 ft, loose clumps of sponges 4-8 in. in diameter were seen in densities up to 10 per square meter. On rocks, clumps of unidentified bryozoans and soft corals as well as the urchin, *Diadema* sp., were seen. The stony coral, *Porites* sp., was scarce but was seen down to 350 ft. Large spiny lobsters were abundant at 250 ft and were seen down to 360 ft. The cleaning shrimp, *Stenopus hispidus,* was seen among rocks at 180 ft.

EVERET C. JONES
Bureau of Commercial Fisheries
Biological Laboratory

3. USE OF A SUBMARINE TO RECORD MARINE BIOLOGICAL SOUNDS

Four dives were made by the 17-ft long, two-man research submarine *Asherah* in Hawaiian waters off the leeward coast of Oahu in order to (1) evaluate the potential of using a submarine to record marine biological sounds, and (2) acoustically survey aggregations of marine animals encountered by the submarine. Acoustic data were collected at depths of 170-350 ft. Four known or suspected sound-producing fish of the families Holocentridae and Balistidae were seen at the precise locations of tape recording. The sounds recorded were similar to those previously reported for closely-related species. The four sound producers were: *Myripristis chryseres, Holocentrus lacteoguttatus, Holocentrus* sp. (*ensifer?*), and *Balistes bursa.* Spectrographic analysis of the recordings showed the presence of fixed-interval staccato sounds and variable-interval grunt-like sounds. The recordings were made by using a hydrophone mounted on struts projecting from the bow of the submarine and a portable amplifier and tape recorder located inside the 5-ft diameter pressure hull. Skillful piloting succeeded in placing the hydrophone within the small caves containing the sound-producers. The dives demonstrate the feasibility of using a submarine to carry out studies on the acoustic behavior of marine animals.

ROBERT T. B. IVERSEN
Bureau of Commercial Fisheries
Biological Laboratory

4. THE OPIHI: HAWAIIAN LIMPETS

Although the Hawaiians and modern fishermen distinguish three or four kinds of opihi, or limpets, conchologists today recognize only two species of the gastropod genus *Cellana* in Hawaiian waters: *C. argentata* (Sowerby, 1839) and *C. exarata* (Reeve, 1854). My own studies indicate that three morphologically and ecologically distinct species of *Cellana* occur along the shorelines of the main islands, and that a fourth may be the dominant species on the leeward islands, e.g., Midway and Necker.

Specimens of *C. argentata,* the largest species of opihi in the Islands, measure more than 100 mm in length. Shells are dome-shaped, brown, and finely ribbed, and are usually covered with dense algal growths, since the animals live below the tidemark in 1-2 meters of water. Present data indicate that this species is limited to the main islands of the Hawaiian chain.

Specimens identified as *C. exarata* by several workers include two species, *C. exarata* and *C. sandwichensis* (Pease, 1861). Shells of *C. exarata* are variable, black or speckled black and white. The shells are never covered with algae, for the animals live in the splash zone. The ribs are moderately developed and the edge of the shell is smooth. Shells reach a length of 40 mm. The foot of the animal is gray and the lateral teeth of the radula are notched and cusped. *C. exarata* occurs on all islands in the Hawaiian chain.

C. sandwichensis is distinguished by its heavier, coarsely ribbed shell, which is covered with a deposit of coralline or macroscopic algae. These animals live in the surf zone and are frequently indistinguishable against the pink coralline alga on the rocks. The shell margin is serrated by coarse ribs, and shells reach a length of 42 mm. The foot of the animal is yellow, and the radula has cusped lateral teeth. *C. sandwichensis* occurs on all the Hawaiian Islands.

Animals which may represent a fourth species, *C. melanostoma* (Pilsbry, 1891), occur principally along the shores of the leeward islands. Shells of this form are large (52 mm in length), peaked (42 mm in height), and scabrous, resembling *C. stearnsi* (Pilsbry, 1891) from the Bonin Islands. The radular teeth of a single specimen examined appear to differ from those of the other species, but further studies are necessary to determine the taxonomic status of these animals.

E. ALISON KAY
Department of Science
University of Hawaii

5. ELECTROPHYSIOLOGICAL RESPONSES TO VARIOUS STIMULI IN THE ANTENNULAE OF CERTAIN CRABS

It is widely held that the small first antennae, or antennulae, of crustaceans are the seat of chemoreceptors which enable the animal to sense chemical stimuli arriving from a distance, whereas those located on the limbs and mouth parts would primarily serve to "test" such substances when they are touched by these appendages. Most of the work done has been based on behavioral responses. Direct recordings of the action potentials originating in the antennulae are few; hence a more detailed investigation seemed appropriate. In the following experiments the antennula was pierced through the carapace by a semi-microelectrode, and the various solutions dropped on the antennula. The Hawaiian crab, *Podophthalmus vigil,* and the haole crab, *Portunus sanguinolentus,* were used in this investigation. Results showed that the seat of the sense organs is the flagellum of the antennula.

A. *Chemical substances.* A number of amino acids and the dipeptide glycyl-glycine at the concentration of 0.05 mol/L sea water, were tested. Reactions, although different ones, were recorded in both species. In *Podophthalmus* the effectiveness in invoking an electrical response was: glycine > DL-norleucine > glycyl-glycine, chloracetyl-L-tyrosine, L-asparagine; whereas in *Portunus* the sequence was: glycine, glycyl-glycine, DL-norleucine > L-asparagine > chloracetyl-L-tyrosine. *Portunus* showed the strongest response to all substances tested. It is obvious from these data that the molecular size of the substances does not seem to play a very important role in inducing the electrical response.

B. *Sea water concentrations.* Concentrated sea water of 125 per cent did not evoke any particular electrical response. Diluted sea water did so, however. Electro-activity increased, in respect to the frequency of the spikes and the increase in their height with increasing dilution. Fresh water caused "wild" electro-activity. Whereas *Podophthalmus* showed already increased activity with 95 per cent sea water, the threshold value for *Portunus* seemed to be at 85-90 per cent sea water. From these, and from field observations, it was concluded that *Podophthalmus* is more sensitive to sea water dilution than *Portunus,* and that there is a definite osmoperception in these crabs. Since *Podophthalmus* is a very poor osmoregulator (data on osmoregulation of *Portunus* are lacking), the early sensing of dilution of the sea water will allow the crab to flee such a dangerous environment in time.

C. *pH.* A pH different from the normal pH of sea water (pH 8.4) also elicited electro-activity. It seemed that a pH higher than normal (pH 8.8) was sensed easier than pH 6.68, but at the extreme low pH 5.9 the response was greater than at the extreme high pH 9.8. Used as an acidifying agent, CO_2 did not elicit responses different from those produced by HCl. Since CO_2 easily penetrates living cell membranes, while HCl does not, it was concluded that the seat of the pH-perception must be at the exposed cell membrane, not in the cytoplasm of the sense cells.

D. *Feedback.* A very interesting and definite feedback into the antennula was found to occur when the appendages of both species were touched. The electro-activity, evoked by this feedback, was strongest when the mouth parts were touched, less upon stimulation of the antennae, and least, but still very definite, upon touching or moving a walking leg. The recorded spikes were of both the motoric type which could be expected, and the sensoric. The meaning of this feedback causing the sensoric cells to fire is still obscure.

P. B. VAN WEEL
JAY P. CHRISTOFFERSON
Department of Zoology
University of Hawaii

6. PLANTS GROWING ON LIVING INSECTS IN NEW GUINEA

Certain beetles, like weevils and colydiids, that live in very damp environments in New Guinea mountains have cryptogamic plants growing on their backs. In particular, weevils of one genus have extensive plant growth on their backs—fungi, algae, lichens, liverworts, and diatoms; at least 12 families of plants are involved in this association. Living in the plants on the weevils' backs is a species of oribatid mite representing a new family, and also rotifers and nematodes. Psocopterans (bark lice) found on the beetles may have been feeding on the algae or fungi. The relationship appears to represent symbiosis. Apparently modified to encourage plant growth, the backs of the weevils have depressions, grooves, and other structures to encourage and protect the plants. Specialized hair and scales in the depressions, and hair around the edges of the depressions, appear also to serve these purposes. Also, a sticky secretion, particularly noticeable on newly emerged adult weevils, seems to encourage the growth perhaps by catching spores and providing nutrient for the plants. The mite appears to pass its entire life-cycle on the weevils and may transfer spores.

Gymnopholus weevils (Leptopinae), the dominant hosts for this association, are large in size, 25-40 mm long and fairly broad, and often have their dorsal surfaces entirely covered with the growth. This genus is limited to New Guinea, and is known only in altitudes above 1,000 meters. Furthermore, only one species is from western New Guinea; the species involved in the symbiotic association are all from the Finisterre, Owen Stanley, Bismarck, and other central ranges of eastern New Guinea. *Gymnopholus* includes at least 43 species, of which 29 are now being described as new, including nine of the 13 symbiotic species. The non-symbiotic species are smooth-bodied and occur mostly at medium altitudes. Species of another group of weevils, somewhat smaller in size (large Cryptorrhynchinae), are also hosts of the same groups of plants. All of these weevils are flightless, fairly slow moving, and live on leaves of woody plants in high-altitude moss forests or in alpine shrubbery at the edge of grasslands. These environments are near the tops of mountains, in the cloud zone, from 2,500-3,500 meters in altitude. However, another type of weevil, which lives in lowland jungles, seems to have another type of mite associated with lichen growth on its back.

One species of beetle in another family, Colydiidae, with its upper surface entirely covered with lichen growth, was found under damp grass beside a splashing stream at 1,200 meters altitude, and other specimens of the same species were found down to 900 meters altitude.

J. LINSLEY GRESSITT
Entomologist
Bishop Museum

7. WHY DO PINEAPPLE PLANTS MAKE BROMELAIN?

One beautifully green pineapple plant contains more protein-digesting enzymes than do the stomachs of 20 healthy hungry young men. Obviously, since man needs and has enough protein-digesting enzymes to break his ingested food into usable fragments, and since, equally obviously, a pineapple plant does not need proteases for a similar function, we can well wonder what role this spectacular supply of protease plays in the physiology of the pineapple plant.

Early studies on bromelain, which began in 1950, led to a negative statement of the bromelain's function. Distribution studies showed that wherever the metabolic activity was high, such as in the basal white portion of the leaf or in the succulent tips of stems, bromelain was completely absent; but wherever the metabolism rate was low, such as in the mature stem tissue or the old leaf tissue, bromelain was present. From this it was concluded that regardless of the properties of bromelain when extracted, bromelain did not function as a conventional protease in the plant.

Its distribution corresponded to that of a storage protein. As the plant develops, the amount of bromelain, or protein, in the stem decreases. Periods of low enzyme level coincided with those periods when suckers were developing. From these observations developed the "bank theory" of the stem and enzyme. The enzyme represented a potential supply of raw material for new tissues. Later, when the developing tissue had begun to manufacture its own food it could repay part of its loan. This would give rise to an increase of enzyme in the stem.

This theory was later modified and replaced with the "surge tank theory." In this theory, it is assumed that the protein of the mature leaves of a given stem is translocated to the stem for storage. When new tissues arise from that stem, the stored protein, i.e., the enzyme, is translocated to the growing points. According to this theory the movement of protein and enzyme is all in one direction.

As far as this theory goes, it is undoubtedly true. However, it is esthetically not satisfying. Why should the pineapple plant produce one of the world's most interesting proteases for such a mundane purpose as storage, when most other plants produce such prosaic proteins as bean protein and wheat gluten?

A clue to this question came from an entirely unrelated line of bromelain research. Although bromelain is a relatively stable protease, under certain specific conditions it was found that the enzyme autolyzes very quickly to amino acids and small protein fragments. Such a property for a storage protein is invaluable for efficient survival of the pineapple plant.

The pineapple plant is essentially an epiphyte. Such plants must be rugged and have an efficient water conservation system. Furthermore, if such plants are to utilize undependable and sporadic applications of water, they must have an unusual and highly water-sensitive storage protein. This happens to be bromelain.

One would predict that other plants which either grow where the water supply is erratic or which require a sudden supply of amino acids would have similarly unique storage proteins. Actually, the number of species of plants having such proteins runs into the thousands. In fact, the more one studies this problem the more one asks the question whether the "protease" nature of storage proteins may not be the normal state. Perhaps even the mundane bean protein or the gluten mentioned earlier might be very low-grade proteases which have never been investigated with the proper substrate. It could certainly be predicted that the strange proteases found in human lysosomes, the cathepsins, whose only known physiological function today is to digest cadavers, is a similar storage protein. Someday it may be found that when the body requires emergency amino acids, the cathepsins autolyze to supply them.

The theory of immediately-available storage is very satisfying, as far as it goes. However, if the stem must supply the building blocks for new protoplasm on a few minutes' notice, it needs, in addition to amino acids and carbohydrates, a source of building blocks for nucleic acids. If a protease was an instantly available reserve of amino acids, then the pineapple acid phosphatase should be an instantly available reserve of part of the building blocks for nucleic acid. Although acid phosphatases have been studied since 1950, a pure sample has never been gotten. No matter how much the acid phosphatase was purified, it either decomposed or remained impure. Recently, through Sephadex fractionation the acid phosphatase was found to be rich in phosphorus, pentose sugars, and aromatic materials. These are the building blocks for nucleic acids. Perhaps this is as pure as this acid phosphatase can ever be.

This new addition to the storage theory is most satisfying, since it was predicted from the protease theory. However, there still are some additional points to work out.

RALPH M. HEINICKE
Dole Company

8. Kinetic Studies on Echinoplutean Alkaline Phosphatase

Using mass cultures of the sea urchin *T. gratilla* eggs, a method was worked out for extracting fairly large quantities of the enzyme alkaline phosphatase, a phosphomonoesterase. The extracted enzyme showed a single ultraviolet absorbance band after elution from Dowex 2 column, and the material which absorbed most strongly at this wave length contained alkaline phosphatase. It showed two characteristic bands in starch-gel electrophoresis. When 6.25 mM p-nitrophenyl phosphate was hydrolyzed in glycine buffer at 38°, the optimum pH was 10.5. The hydrolysis conformed to a first order reaction, and the reaction constant was 0.00864 min^{-1}. The optimum temperature for enzymatic action was 25-30°, coinciding with the range of fluctuation of the animal's ambient temperature. The temperature-activity curve showed a close conformity to the Arrhenius equation, and the activation energy was 11,250 cal/mole. The value of K_m (Michaelis constant) obtained at pH 10.5 at 25° is 2.169 x 10^{-6} M of p-nitrophenyl phosphate per liter.

SIDNEY C. HSIAO
Department of Zoology
University of Hawaii

9. The Effect of Stimulation or the Law of Initial Values in the Human Neonate

The relationship of a response to the initial level of that function is interpreted to mean that "the higher the initial value of a function, the smaller its rise in response to a standard exciting stimulus and the larger its fall in response to a standard depressing stimulus." This Law of Initial Values (LIV) has been shown to hold for a number of psychological and physiological variables. The question of the effects of repetitive stimulation on the LIV has not been definitively answered. This paper is directed at examining the effects of repetitive stimulation on the LIV and at determining whether or not the LIV is affected by systematic variations in response, such as latency, amplitude, prestimulus levels, and peak response levels.

In ten trials, normal two-day old neonates were repetitively stimulated with full strength acetic acid. Stimulation consisted of placing a Q-tip soaked in acid 5 mm under the subject's nose for 2.5 sec. Heart rates were recorded with two precordial leads. Signals were fed to an Offner cardiotachometer and monitored on an Offner type-R dynograph. Heart rates were measured in terms of the fastest and slowest beats occurring in two 3-sec prestimulus intervals and four 3-sec post-stimulus intervals.

Regression equations and coefficients of correlation indicated that the LIV did apply in these cases of repetitive stimulation. Four analyses of variance examining the effects of repetitive stimulation indicated that no systematic response variation occurred over the ten trials.

RAYMOND K. YANG
DAVID H. CROWELL
Pacific Biomedical Research Center
University of Hawaii

10. A Factor Analysis of Measures of Response Speed, Memory Span, and Physiological Indices of Activation Level

A factor analysis was undertaken in order to find the common factors underlying a correlation matrix of 13 measures, selected because of some relationship in psychological literature with activation level, immediate memory, or EEG alpha waves. The tests were: Alpha Frequency, Alpha Quality, BSR, Tapping with Stylus, Tapping with Finger, Talking Rate, Minnesota Clerical Test, Verbal Fluency, Digit Span, A-B Span, Generation, Coding, and Dot test.

Six meaningful factors were extracted from the correlations, and were interpreted as: (1) memory span, (2) clerical or visual perception speed, (3) motor speed, (4) ideational fluency, (5) activation level, (6) EEG or alpha. Several hypothesized relationships were found in modified form or else did not materialize at all. In particular, the analysis failed to find any evidence to support the hypothesis that immediate memory, as measured by digit span, and EEG-alpha are related. Alpha and tapping speed also failed to correlate with each other. Explanations were given for the discrepancy between the present and past results, along with suggestions for further research.

RICHARD A. HAAG
WILLIAM T. WOODARD
JOHN M. DIGMAN
Department of Psychology
University of Hawaii

11. Indices of Integration among Orientals in Hawaii and in the U.S. Mainland

Data available for the first time from the 1960 population census permit comparisons between the experience of various immigrant groups in Hawaii and continental U. S. and the testing of widely held impressions regarding the integration of peoples from the Orient in various parts of this country.

The first of the three indices selected for special attention in this study was the median annual income of Japanese, Chinese, and Filipino males. Although clearly reflecting the disadvantaged position of the latter two groups in the country as a whole, the data also reveal that Japanese males enjoyed a somewhat higher median annual income ($4,305) than males in the general population ($4,103), and significantly higher than the Chinese ($3,471) or the Filipinos ($3,051). By the same measure, in Hawaii the Chinese males earned higher median incomes ($5,096) than did males in the general population ($3,753) and higher than Japanese males ($4,302) or Filipino males ($3,071). Thus, contrary to usual impressions, the Japanese have fared better economically in most parts of continental U. S. than in Hawaii, although the reverse has been true of the Chinese. As recent immigrants, Filipinos have trailed behind the average throughout the U. S.

A second index of integration—the degree of participation in the full range of occupations and especially in the preferred occupations—reveals somewhat similar patterns. Again the Chinese and Filipinos in the U. S. as a whole were overly represented in the less desirable and menial occupations; the Japanese proportions in these occupations were only slightly higher than in the total population. Thus 51.2 per cent of the employed Filipino males in the U. S. were confined to the unskilled labor and service occupations as compared with 15.7 per cent in the total population. Corresponding figures were 17.0 per cent for the Japanese and 25.7 per cent for the Chinese. On the other hand, as compared with 21 per cent of all employed males in the total population engaged in two preferred professional and proprietary occupations, 39.6 per cent of the Japanese, 33.0 per cent of the Chinese, and only 9.2 per cent of the Filipinos were so engaged. In Hawaii, the Chinese were most markedly over-represented with 33.1 per cent in the preferred occupations as compared with 20.7 per cent of the Japanese, 20.6 per cent of the total population, and 3.1 per cent of the Filipinos. At the other end of the scale in Hawaii, the Filipinos had 50.6 per cent in the unskilled and service occupations in contrast with 22.5 per cent of the total population, 15.2 per cent of the Japanese, and 11.4 per cent of the Chinese.

A third index of integration, the fertility ratio, which is the number of children under the age of five years per thousand women aged 15 to 44, reveals a similar ranking of the three ethnic groups. The Filipinos had the highest fertility ratios—greatly in excess of those in the entire population of the U. S. and Hawaii. This reflects the persistence of the old country peasant traditions where numerous offspring measures a man's position and wealth. Well below those of the total population, the Japanese had the lowest fertility ratios both on the mainland and in Hawaii. The ratios of the Chinese were somewhat above the average, except in Hawaii.

ANDREW W. LIND
Department of Sociology
University of Hawaii

12. Crustal Structure of Hawaii from Seismic-Refraction Studies

In August 1964, the U. S. Geological Survey established seismic-refraction profiles along the northeast, southeast, and west coast of the triangular-shaped island of Hawaii. Shots were fired from the U. S. Coast Guard cutter *Cape Small* at 10 km intervals and were recorded on shore by five refraction units spaced at approximately 25 km intervals along each coast. In 1965, on February 6, April 16, and June 19, the U. S. Navy detonated 500-ton chemical explosions on Kahoolawe as part of its *Sailor Hat* program. These shots were recorded on the 13-station seismograph network and two mobile recording units maintained by the U. S. Geological Survey, Hawaii Volcano Observatory.

Interpretation of the resulting seismograms indicates that the crust is 18-20 km thick under the flanks of Mauna Loa and Mauna Kea, 14 km thick under the west flank of Kohala and Hualalai, and 11-12 km thick under the northeast and southeast flanks of Kilauea. Compressional, or P-wave, velocity in the upper crust increased with depth from 2.0 to as much as 6.0 km/sec; velocities in the upper crust are generally lower on the flanks of Kilauea than on the flanks of the other volcanoes. Clearly recorded secondary arrivals indicate that a 7.2 km/sec layer formed the lower 4-8 km of the crust under each coast. Early P-wave arrivals associated with the summits and major rift zone of the volcanoes indicate that material with velocities as high as 7.0 km/sec approaches to within 2 or 3 km of the surface under these structures. The upper mantle P-wave velocity under each of the coasts is about 8.2 km/sec.

DAVID P. HILL
Hawaii Volcano Observatory

SECOND SESSION

13. ASTRONOMICAL RESEARCH AT THE UNIVERSITY OF HAWAII

Astronomy at the University of Hawaii has grown at a remarkable rate in the past two years, thanks to generous support both from the state and the federal governments. This growth is, of course, simply a reflection of the great potential for astronomical observations found on the high mountain peaks in the Hawaiian Islands. The origin of these superior observing conditions can, in turn, be traced to the isolation of the sites from large centers of population and industry and to their altitude, which places them above the trade wind inversion so that the air near the peaks is largely free of contaminants, like salt spray, generated near sea level.

The astronomy program has the two complementary aspects of research and the training of graduate students. Graduate instruction is carried out in the department of physics and astronomy, through which a comprehensive set of courses in astronomy is to be offered starting in the fall of 1966. A plan for a Ph.D. degree in astronomy has been submitted to the University. It is hoped that this will start at the same time.

The research programs which are carried out within the Hawaii Institute of Geophysics are broad in scope. Observational facilities on Haleakala are devoted to studies of the sun and to nighttime observations of the zodiacal light and the radiation emitted by the earth's atmosphere. The pure sky conditions at this site are essential to the night-sky studies, since the radiation is so extremely faint that atmospheric pollution or stray light could make them quite unobservable. Solar observations also require pure skies, since much of this research is devoted to study of the corona whose very faint radiation is normally visible only at a total solar eclipse. By taking extensive precautions in the design of an optical telescope and by locating this telescope at a site with very clear skies, the corona can be studied outside of eclipse. Such studies are in progress at Haleakala. However, eclipse observations are needed to reach the very faintest coronal emission. A successful University eclipse expedition to the South Pacific in 1965 is to be followed by an expedition to South America in November 1966.

Mauna Kea, which is 13,800 ft high, has been selected as the site of the new 84-in. aperture telescope for which the University received funds from the National Aeronautics and Space Administration. This site was chosen on the basis of an extensive and continuing survey of the astronomical observing conditions at locations near the top of the mountain.

The telescope is being designed in Los Angeles, and it is hoped that fabrication will begin in the latter half of 1966. Parallel with this, design studies for associated buildings are in progress. The telescope is intended for studies of the planets as well as the stars. The very dry conditions encountered at the summit of Mauna Kea are especially favorable for infrared observations, and it is especially favorable for planetary studies, since planets emit strongly in these spectral regions.

J. T. JEFFERIES
Department of Physics and Astronomy
University of Hawaii

14. PREDICTION AND PREVENTION OF LARGE EARTHQUAKES AND TSUNAMIS

The problem of prediction is to determine causal or statistically significant relationships between the phenomenon of interest and the phenomena which precede it. In this study, it is assumed that earthquakes cause tsunamis, so this discussion emphasizes earthquakes. The implications for tsunamis are considered self-evident. Each physical phenomenon preceding or associated with large earthquakes is catalogued according to whether the phenomenon is usually detectable at about the time of a large earthquake, whether it is usually identifiable as being definitely associated with the large earthquake, and whether the signal can be interpreted to be of possible use in the prediction of such a large earthquake. More simply, the phenomena are classified according to whether they are detectable, identifiable, or interpretable.

Historically, the prediction of earthquakes has been of concern to the Japanese since the 1930's, to the Russians since the 1950's, and to the Americans since the 1960's.

Some interesting efforts have recently been made by Dr. Blot, now in France, but previously in Noumea. Dr. Blot observed some spatial-temporal relationships of earthquakes and volcanic activity. His ideas are presented to illustrate this effort at prediction, and his applications to South America, including predictions, are given. This review of Dr. Blot's work does not imply acceptance of his methods for everywhere, nor for all time.

The problem of preventing an earthquake is made more difficult by the volume of the earth involved in an earthquake. Tocher has estimated the magnitude-to-fault length-relationship to be

$$M = -2.97 + \frac{\log D}{1.87} + \frac{n}{1.87} \log L$$

where M is the magnitude, L is the fault length, D is about 10^6 cm, and n is determined empirically to be 2.

A theoretical model of a fault has been developed by Chinnery. For a shear stress, there is notable concentration at the ends of the dislocation. Therefore, these points are expected to be significant. Indeed, aftershock maps usually show the dominant shock to have been at one or the other end.

The time and extent of rupture or yielding will be dependent upon the strength of the material. The earth presumably yields under a creep-rate condition—not as a brittle fracture. Like the stress-strain relation, the stress-creep rate is dependent on temperature. The stress is considered to be essentially constant. Hence, to affect the occurrence of the earthquake, the response must be changed, i.e., the creep-rate versus stress function. This might be done by increasing the temperature in the appropriate volume of rock.

It is suggested that large earthquakes may be prevented by releasing the energy as a series of lower magnitude earthquakes. This release would be triggered by increasing the temperature of the rock at the ends of the appropriate fault. This would require that a very large number of lower magnitude shocks be endured to avoid enduring one very large magnitude shock. For example, about a thousand magnitude-6 earthquakes must occur to be equivalent to one magnitude-8 earthquake.

A triggering effect, analogous to that suggested above, may have been inadvertently encountered in a waste disposal effort by the U. S. Army near Denver, Colorado. The U. S. Army sank a 12,045-ft shaft and pumped down 4 million gallons of waste water in March 1962. Mild earthquakes began the following month and have continued with a rate that varies proportionally to the amount of waste water injected into the well. In this case, the water is affecting the creep-rate.

WM. MANSFIELD ADAMS
Hawaii Institute of Geophysics
University of Hawaii

15. Lasers: Characteristics and Potential Application

Lasers may differ from ordinary light sources in three salient properties: (1) extremely high power concentrations, (2) high directionality, and (3) extreme monochromaticity. Their superiority in some of these characteristics is not slight; it may be 10 or 12 orders of magnitude, and thus make feasible applications which are completely beyond the reach of ordinary sources. Illustrative of the high-power capability is the Q-spoiled ruby laser which may give power density of 10^{12} watts per square cm compared with less than 100 watts per square cm from a super-high-pressure mercury arc. The possible monochromaticity of gas lasers is one-thousandth of a cycle per second compared with about one billion cycles per second for normal sources. Directionality of laser beams is, in principle, simply diffraction-limited by the optical system used.

The mechanism of laser operation which makes these remarkable properties possible is stimulated emission, discovered by Einstein in 1917. In ordinary sources, the light is emitted by individual atoms in a spontaneous process which is inherently random. As a result of the randomness, the intensity of the beam radiated by a source consisting of many atoms is simply the sum of the intensities emitted by the individual atoms. Also the light is emitted in all directions. Furthermore, in such a source, a broad distribution of wavelengths results from the random motion of the atoms. The stimulated emission process used in lasers has the property that the wave is in the same direction as the radiation that stimulated the atom to emit, and is also of the same phase and frequency. Therefore, the effect is that large numbers of atoms are forced to emit cooperatively rather than randomly. Since in such a case the amplitudes are additive and, in all cases, the intensity of a wave is proportional to the square of the resultant amplitude, the result may be a beam of enormous intensity going in a predetermined direction and having a very narrow range of frequencies.

The potential applications are diverse. Everything that can be done with ordinary sources can now be done better and more easily. Many things which could not be done before can be done now, and probably unexpected applications will appear soon. The high-power concentration makes possible micromachining applications, even in encapsulated components or in vacuum. Extreme monochromaticity makes ultra-high precision metrology possible even over distances of kilometers and times of one hundred billionth of a second. The directionality of the beam makes possible long-range communication, for example between spaceships or stars, and makes the signals private. Combinations of these properties provide opportunities for more imaginative applications both commercial and scientific.

JOHN R. HOLMES
Department of Physics and Astronomy
University of Hawaii

16. Ionizing Radiation in Bioagricultural Research and Tropical Food Preservation

Ionizing irradiations for commodity treatments are obtained from three major sources—gamma ray emitting isotopes, X-ray machines, and electron accelerators. The Hawaii Research Irradiator on the UH campus has a large 30,000-curie source of radioactive cobalt-60 (Co^{60}), emitting highly penetrating gamma rays. HRI's dose-rate of about 4000 rad/min allows, for example, the prevention of sprouting in ginger by 30-sec treatments, the sterilization of insects in 2 min, or the killing of insects in 20-40 min. These are the approximate dose ranges used in the three major studies of tropical food preservation at UH, supported by AEC contracts. Associated studies with HRI focus on the genetic and biochemical effects induced by irradiation in living cells.

Co^{60} gamma rays induce no radioactive residues, and can be incorporated into commercial facilities treating foods for perhaps 1¢/lb. The energy of these rays is converted into biological change largely via molecular ionizations; among the significant products of ionization in the aqueous milieu of living cells are peroxides. These and other radiolytic products have figured in recent reports that infer hazards in eating irradiated foods. The following discussion attempts in part to clear the rather muddy waters, agitated interestedly by national magazines, surrounding this issue of hazards.

Studies at UH have concentrated on irradiated papaya, mango, and pineapple. Irradiation in excess of 30 krad eliminates insects that infest these fruits, and adds perhaps 15 per cent to their marketable life. In the mango, control of the seed weevil has not been successful by other methods; hence irradiation affords an exclusive opportunity for Hawaii to develop export markets for this commodity. Other studies illustrate possible commercial application of irradiation in the control of sprouting in ginger and of bacterial spoilage in the fishcake, kamaboko. Radiation levels for insect control do not appear to influence adversely the major qualities and properties of papaya, mango, and pineapple. Biochemical studies reveal few differences at these dose levels under 100 krad, one of these being the increase in peroxidase activity.

For almost 15 years, the AEC and Department of Defense have been conducting animal feeding trials with irradiated foods. Reports of adverse effects from these studies do not exceed expectations due to chance alone. Two-year feeding trials were made with bacon, wheat, and potatoes prior to their clearance by FDA.

Several papers have appeared in the past three years showing the adverse, cytotoxic effects on cell and tissue growth of irradiating cultural media. The most loudly touted of these involved carrot tissues grown on media supplemented by irradiated sugars. Despite inadequate supporting evidence, the article urged caution in the use of irradiated foods. Other investigators had shown previously that prolonged heating (autoclaving), as well as irradiation, hydrolyzes sugars to form cytotoxic products, e.g., formaldehyde. These hydrolytic products are formed in very low concentrations and are metabolized and rapidly converted in most media or living cells into harmless constituents.

Studies of irradiated pineapple confirm this type of cytotoxicity and the ability of the irradiated extracts to break chromosomes in onion roots. However, when irradiated fruits were stored several days before the extracts were taken, the cytotoxicity disappeared. The UH studies are particularly interested in the possibility that some of these products are peroxides which are catabolized by peroxidase enzymes newly-activated by the irradiation. Studies in other labs, using insect feeding trials, suggest that long-lived cytotoxins commonly fail to survive the metabolism of the insect gut. There is abundant evidence to suggest that similar catabolism occurs in mammals.

It is generally agreed that studies such as those of the irradiated carrot medium must be extended to include animal feeding trials before they can be considered of significance to the food irradiation program. In the meantime, it is an impressive enough hurdle to convince the public that foods irradiated with the insidious sounding gamma rays can be perfectly safe to eat, of better quality, and sold at a better price.

JAMES L. BREWBAKER
Department of Horticulture
University of Hawaii

17. STUDIES IN SPERMATOZOAN TRANSPORT

Mammalian testes produce in the order of 10 million spermatozoa per gram per day. When shed into the lumina of the seminiferous tubules, the sperm are immature both morphologically and in their capacity to fertilize ova. The sperm pass into the epididymis in one day and appear in the vas deferens and the ejaculate about 15 days later. The rate of sperm passage is faster around the periphery than down the center of the epididymal tubules, and this results in mixing of more mature sperm with less mature sperm in the ejaculate. During their passage through the epididymis, sperm cells attain their normal motility pattern, shed the cytoplasmic droplet residue from the Sertoli cell attachment, and become fertile. Radioactive thymidine incorporated into spermatozoan DNA is rapidly picked up by dividing cells lining the epididymal lumen. It has been estimated that only half of the spermatozoa that enter the epididymis are finally ejaculated, the remainder being absorbed and possibly being the cause of autoimmune infertility in the male. Enough spermatozoa are contained in every ejaculate to fertilize all the ova ovulated in a given species. Male fertility does not decrease with the frequency of ejaculation.

Semen is deposited in the vagina of some mammalian species and in the uterus of others. In the rabbit, and probably also in the human, spermatozoa leave the vagina and enter the uterus as a result of their own motility. Sperm are then transported to the fertilization site in the oviduct much faster than they can swim, the entire process taking only a few minutes in some species. These first spermatozoa are not able to fertilize the ova, however, because further conditioning of 3–6 hr in the female tract is a prerequisite for penetration of the ova. The nature of this process, known as capacitation, is not well understood. In the rabbit, within 4 hr after copulation, an equilibrium is established in which hundreds of thousands of sperm can be recovered from the uterus and only a few hundred from the oviduct. Whether sperm are remaining at constant positions in the tract, whether they are passing up the tract in a "phalanx," or whether they are passing both up and down the tract is unknown. Factors suspected to be of importance in this equilibrium are sperm motility, peristalsis of the uterus and tube, secretion of uterine and tubal fluid, and ciliary currents. The cervical os and the uterotubal junction are barriers or, better, regulators, of sperm transport. Estrogen and progesterone are known to play important roles in sperm transport in the female tract, and large variations in the fertilization process result from small variations in female endocrinology.

ROBERT W. NOYES, M.D.
Department of Anatomy
University of Hawaii

18. Fertility Control in Humans

Recent publications in lay and professional journals have made clear the fact that the uncontrolled fertility must be controlled through safe and effective methods. The medical profession has been reluctant to take a strong stand upon this subject because of the controversial nature of birth control methods and because uncomplicated, highly effective, and safe methods were not available until recently.

Since the contraceptive pills were shown to be virtually 100 per cent effective and safe, the medical profession's viewpoint on population has undergone a dramatic change. In addition to the contraceptive pills, the introduction of the intrauterine devices for less-motivated patients has strengthened the determination of those who wish to see the need for family planning filled, especially for the socially and economically deprived.

The concluding paragraph of the statement issued by the American College of Obstetricians and Gynecologists on June 3, 1964, regarding family planning to reduce the incidence of mental retardation, is extremely pertinent: "Family planning is part and parcel of good maternity care. For the socially and economically deprived, it is the single most effective means of limiting mental retardation. The rich always had this type of care, but the poor rarely and never effectively. We now have simple and effective methods compatible with the mores of the socially deprived. If they are not widely employed, no program of improved maternity care, no poverty program and no program to control mental retardation is worth a hill of beans."

The American Medical Association has outlined an educational program in human reproduction for this nation's physicians. The following four-point policy statement of the AMA on human reproduction, including population control, was made on January 22, 1965, by Dr. Raymond T. Holden, chairman of the Committee on Human Reproduction:

"1. An intelligent recognition that the problems that relate to human reproduction, including the need for population control, are more than a matter of responsible parenthood: they are a matter of responsible medical practice.

"2. The medical profession should accept a major responsibility in matters related to human reproduction as they affect the total population and the individual family.

"3. In discharging this responsibility, physicians must be prepared to provide counsel and guidance when the needs of their patients require it or refer the patients to appropriate persons.

"4. The AMA shall take the responsibility for disseminating information to physicians on all phases of human reproduction, including sexual behavior, by whatever means are appropriate."

The AMA Committee further stated that:

"It is recommended that the prescriptions of child-spacing measure should be made available to all patients who require them, consistent with their creed and mores, whether they obtain their medical care through private physicians or tax- or community-supported health services."

Talking about family planning encourages people to have "children by choice rather than by chance." An explanation regarding conception-control can best be given if the physiological and endocrine mechanism of menstruation is clearly understood.

The two most effective and acceptable methods of birth control are the contraceptive pills and intrauterine contraceptive devices. An important fact about these two methods which have found such universal acceptance is that both are applied by the individual at a time disassociated from the sex act.

The contraceptive pills are safe, and they are virtually 100 per cent effective when taken as directed. Side reactions usually are not troublesome. Most of them mimic the symptoms of early pregnancy and include nausea, breast tenderness, occasional headaches or dizzyness, some swelling or weight gain, and intermittent uterine bleeding. These reactions occur because the doses of estrogens and progestins in the pills are large enough to suppress the secretion of gonadotrophic hormones of the anterior pituitary. By so doing, ovarian stimulation is prevented, and ovulation does not occur. Fortunately, these side reactions occur only in about 5 per cent of women taking the pills and usually subside after the first few cycles.

In addition, many women with incapacitating dysmenorrhea, premenstrual tension, and excessive menstrual bleeding find that their symptoms disappear or are markedly improved while they are taking the pills. Evidence is accumulating that women who are taking the pills appear to have a lower incidence of cancer of the breasts and uterus. The fear that permanent infertility may result from the pills is unfounded, because normal pregnancies promptly result when the pills are discontinued.

The intrauterine devices now on the market are the Birnberg Bow, Hall Ring, Margulies Spiral (Gynekoil), and the Lippes Loop. The Lippes Loop D seems to be the best tolerated and has the lowest incidence of spontaneous expulsion, which is about 10 per cent. The incidence of pregnancy in women who retain the device is about two per 100 women-years. Although no one knows for certain how they work, the explanations seem to be related to excessive peristalsis of the Fallopian tube so that the egg, even if fertilized, reaches the uterus in much less than the normal 72 hours required for the 2½-inch journey, and is too immature to implant itself in the still unprepared endometrium.

GEORGE GOTO, M.D.
Honolulu

19. INFERTILITY IN FARM ANIMALS

Fertility in the female may be defined as her ability to conceive, gestate, and give birth to a number of normal young of the species and according to a schedule which permits maximum reproduction without unduly sacrificing the dam. This gives a reference point for an objective appraisal of infertility of farm livestock in Hawaii.

If the female is given maximum exposure for reproduction, five major causes of infertility may be considered: (1) pathology of organs, (2) infectious diseases, (3) nutritional deficiency, (4) environmental stress, and (5) deleterious constituents of the diet.

Pathological causes of infertility tend to be very much the same throughout the world. They account for about 5 per cent of failures in farm animal reproduction. Swine are affected more than other species. An example is hypoplasia of the gonads due to a recessive gene with incomplete penetrance as found in cattle of the Swedish Polled breed. Fortunately, pathology is of no more importance in Hawaii than in the population as a whole.

Disease has been a major limiting factor until recently. It is still important in Hawaii. The application of knowledge available concerning disease would reduce it to a minimum or eliminate some diseases completely. Organized programs are working toward this objective.

Nutritional deficiency varies from a chronic to a sporadic problem. Most of the pasture lands of Hawaii provide inadequate phosphorus to meet the animals' needs. This is being overcome by supplements. Energy deficiency accompanies each drought. Evidence indicates that severe drought may decrease the calf crop of range cattle by 20–30 percentage points. Other specific nutrient deficiencies have an effect on reproduction, but not as marked as deficiencies of phosphorus or energy.

The effect of environmental stress is undoubtedly of major importance. It acts primarily in two ways: first, by decreasing libido, and secondly by increasing embryonic mortality. As the ambient temperature and relative humidity rise, the animal loses its appetite. This is followed by a reduction in activity at all levels, including reproduction. Near the stress range, a small increase in temperature and/or relative humidity may increase body temperature two to three degrees Fahrenheit. When this occurs early in gestation embryonic mortality is high. Much of the tropical land area of the world has either a high ambient temperature or a high relative humidity. Very often, it has both. In Hawaii, this may account for a major portion of the infertility. On Oahu, dairy herds have a 20–40 per cent conception rate compared with 60-70 per cent in the major dairy states.

A number of tropical forages contain substances which interfere with reproduction. In Australia, subterranean clover was found to be the cause of infertility in sheep. Its high estrogenic content interfered with normal hormonal balance. In Hawaii, *Leucaena leucocephala* (Lam.) de Wit., known locally as koa haole, interferes with reproduction in non-ruminants. Included in the diet of swine, it increased the number of services required for conception and decreased the number of young born per litter and the size of piglets. Other substances, not normally consumed by farm animals, may have more drastic effects.

In summary, it can be said that infertility in farm animals raised in the tropics may be ascribed to five general causes. Some of these are of great magnitude and difficult to overcome. Efforts to solve these problems are very much worthwhile because the tropical land areas of the world are potentially the greatest hope of humanity for feeding an ever-increasing population.

OLIVER WAYMAN
Department of Animal Sciences
University of Hawaii

20. NUCLEAR MEDICINE: CURRENT PRACTICE AND A FIVE-YEAR PREDICTION

Nuclear medicine, a specialty in the practice of clinical medicine, makes use of radioactive isotopes for the diagnosis and treatment of disease. Most current uses are diagnostic. The information derived is often unique, but sometimes it is just simpler, safer, or faster.

Radioiodine may be used as an example. This travels selectively to the thyroid gland. Its most obvious use is to determine the amount and speed of its accumulation in the gland by counting radioactivity externally over the thyroid. This was first done in humans in 1939 and has become a standard test of thyroid function. By increasing the dosage and making use of the beta rays of I^{131}, the overactive thyroid can be reduced to function normally, thus eliminating the need for surgery. By further increasing the dosage, post-operative functioning thyroid cancer can be tracked down anywhere in the body and be eliminated. The techniques differ only in the amounts of I^{131} used: for tracer testing of function, 5 microcuries; for reduction of thyroid function in hyperthyroidism, 5,000 microcuries; and for treatment of functioning thyroid metastases, 150,000 microcuries.

Radioactive isotopes have become increasingly useful in "scanning," the anatomical mapping of organs or tumors. Using a mechanical detector which moves across the area of interest, a picture of the organs or tumor can be displayed. The thyroid gland is mapped with radioiodine as the tracer. By labeling materials, other areas can be scanned, many of them previously blind to X-ray, as well as palpation; e.g., liver, kidneys, brain tumors, spleen, bone marrow, lungs, and bone tumors.

Labeled substances may also be used for measuring body pools and for determining absorption rates and for organ function. These include measurement of plasma and red cell volume (I^{131}-albumin, Cr^{51}-red cells), fat absorption and residual stool fat (I^{131}-fat), kidney function and urinary tract obstruction (I^{131}-hippuran), red blood cell life span (Cr^{51}-red cells), formation rate of new red cells (Fe^{59}), in vitro thyroid function (I^{131}-triiodothronine). Altogether about 40 clinically useful techniques are currently used.

Although radioisotopes provide highly useful information, there are certain deficiencies. The scanning time is too long: scanning for a brain tumor may take two hr, liver 30 min, spleen 30 min, thyroid 15 min, lung 20 min. Scanning resolution is not good enough; currently an area of activity over 10 mm can be distinguished under ideal circumstances; but when imbedded in the liver, the area of activity must be over 30 mm. Certain important organs are unable to be scanned: pancreas, parathyroids, adrenals. Our cancer-finding ability is limited to brain, bone, liver, spleen, kidneys, and thyroid. With the exception of thyroid and certain blood tumors, radioisotopes have not been found which are specific enough to treat cancer.

Certain of these deficiencies will probably be overcome in the next few years. The current back-and-forth scanners will be replaced by "gamma-cameras" which visualize the entire field simultaneously. This will shorten scan-time of, for example, the liver, from 30 min to 30 sec. Portrayal of dynamics will then be possible. The use of short half-life isotopes has great advantages by increasing the counting statistics while decreasing radiation to the individual tested. Ready now is technetium^{99m} with a 6-hr half-life, milked from a molybdenum^{99} "cow." Resolution of the scanners should increase from the current 10 mm to about 1 mm. Scanning of the pancreas, adrenals, and parathyroids should be satisfactorily done in a few years. While nothing specific has been found for localizing tumors other than those mentioned above, a few reports indicate partial success. This may take more than five years, but will be of obvious importance in early detection of cancer.

Certain other approaches are advancing rapidly and should soon be applicable to clinical medicine. Radioimmunoassay methods are being developed which are highly sensitive for detection and quantitation of various hormones, such as TSH, estrogens, testosterone, and insulin. Activation analysis methods are advancing and may become practicable for clinical use in a few years. Development of liquid scintillation counting has increased the sensitivity of beta counting, so that C^{14} and tritium, long available to biochemists, can be used in humans within the permissible dose range.

ROBERT A. NORDYKE, M.D.
The Straub Clinic

NECROLOGY

The Academy records with sorrow the death of the following members during the year:

Ernest L. Hood
Marie C. Neal
Frank Spencer

MEMBERSHIP MAY 1966

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Akamine, Ralph N.
Akana, Mildred
Akau, Thelma I.
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Alkire, William H.
‡Allison, Samuel D.
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Appleton, Vivia B.
Apt, Walter J.
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Bennett, Truett
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Bovee, Clifton W.
Bowen, Robert Neal
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‡Chao, Tsun Tien
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*Member, Hawaii Division, Hawaii Academy of Science.
†Member, American Association for the Advancement of Science.
‡Fellow, American Association for the Advancement of Science.

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Corboy, Philip M.
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‡Kamemoto, Haruyuki
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†Kanashiro, James Z.
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Kaneshiro, Francis T.
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†Kato, Kenneth N.
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Kaufmann, George
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‡Krauss, N. L. H.
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PROCEEDINGS OF THE

HAWAIIAN ACADEMY OF SCIENCE . . . .

FORTY-SECOND ANNUAL MEETING 1966-1967

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THE HAWAIIAN ACADEMY OF SCIENCE WAS ORGANIZED JULY 23, 1925. ITS OBJECTS ARE "THE PROMOTION OF SCIENTIFIC RESEARCH AND THE DIFFUSION OF SCIENTIFIC KNOWLEDGE, PARTICULARLY AS RELATED TO HAWAII AND THE PACIFIC AREA."

PRESIDENTIAL ADDRESS 1967

AGRICULTURE IN OUR CHANGING WORLD

Louis G. Nickell*

Many of the problems facing the scientist of today did not affect our predecessors—problems such as the accumulation of knowledge at so rapid a rate that information retrieval has become a major bottleneck to progress in some areas. Other problems have been with us always, but need special emphasis in today's rapidly changing world. Such an age-old problem is communication between science and society—effective communication, that is. The cost of ineffective communication is a loss, or worse yet, antagonism of the readers or listeners whom we should reach.

The problem that may well be called our number one current problem is the world's ever-increasing population and what to do about it. Can we control it or, if we do not control it, can we feed it?

What about this problem of over-population, and the business of taking care of the stomachs involved? If we focus on 1980—only 13 years away—projections say that the world's population will probably increase by 1.2 billion. These additional people will need a minimum of 200 million tons of grain per year, plus other agricultural products, in addition to the amount being produced today. Most of this tremendous increase in population, in fact about 1 billion out of the 1.2 billion, will occur in Asia, Africa, and Latin America. This leaves only 200 million for increase in North America, Europe, the Soviet Union, and Oceania, the parts of the world which are already relatively developed and well-fed. In fact, this increase of population in Asia, Africa, and Latin America will more than equal the total population of the developed countries today.

Why can't Asia, Africa, and Latin America feed themselves? It would appear that all they have to do in order to have plenty to eat is to adopt the modern scientific agriculture that is practiced in North America, Europe, Japan, and even Russia. This answer is too pat. At least 90 per cent of the farmers of these areas are illiterate, so that even simple printed instructions cannot be followed. One almost is forced to think of a 1:1 ratio of instruction—one teacher to one pupil—the most inefficient and thereby most expensive type of instruction in the world. Equally important is the lack of capital to buy fertilizer, to build irrigation systems, to provide pest control, to improve varieties, and to obtain better agricultural tools.

"Population explosion" is a relatively new term. Let us see how unbelievably applicable the term "explosion" is. Take three dates which are a hundred years apart—1830, 1930, and 2030— and see what the population of the world in these three years was or probably will be. 1830: 1 billion. 1930: 2 billion. 2030: 14 billion at the present trend. The high population growth rate for the world is accounted for mostly by the high birth rates in Asia, Africa, and Latin America, together with steadily decreasing death rates all over the world.

The most obvious solutions to having enough food have been known for a long time: either reduce birth rate, or increase food supply. What are the chances of success for these two routes? Today, technical advances have given us truly effective birth control methods. The solution by birth control, then, lies in the philosophical, religious, and social approaches that are, by definition, outside of today's topic.

The other suggested solution falls within the area of today's subject. A doubling or tripling of agricultural production in Asia, Africa, and Latin America is theoretically possible simply by using the agricultural technology whose basic principles are already known to us. However, time is against this simple solution. The adoption of improved

*Assistant Director, Experiment Station, Hawaiian Sugar Planters' Association.

agricultural methods requires a basic social and cultural change, and this change is always a slow process. Social, cultural, and educational factors, not technical factors, may be the *real* bottlenecks in improving agriculture in such regions. Increased agricultural production throughout the world might feed the anticipated population for a while. But eventually even optimum agricultural production will not be enough and society will have to come to terms with the birth control problem.

The famous (or infamous) American surpluses of food materials of the recent past are gone. There is now an interesting new type of surplus—a surplus of empty storage bins. I wonder how many people realize this? And I wonder even more how many people know why?

The change in policy which altered the status of our surpluses is another area outside of today's discussion. Nevertheless, we in the developed countries, especially in the United States, will have to continue to carry the bulk of this feeding burden for the forseeable future. How, then, can we achieve the necessary output, and what changes can we expect? A recent report from Iowa State University (CAED Report 27, 1966) suggests some of the changes which will take place in the American farming industry by 1980 (again, only 13 years from now). Operating inputs (machinery, buildings, fertilizers, and such) used per farm are expected to be nearly three times those of current inputs. The size of farms will be doubled by 1980. The management of farms will be increasingly influenced by the firms which supply the input materials. Such firms will have advanced systems analysis divisions to supply managerial services. By 1980, the leading commercial farms will be using the services of electronic computers for annual planning. General economic growth in the United States will require agriculture to use more and more capital, just as it will continue to foster the generation of more scientific and technological information useful in farming. In other words, as one economist has advised farmers, "In the near future, get big, or get out." Dr. Robert Cushing, Director of the Experiment Station of the Hawaiian Sugar Planters' Association, put this trend succinctly when he said that agriculture will have to "capitalize, mechanize, and specialize!"

In our eagerness to "feed the world," we must be realistic about what we export, other than food and goods grown or manufactured in the United States. We can export scientific principles, but we must be careful not to over-exaggerate the effective exportability of the highly publicized American "know-how." In one of his recent bulletins, Dr. James Horsfall, Director of the Connecticut Agricultural Experiment Station, said, "When we export 'know-how' to hungry nations and it falters, we are puzzled. I saw a similarly puzzled Iowa farmer when I was a boy in Arkansas. He spent his money. He tried. He failed. And he returned to Iowa when he learned that he could not inject a corn-hog 'know-how' into a peanut-cotton economy." We can, however, export the "know-how" needed to develop new "know-how" on the spot. Local problems demand local invention. What works in Iowa or even in Hawaii in the way of the proper variety of crop plant, the proper type of fertilizer, the proper amount of fertilizer, the methods to be used, and many other things, often are not likely to work as well in regions half way around the world.

We must be realistic also about the potential danger of thinking of the future in terms of the immediate past. A lack of flexibility in this case can be defeating. Apart from changes in weather and other natural phenomena with which we are familiar, many factors enter into the problem of agricultural production that are other than scientific and technological. Consequently, we must keep in mind that victories in agriculture tend to be local, limited, and many times temporary. Because of this, it is again important to remain flexible, to be able to modify our thinking as well as our actions in coping with problems as they arise. We also have to keep in mind the danger of being over-assured by past performances. I am thinking particularly about the 15 plants which have provided the bulk of the world's food as far back as recorded time. Many, including scientists, assume that because these plants have been cultivated for many centuries, we know all there is to know about them. This is far from the truth. In fact, we know all too little about many of them, if not all of them. Lest, because of my role as an agricultural investigator, I appear to you to be biased, I refer those who have not yet seen it, to the recent report of the Panel on the Plant Sciences for the Committee on Science and Public Policy of the National Academy of Sciences (The Plant Sciences—Now and in the Coming Decade. Washington, 1966) upon which this point was based.

If this country is to continue to help feed the world (even for the foreseeable future), we have to increase production.

The two classic ways of increasing agricultural production are to cultivate more land, and to increase yields on land already cultivated. Whichever approach we try to take, we are facing a double fight. Prime land is being devoured by cities, suburbs, highways, airports, industries, and many other works of men. In the U.S. alone about one million acres of productive agricultural land are being converted to urban living and industrial use each year. Most of the world's agricultural production comes from areas which originally were prairie, steppe, or broadleaf forest. Where terrain permits, most such areas are already under cultivation, so that we cannot expect any major expansion of agriculture in such regions. This leaves what is in effect only marginal and sub-marginal land for agricultural expansion.

Dr. Horsfall, in another of his bulletins, said, "Agriculture is a remarkable industry. It does not destroy the resource that nourishes it. It does not exploit its riches. It husbands them. Connecticut may some day regret that our houses and industries and supermarkets are in the fertile valleys rather than on the hills where land is not fertile for food crop. The nation may live to curse the bulldozer, symbol of progress in the 20th Century as it covers fertile soil with crush rock, cellar holes, concrete, and asphalt. Who knows?"

The term "green belt" has such a righteous sound–to be in favor of a green belt shows our foresightedness–but one wonders if a little hypocrisy doesn't creep in from time to time. The mythical green belt which is talked about so optimistically throughout the nation is already cinched too tightly around society's middle. Maybe the excuse is that we in the United States are in fact overfed because our agricultural technology has done such an effective job of feeding us at home and has resulted in over-production. Maybe that is the excuse for trading agricultural land for a variety of other purposes. Maybe that is how agriculture has almost become a dirty word, and certainly far from a very profitable venture.

If we are to fill the world's "opu,"* the green belt will have to be let out. Just because agriculture is steady, dependable, familiar, there is no reason to treat it like a stepchild or be condescending toward it. Society has depended, and always will depend, on agriculture, so, of course, it will never be new. Unfortunately, glamour, even in science, seems to be reserved for newness; and agriculture is almost as old as man. We have lost farmers, but up to a point some of them can be replaced by machines. Machines aid science and technology. They do not replace investigators. Even in the highly productive American agriculture we have skimmed the cream off many approaches to increased yields. To continue to advance at the rate which now apparently will be demanded of us, we need new approaches–the exclusive realm of the investigators. Without the proper support, agriculture will lose the investigators, a trend which has already started.

Because I have stressed the problems connected with the feeding of the world, and have reiterated a few of the hidden dangers which we must avoid, do not think for a minute that I am a pessimist. I would rather call myself a cautious optimist. I feel strongly that much more can be done than we have ever dreamed of, *if* we define our goals (and are allowed to stay on course), and *if* we concentrate our efforts on those goals (and let's face it, this means brains and money, and more brains and more money). If I were not optimistic, I would never have gone into agriculture, I would never have come to Hawaii, and I would not be appearing before you now.

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*Hawaiian for "stomach."

ANNUAL REPORT 1966-1967

At the end of its forty-second year, the Academy had a total membership of 1,253. The Academy Council met three times: on December 1, 1966, January 27, 1967, and on April 6, 1967. Minutes of these meetings are on file. The Academy Council again approved presentation of $25 as an award for a meritorious project entered in the Hawaii Science Fair. This year the award went to How Man Lam, of McKinley High School, for her project, "Using Organic Matter as an Electrolyte."

Robert E. Coleman, *Secretary*

OFFICERS

1966-67

Louis G. Nickell .... *President*
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Martin Vitousek .... *Councilor*

NOMINATIONS

The Nominating Committee presented the following slate of candidates for Academy offices during the year 1967-68:

President-Elect (one to be elected): Charles Lamoureux, Saul Price
Councilor (two to be elected): Robert E. Coleman, John J. Magnuson, Jimmie Bob Smith, Leslie D. Swindale
Secretary (one to be elected): Duane Bartholomew, Ira J. Lichton
Treasurer: Mrs. Eleanor S. Anderson

PUBLICATIONS

During 1966-67, *Proceedings* for the Academy's forty-first year were published and distributed to the membership.

O. A. Bushnell, *Chairman*

ACTIVITIES OF THE INTER-SOCIETY SCIENCE EDUCATION COUNCIL 1966-67

The activities of ISSEC during 1966-67 are enumerated and reported below. Leadership shown by the different chairmen of the various activities was outstanding, and the highly successful programs throughout the year were a result of effort, energy, and imagination exhibited by the chairmen.

Early in the year the Science Film Service was turned over entirely to the Library of Hawaii for administration. The combination of increasing demands for film, somewhat inadequate storage and maintenance facilities, as well as insufficient help for complete administration of this service, resulted in the decision to turn the program over to the State Library, which has the necessary facilities and which indicated willingness to continue the program.

During the year ISSEC joined with the Academy of Science in sharing a paid secretary who, through the courtesy of the Bishop Museum, is now housed in an office at the Museum. Consideration of the future of ISSEC, as begun by the previous administration of ISSEC, was held in abeyance this year because of the establishment of the Hawaii Science Curriculum Council. Until fully defined aims and programs are established by HSCC, it was thought that the possibility of running parallel programs and projects might occur. It was decided that ISSEC this year continue its regular work and hold off on philosophical considerations of the future until the activities of HSCC are defined. Inasmuch as the HSCC council is composed of a large number of ISSEC chairmen, it was felt that common goals would be amicably established.

Thanks are due to the many members of our community who gave so freely of their time and thoughts during the year to advance the work of ISSEC. To the committee chairmen, and the many individuals they invited and drafted into their services, to the active affiliated member societies, to the officers, John Hylin as assistant chairman, Dwight Lowrey as continuing treasurer, John Payne as chairman of the Community Participation Fund, and to the unlisted and comparatively unsung individuals, institutions, organizations, and business firms who gave generously to support our work, go my personal thanks.

Albert M. Nagy
Chairman, ISSEC, 1966-67

TREASURER'S REPORT

Fiscal Year–April 1, 1966-March 31, 1967

Opening Balances–April 1, 1966

ISSEC Account	$ 5,624.00
9th Fair	(2,576.77)
Savings and Loan Accounts	12,023.75
	15,070.98

Receipts

Contributions: '65-'66 year	$2,581.00	
Contributions: '66-'67 year	7,233.00	
Interest	738.26	10,552.26
		25,623.24

Disbursements

Science Camps	300.00	
Awards	50.00	
Teachers Workshop	217.39	
Film Service	52.00	
Secretarial Service	500.00	
Printing and Stationery.	278.16	
Ninth Science Fair	4,036.78	
Tenth Science Fair	333.36	5,767.69
		$19,855.55

Closing Balances–March 31, 1967

ISSEC Account	$ 8,032.10
10th Fair	(248.36)
Savings and Loan Accounts	12,071.81
	$19,855.55

Dwight H. Lowrey
Treasurer, ISSEC

COMMUNITY PARTICIPATION COMMITTEE

Contributions received totaled $6,280. This compares with $6,220 in 1965-66.

The list of contributors below is essentially the same as in the past. Local trusts and foundations provide the principal support since the withdrawal of the HSPA and PRI.

DONATIONS
1966-67

Central Pacific Bank	$ 25.00
Hawaiian Telephone Co.	250.00
First National Bank	100.00
Honolulu Gas Co., Ltd.	25.00
Jas. W. Glover, Ltd.	10.00
H. S. Gray Company, Ltd.	10.00
Watumull Foundation	100.00
Bank of Hawaii	100.00
Hawaiian Cement Corporation	10.00
Hawaiian Electric Co.	200.00
First Insurance Co. of Hawaii	25.00
Coca Cola Bottling Co.	25.00
McInerny Foundation	1,000.00
Earle M. Alexander, Ltd.	10.00
H. C. & D.	100.00
Oahu Transport Co., Ltd.	50.00
Charles M. & Anna C. Cooke TR	500.00
Castle & Cooke, Inc.	300.00
Juliette M. Atherton Trust	1,500.00
Frear Eleemosynary Trust	250.00
Hawaii Medical Assn.	100.00
F. C. Atherton Trust, Inc.	500.00
Sears Roebuck	50.00
Saml. N. & Mary Castle Found.	1,000.00
American Society of Agronomy	20.00
Hawaii Dietetic Association	20.00
TOTAL - 1966-67	$6,280.00

J. H. Payne, *Chairman*

SCIENCE TEACHERS WORKSHOP

Description of the Program

The Science Teachers Workshop was held on Thursday, March 30 and Saturday, April 1, 1967 in conjunction with the annual Science Fair. This workshop was sponsored by the Hawaii Science Teachers Association, the Conservation Council for Hawaii and ISSEC.

The workshop was planned for a two-program presentation. The theme for the Thursday session, held at Punahou School, was "New Designs in Elementary and Secondary Science Programs." Dr. Albert Carr, Professor of Elementary Science, University of Hawaii, conducted the session on "Current Objectives and Approaches in the Science Curriculum Improvement Study." Dr. E. J. Piel, Associate Director of the Engineering Concepts Curriculum Project (ECCP), explained how the new course developed technological literacy in the general student. Mr. Charles Stoughton, instructor at Iolani School, demonstrated some of the ECCP equipment.

As part of the program, Mrs. Iris Fukui held a special session for principals and counselors to hear Dr. Piel and to become familiar with the ECCP materials and concepts.

On Saturday the theme was "Natural Resources: Our Problem and our Concern." This session was held at Kamehameha Schools. Dr. Vernon E. Brock, Director of the Hawaii Institute of Marine Resources, spoke on "Hawaii's Marine Environment." "The Terrestrial Environment" was Dr. Andrew J. Berger's topic, and Mr. Saul Price spoke on "Air Pollution in Hawaii: Fact or Fancy."

The Honorable Patsy T. Mink presented a luncheon speech on "National Implications of Our National Resources." "Soil Erosion: Causes and Control" was discussed by Dr. Paul Ekern, hydrologist with the Water Resources Research Center at the University of Hawaii. Following these presentations, inquiry and reaction sessions were led by selected group discussion leaders.

During the morning session, twenty-four audio-visual and science-supply companies displayed and demonstrated their products.

Over 300 participants attended the two-day workshop. Of these, 29 were from the neighbor islands. Those desiring credit, received it by attending the entire 8-hour program.

Financial Report

The HSTA decided this year to charge the workshop participants a registration fee, thus relieving ISSEC of some of the financial responsibility. This fee included payment for two meals and other expenses. ISSEC was responsible for two large expenses: Plane Fare Reimbursements $965.20, and Honoraria to Speakers $220.00, for a total of $1185.20.

A statement was submitted to Dwight Lowrey, treasurer of ISSEC, for the above expenses.

Evaluation of the Workshop

An evaluation by the participants of the workshop was made and a summary of this evaluation was compiled. Response to the workshop was very favorable. Next year's committee will be able to profit from the suggestions and recommendations of this evaluation.

Recommendations

1. Plane-fare reimbursements to neighbor island teachers could be given at half or three-fourths fare, to allow more of them to attend.

2. The workshop sessions could be held at the Ilikai or in near vicinity to the Hawaiian Hilton, to allow a closer tie-in with the Science Fair.

3. This science workshop should be our largest and most important activity of the year. It could be a combination conference and workshop for HSTA members.

4. Determine the possibility of having the ISSEC secretary do the clerical work (ditto, stencil, typing letters, etc.) for workshops sponsored by HSTA.

5. A committee chairman should be selected now and plans should be made for the 1968 workshop.

Charles K. Burrows

SCIENCE TALENT SEARCH COMMITTEE

Hawaii participated for the eighth year in the Twenty-Sixth Annual Science Talent Search for Westinghouse Science Scholarships and Awards. Twenty schools requested 139 examinations and entry forms. Students submitted 27 completed entries in December 1966 for national competition. The project by Carol Lee Hong of Kalani High School was selected for the Honors Group —those in the top 10 per cent of the competition. To date, Hawaii has qualified 11 students in the Honors Group and one student as a national winner.

The project reports were returned in February for local judging and selection for the 8th Hawaii Science Talent Search Awards. Dr. Jimmie Smith of the Pineapple Research Institute, Dr. John Hylin of the University of Hawaii, and Mr. George Sloane of the HSPA Experiment Station selected the following students for recognition:

Linda L. Y. Chun	Roosevelt High School
Carol Lee Hong	Kalani High School
Nelson Enriques	Kohala High School
Mary H. Matsuda	Kaimuki High School
William Merrow	Leilehua High School

These students were given recognition at the Hawaiian Academy of Science 42nd Annual Meeting at the East-West Center and received cash awards. Of the $75 budget a total of $56 was expended in 1966-67.

Edwin Y. H. Chinn

STUDENT SCIENCE SEMINARS

Started under ISSEC auspices by Dr. Carr in 1959, this program is now also funded through the Academy with a grant from NSF. Thirty specially selected high school students formed four seminar groups, one each on Oahu, Kauai, Maui, and Hawaii. Associate directors on the neighbor islands are Champ S. Ono (Kauai), Clifford Kekauoha (Maui), and Shuichi Tanaka (Hawaii). Twenty-five sessions were held on Oahu, about sixteen each on the other islands. The seminars afford these students the opportunity of additional science instruction together with interchange with professional scientists. Funds have been granted by NSF for continuance in 1967-68.

Albert Carr

SCIENCE TEACHER COORDINATION COMMITTEE

Science teachers were kept informed by brochures and memoranda of the science education activities of ISSEC, particularly the Hawaiian Science Fair, the State Science Talent Search, and the Science Fair Teachers Workshop. This helped to promote excellent participation of students and teachers in all activities.

Edwin Y. H. Chinn

FINAL REPORT OF THE TENTH ANNUAL HAWAIIAN SCIENCE FAIR

The Tenth Annual Hawaiian Science Fair was held from March 31 to April 2, 1967 at the Hilton Dome. One hundred and twenty-eight exhibits were selected for judging. There were 36 research projects and 14 display projects in the Senior Division. The Intermediate Division exhibited 57 research projects and 21 display projects. Wayne Okamura of Jarrett Intermediate School, won the Clayton J. Chamberlain Memorial Award, the top Intermediate research prize, for his project "The reaction of *Tilapia mossambica* fry to various artificial and live models of the mother." Donald Masutani of Waipahu High School, and Wayne H. Toyofuku of Waimea High School, Kauai, were selected as top winners in the Senior Research Division with projects entitled "Some biological and physical aspects of the Pearl Harbor Mangrove Swamp" and "The location of the toxic venom in the *wana*," respectively. They were accompanied to the Eighteenth International Science Fair in San Francisco, by their teachers, Mrs. Wendt and Mr. Higa, and by Dr. Yoneo Sagawa, Associate Director. Dr. Sagawa will serve as director of the Eleventh Hawaiian Science Fair in 1968.

Ira J. Lichton, *Director*

VISITING SCIENTISTS PROGRAM

The Visiting Scientists Program of the Hawaiian Academy of Science had a successful operation during the 1966-1967 school year. The following is a summary of the program up to and including this year:

Total no. of lectures given:	No. of schools participating:	Scientists participating:
1963-64: 124	26	60
1964-65: 130	53	36
1965-66: 159	51	55

1966-67:

1. Total number of presentations completed or booked: 124. Oahu - 86; Hawaii - 12; Maui - 12; Kauai - 14.
2. Number of different schools and groups utilizing program: 33. Oahu - 12; Hawaii - 7; Maui - 5; Kauai - 6; groups - 3.
3. Number of scientists listed in Brochure: 43.
4. Number of lectures given by individual scientists:

16 gave 1 lecture	4 gave 6 lectures
5 gave 2 lectures	2 gave 7 lectures
1 gave 3 lectures	1 gave 8 lectures
6 gave 4 lectures	1 gave 9 lectures
1 gave 10 lectures	

5. Personnel:
   Richard K. Coburn, Director
   Elissa S. Leong, Secretary
6. Visiting Scientist Brochure:
   Because of the decrease in our budget allowance, no formal brochure was sent out. However, we did send out a mimeographed list of the scientists and their topics.
7. Comments on the program:
   The outer islands indicated that they would like more visits.
8. Schools participating in the program:
   Oahu: Aiea High School, Campbell High School, Kalaheo Intermediate, Kamehameha Schools, Kaimuki High School, Leilehua High School, McKinley High School, Punahou High School, Roosevelt High School, Sacred Hearts Academy, St. Francis Convent, Waialua High School. Hawaii: Hawaii Preparatory Academy, Hilo High School, Honokaa High School, Laupahoehoe High School, Pahoa High School, St. Joseph's High School, Waiakea High School. Maui: St. Anthony School, Baldwin High School, Kihei High School, Lahainaluna School, Maui High School. Kauai: Kalaheo School, Kapaa School, Kauai High School, Koloa School, St. Theresa School, Waimea School.
9. Groups requesting service: Associated Science Clubs of Hawaii, Catholic School's Science Teachers, Hawaii Science Teacher's Association.
10. Approval for funds to continue the Visiting Scientist Program has *not* been given by the National Science Foundation.

Richard K. Coburn, *Director*

ASCH ACTIVITIES

1. Membership:
   Science clubs of 31 different schools on Oahu, Molokai, and Kauai participate actively in ASCH activities or receive the newspaper, *Ke Akeakamai.*

2. Activities:
   A. A money-making dance was held in October at the Honolulu International Center. All participating schools on Oahu helped to sell tickets. Carey Tanaka, chairman of the program committee was in charge, with sub-committee chairmen from the general membership and ticket sales in each individual club coordinated by the club representative to ASCH council. A small profit of $161.51 was netted. From this, we spent $60 to subsidize a bus to the physical science workshop at Laie, and $10 to pay for refreshments at the workshop at Waianae.

   (1) Additional money was to be appropriated for the election convention which was to be held in February or March but had to be cancelled.

   B. Workshops: A total of 5 separate workshops were conducted this year with the help of the visiting scientists program.

   November 12, 1966–Title: "Hormone Influences in Regulation of Body Mechanisms." Instructors: Dr. F. Kamemoto, Mr. K. Kato, Mr. S. Oyama. Place: Waianae High School.

   December 10, 1966–Title: "Some Problems in Early Embryological Development." Instructors: Dr. A. Banner, Dr. S. Townsley.

   February 18, 1967 –Title: 1. Vapor pressure of organic liquids. 2. Determination of the dichromate ion by ultraviolet spectrophotometry. Instructors: Dr. David Miles, Prof. R. Niedrich, Mr. G. Orsmby. Location: Church College of Hawaii.

   February 18, 1967 –Title: Determination of the Gravitational Constant by free fall and by velocities on an air tract. Instructors: Prof. R. Graham, Prof. Alvin Yee. Location: Church College of Hawaii.

   February 18, 1967 –Title: 1. Analytical methods in solving inequalities. 2. Determinants and their application in mathematics. Instructors: Prof. R. Coburn, Prof. Johnson.

   January 28, 1967 (Lecture) Title: "Hawaiian Anthropology." Speaker: Dr. Elbert. Location: Star of the Sea High School.

   All workshops are conducted as laboratory sessions, and collection of specimens, organization of equipment and information is coordinated by the volunteer host club. As an example, Waianae High School was in charge of the workshop on hormone influences on marine animals; St. Francis High School was in charge of the workshop in embryology; and Kalani High School was in charge of the series of three workshops at the Church College of Hawaii. The lecture on "Transmigration of Pacific People" was arranged by Pat Mow of Star of the Sea High School and was hosted by her club.

   C. Service Projects: Students from Dole Intermediate School, Aiea High School, Kalani High School, Star of the Sea High School, and St. Francis High School, helped as greeters and projectionist at the annual Science Fair.

D. Although the annual election convention will not be held this year, election of officers for the year 1967-68 are now being completed. Nominations are coordinated by mail and the election will take place at a joint session of the representative council and the executive committee.

Iris H. Shinseki

SCIENCE CAMPS

The 8th annual Senior and Junior Science Camps under the joint sponsorship of ISSEC and HSTA were held at Laie in the Church College of Hawaii during the weekends of April 14 - 16 and May 5 - 7.

There were 104 students from 15 different high schools at the senior camp, and 123 students from 12 junior high schools at the junior camp. Both public and private schools participated in the program.

A theme of "Science of Polynesia" was presented to the students at both camps. Subjects in geology, oceanography, anthropology, and sociology of Hawaii and the Pacific Basin were covered. Students were given the opportunity to tour the Polynesian Cultural Center and to attend the Polynesian performance at night. Scientists from the Church College conducted most of the classes. This phase was supported by the Visiting Scientists Program.

In addition to the $875 donated by ISSEC, each student was charged $15 to help defray the expenses.

The Senior Science Camp was directed by Walter Luke, a science teacher at Stevenson Intermediate School, while the Junior Science Camp was under the directorship of Esther Shimizu from the University High School. President of the HSTA is Iris Fukui.

Much aloha is extended to Dr. David Miles and other members of the Church College for their cooperation and help.

Walter Luke

EXPLORING NATURE IN HAWAII

Elementary Texts by Sister Mary St. Lawrence

The Hawaii Science Curriculum Council is currently drafting a Grade 7-9 science curriculum which contemplates including, and producing materials on, the Hawaiian ecosystem. Until this project becomes defined, "Exploring Nature in Hawaii" will not be revised or reprinted although it continues to sell at about the same volume. The author of "Exploring Nature in Hawaii" is engaged in development of the new Grade 7-9 curriculum. A status report of the new project follows.

Hawaii Science Curriculum Council

The Hawaii Curriculum Center was conceived and established in early 1966 for design and development of improved curricula under joint sponsorship of the University of Hawaii and the State Department of Education, with additional funding from the Federal Elementary-Secondary Education Act, P.L. 89-10, Title III.

In June, 1966, sponsored by the Assistant Superintendent for Curriculum, the Hawaii Curriculum Center held a conference to discuss school curricula in eight areas, one of which was science. The group concerned with science made many recommendations, including one that a Science Curriculum Council be established to give direction to science education for Hawaii.

Twelve selected scientists and science educators in Hawaii consented to serve on this Council and take on the work of examining and developing science teaching and learning programs. Although vast improvement of the entire K-12 science curriculum is envisioned, the effective point of ingress seems to be at grades 7-9. It is to this area that the Science Curriculum Council has addressed its initial attention. A draft proposal was prepared by the Council in the winter of 1966.

Early in February, 1967, this draft was discussed with an official of the National Science Foundation in Washington. General interest in the ideas was expressed and the Hawaii Curriculum Center was encouraged to submit a formal proposal for review. Normal procedure requires up to six months before a decision can be expected.

Meanwhile, it is important to secure written expressions of interest in the project from appropriate segments of the scientific, educational, and local community. Supporting letters of interest may be addressed to the Hawaii Science Curriculum Council, in care of the Hawaii Curriculum Center, Room 306, 1040 S. King St., Honolulu, Hawaii 96814.

Salient Features of the Proposal

The Student Program

Two separate, but interlocking, programs will be developed for intermediate grades 7, 8, and 9; one in thermodynamics and the particulate structure of matter, the other in ecological relationships. These co-projects will be scheduled in sequence on a shared-week basis to derive maximum advantage of theoretic interchange while emphasizing specifics of each of the disciplines involved.

The Teacher Program

A training program for grades 7-9 science teachers will combine academic instruction with laboratory school practice, followed by supervised teaching in field schools. This intensive training will extend over two to three years for each teacher, followed by continuing contact with the project. Graduate students in education will be invited to do some of their preparatory work in science in this program.

Evaluation

Continuous feed-back from practical field experience will be used in revision of each phase of the student and teacher-training programs. Data processing techniques will be employed in a longitudinal study to assess the long-term import on the Hawaii educational scene.

Scope and Flexibility

Advantage will be taken of the full range of communications media as well as of published materials already available. Maximum attention will be given to school scheduling and to the individual needs of science teachers and students.

Chronology

Year 1 ..... basic research and design of all parts of the program.
Year 2 ..... beginning selection of field schools and teachers for training.
Year 5 ..... seventh grade materials complete.
Year 6 ..... eighth grade materials complete.
Year 7 ..... ninth grade materials complete.
Year 8 ..... special topics for gifted and for slow learners complete.

Rationale for Grades 7-9 Science Program

The present disciplinary approach to science in the secondary school fails to give students a sense of theory interchange between the disciplines. Intermediate school science has been dominated by the general science approach which, with its stress on technology and generalities, does not give adequate background in the fundamentals.

Students need to be exposed to a group of sciences, chosen to sequentially develop fundamental concepts. This requirement is met by taking a discipline which focuses on foundational concepts and teaching it simultaneously with a discipline that uses these concepts in its own theory structure. One of the co-projects of this proposal will contribute basic research topics in thermodynamics and the structure of matter, here referred to as "The Foundational Approach to Science Teaching," while the other co-project, "The Ecological Approach to Science Teaching," provides an understanding of relationships both biological and physical within a composite discipline.

PUBLIC RELATIONS COMMITTEE

The activities of this committee consisted of revising and publishing the ISSEC brochure. In addition, all Science Fair and Science Teacher's Conference publicity was gathered and released by this committee.

Richard Ekimoto, *Chairman*

THE HAWAII SCIENCE TEACHERS ASSOCIATION NEWSLETTER

The first issue was published in October. The second issue was a four-page special featuring new programs in science and recognizing participating teachers and schools. The third and last issue is also a four-page newsletter spiked with science humor and including highlights of the National Science Teachers Convention in Detroit. Typing and printing the newsletter cost $120.

Plans for next year are to publish four 2-page issues with publication dates in September, December, March, and June. Typing and printing costs are anticipated to be approximately $120. In addition, a petty cash fund of $30 will be requested to cover photographic and other miscellaneous supplies. The total publication cost anticipated for 1967-1968 is $150.

Inasmuch as a formal request from ISSEC was not made, I am requesting that the Hawaii Science Teachers Association be reimbursed for the 1966-1967 printing and typing costs. If it pleases the committee, the anticipated cost of publication in 1967-1968 might also be granted at this time.

Katherine H. Aratani, *Editor*

The 42nd ANNUAL MEETING 1966-1967

Programs

FIRST SESSION

December 2, 1966, Agee Auditorium, HSPA
1527 Keeaumoku Street

"Recent Developments in Science in Japan and Asia"

1. John Magnuson, U.S. Bureau of Commercial Fisheries: Fishery Biology.
2. Ivan Buddenhagen, University of Hawaii: Plant Pathology.
3. Leon Rosen, U.S. Public Health Service: Helminthic Diseases.

December 2, 1966, Agee Auditorium, HSPA

4. George Woollard, Hawaii Institute of Geophysics: Geophysics.
5. Robert W. Hiatt, University of Hawaii: Role of Asian Universities in Cooperative Science Programs.
6. Klaus Wyrtki, Hawaii Institute of Geophysics: Oceanography.

SECOND SESSION

April 22, 1967, Hawaii Institute of Geophysics
Auditorium, University of Hawaii

7. Ernst S. Reese, University of Hawaii: Water Pollution.
8. Rudolph J. Rummel, University of Hawaii: Dimensionality of Nations.
9. Richard A. Barkley, U.S. Bureau of Commercial Fisheries: Impact of Computers on Science.
10. Wilhelm G. Solheim, University of Hawaii: Recent Archeological Results in Thailand.

Business Meeting

Luncheon

Presentation of Awards

PRESIDENTIAL ADDRESS

"Agriculture in Our Changing World"
Louis G. Nickell
Experiment Station
Hawaiian Sugar Planters Association

11. Helen Altonn, Honolulu Star Bulletin: Science and News.
12. Emmanuel Voulgaropoulos, University of Hawaii: International Program of the College of Health Sciences and Social Welfare.

PAPERS AND ABSTRACTS

RECENT DEVELOPMENTS IN FISHERY SCIENCE IN JAPAN AND ASIA

John J. Magnuson*

Approximately 40 per cent of the world's catch of fish is made by Asian countries, notably Japan, Russia, and mainland China. Numerous developing countries in Asia are eager to expand and improve their harvest. Research appears to have the broad aims of developing new fisheries, managing existing fisheries effectively, and improving fish-culture techniques. Recent developments were presented at several symposia at the 11th Pacific Science Congress in Tokyo, 1966, on subjects as diverse as the high seas tuna resources and culture of algae. More comprehensive summaries of developments were presented at the 12th Session of the Indo-Pacific Fisheries Council in Honolulu, 1966. An additional Symposium on Tuna Fisheries was held in Tokyo in 1966 and was summarized in the *Bulletin of the Japanese Society of Scientific Fisheries*, volume 32, number 9.

Developments have occurred in the research on many fisheries but because of our position in the central Pacific, those in Japan's high seas tuna fisheries are perhaps of most interest to Hawaiians. The Nankai Regional Fisheries Research Laboratory, responsible for this research, has been studying tuna biology, stock assessment, and tuna oceanography since 1950. The research depends largely upon the fishery as a source of data. During the early growth of the tuna longline fishery, the resource was considered to be practically inexhaustible. From 1952 to 1962 longline fishing spread to all the oceans of the world and increased fivefold. In their stock-assessment studies Japanese scientists have recently noted that some tuna stocks appear to have been fished at equilibrium levels since the early 1960's. In some areas additional fishing effort would not be expected to increase the yields. A new high seas laboratory, being established in Shimizu City, will combine all research activities on Japan's distant-water fisheries. The work will include research on tuna, salmon, distant-water trawling, whales, and fur seals.

Research to improve the efficiency of fishing gear so as to reduce manpower requirements is receiving new impetus in many areas of Japan, because it has become increasingly difficult to recruit young men to a sea-going life. Present activities include attempts to mechanize both longline and pole-and-line fishing, and also to improve accuracy in selecting the depth at which longline hooks are fished.

Fish culture, important in Asia, is certainly not new. Common carp (*Cyprinus carpio*) was economically important in China 2,400 years ago. Today in Japan the most important species cultured are eel (*Anguilla japonica*), yellowtail (*Seriola quinquiradiata*), common carp, rainbow trout (*Salmo gardneri irideus*), alga laver (*Porphyra tenera*), oyster (*Ostrea gigas*), and pearl oyster (*Pinctada martensis*). In 1964 these and other cultured species made up 7 per cent of the total Japanese output. In mainland China about 40 per cent of the total catch is from fresh water. Apparently most of this catch is cultured. A major development in fish culture has been the perfection of techniques to induce spawning artificially by injecting pituitary hormones. It is expected that this recent development will ensure a large and regular supply of fish fry for culture. Progress in inducing spawning was realized in at least four different countries with at least eight species from fresh and brackish water culture. Another advance is the increase in cultivation of shrimp and other invertebrates.

*U.S. Bureau of Commercial Fisheries Biological Laboratory, Honolulu

PLANT PATHOLOGY IN JAPAN AND OTHER COUNTRIES IN ASIA

Ivan Buddenhagen*

The history of man is the record of a hungry creature in search of food. The great American plant pathologist, E. C. Stakman, commented: "This statement may shock some people who know much history without knowing much about biology; but it does not even surprise biologists who are concerned with problems of life and what sustains it, and of death and what causes it.

"Biology is the most fundamentally important science for satisfying the most basic human need—human subsistence." And plant pathology—the study of plant disease in all its aspects—is a fundamental part of biological science.

It is doubly important in Japan and Asia, where people understand hunger and know that plants, not machines, must make our food.

In Japan the importance of the science of plant pathology is recognized by a complex organizational structure which supports this research. And why not, in this crowded wet-summer country that is the largest importer of agricultural products from the United States, and which even imports 700 million pounds of U.S. rice? In this country of less size than California, there are 45 plant pathology and 3 nematology laboratories, maintained in 16 institutions of the Ministry of Agriculture. The 46 prefectural governments have one or more plant pathology laboratories each. Forty-three universities and agricultural colleges have plant pathology laboratories; some biochemical laboratories in these universities also are used for plant pathology research. Only seven universities, however, provide a doctoral course in plant pathology. Several semi-autonomous institutes carried out advanced coordinated research on specific subjects, such as the Institute for Plant Virus Research, with 29 scientists, at Chiba; and developmental pesticide laboratories at several locations. The Phytopathological Society of Japan is well developed, with 1,300 members, a journal, and annual meetings.

Plant pathology includes four main divisions: fungi, bacteria, nematodes, and viruses. Virus research is being pursued most actively. Ninety plant viruses have been purified and shown electronmicrographically. Of the 300 original articles published annually on plant pathology subjects in Japan, about 100 are on viruses. Virus taxonomy, transmission, serology, and structure, chemotherapeutics and biochemistry of infection are all being actively pursued, probably more so than anywhere else.

While virus research is clearly the most intensive, bacterial research has advanced and a bacteriophage field-sampling method for forecasting bacterial blight of rice has been developed. Bacterial research is usually carried from practical symptomatology descriptions to electron microscopy work on the bacteria and even on their 'phages.

Fungal work is most intensively pursued on races and on physiology of disease.

Although many other facets of plant pathology are under investigation and too numerous to elaborate here, I should comment that some areas seemed to be receiving lesser emphasis: ecology of disease, soil-borne diseases, nematology, traditional mycology, and applied disease-control methods. As in the United States, molecular biology has taken over rapidly and in some ways has resulted in the neglect of very important but less glamorous facets of research.

Pesticide research has expanded recently, with many discoveries. Several new antibiotics have been found (Blasticidin S and Cellocidin), which are effective against both fungal and bacterial diseases of rice. A search of interesting biological systems as sources for potential pesticides is a cooperative and coordinated effort and a valuable one at several institutes.

Plant pathology at the Congress was represented by a symposium on "Plant Diseases in the Pacific" (convened by Prof. H. Asuyama, chairman of the Department of Plant Pathology, Tokyo University); by a divisional meeting on plant protection (organized by Drs. Ishikura, Ministry of Agriculture and Forestry, and Y. Iwata, head of the Department of Plant Pathology and Entomology at the National Institute of Agricultural Sciences, Japan); and by a sub-committee meeting of contributed papers on crop protection in the Pacific area (chaired by Drs. K. Maramorosch, Boyce Thomson Institute, New York, and L. Chirappa of FAO, Rome). These meetings were well organized and they have provided an impetus for much needed communication among plant pathologists in Asia.

A quick glance at titles of Japanese papers presented at the Congress, and at a recent NSF-supported conference at Gamagori gives an impression of the scope of plant pathology in Japan:

1. Epidemiology of bacterial leaf blight of rice and use of phages for forecasting.
2. Electron microscopic study of multiplication of rice dwarf virus in plant and insect host.
3. Antibiotics and new fungicides for control of rice diseases.
4. Chemical control of fruit tree diseases.
5. Rice-infecting nematodes in the Pacific Basin.
6. Leafhopper-transmitted plant viruses in Japan and adjacent countries.
7. Fruit tree diseases in the Pacific Basin with special reference to the striking contrast between East and West.
8. An anatomical approach to the mechanism of fungal infections in plants.
9. Biochemical response of plants to fungal toxins produced by pathogenic fungi.
10. Change of nuclear contents of host-cells infected by virus.
11. Biochemistry of RNA of rice dwarf virus.
12. The relation of metabolic changes in infected plants to changes in enzymatic activity.

I should comment on plant pathology education and research at the universities. A modified German system is used, with one senior professor and a number of men under him. The senior professor teaches all or most of the plant pathology courses and, therefore, the experts in different branches of plant pathology do not teach the students. A whole department may specialize in only one aspect of the field, e.g. virus disease research, and at the same time they are supposed to teach the complete science. Since the universities, unlike those in the United States, are not connected with experiment station research, there is a large gap between plant pathology teaching and research at the university and the needs and potentials for research at the experiment station and field level. Likewise, this lack of connection severely limits research funds for the university departments and governs their direction of research, and probably makes it necessary to set up separate research institutes covering specific problems from the applied to the most basic aspects.

Plant pathology research and organization of the scope attained in Japan does not exist in any other Asian country. There are scattered researchers in Korea, Thailand, Malaysia, Taiwan, and the Philippines, and other countries, but there is a tremendous gap between the research needs in relation to food production and research support, staffing, and organization.

The most significant undertaking involving plant pathology in other Asian countries is the International Rice Research Institute in the Philippines, sponsored by FAO of the United Nations and underwritten by the Ford and Rockefeller Foundations. Three great diseases, blast, bacterial-blight, and viruses, have been investigated intensively by an international staff and great progress has been made in applied and basic studies. The single disease, blast, was the sole subject for an international symposium in 1963.

Less well known but similar institutes support research on diseases of coconut in Ceylon, India, and the Philippines; on tea, in Ceylon, on rubber in Malaya. Coconut, a great crop in the Philippines, is being decimated by a disease called "cadang-cadang," believed to be of a viral nature but still undetermined. Bananas receive essentially no research in Asia, even though they are a basic food, except for a few studies on bunchy-top virus in the Philippines and on leaf spot in Taiwan.

FAO is playing a large role in the development of applied research and its coordination in much of Southeast Asia. Other international organizations also assist in these efforts.

The titles of the papers presented at the Congress dealing with plant pathology in other Asian countries give an impression of the scope of work: Cotton diseases in Thailand; Recent advances in plant protection in the Pacific region and the role of FAO; An international laboratory for plant pathogens, especially viruses and their vectors; Varietal resistance to three major diseases of rice in Southeast Asia; Control of sugar cane downy mildew disease in Taiwan; Viruses and virus diseases of potato in the Soviet Far East; Transmission studies of banana bunchy-top virus in the Philippines; Results obtained from studies on the transmission of cadang-cadang disease of coconut in the Philippines; Recent outbreak of corn smut in Indonesia; *Fusarium* sp., causing root rot of Korean ginseng.

In Asia, outside of Japan and a few research institutes, expansion of the science of plant pathology is greatly needed to increase food supplies and decrease agricultural poverty. Many discoveries of fundamental biological science will be made as side benefits. This plant pathology research can go a long way in changing the social, political, and military patterns of life which have their roots in low agricultural production.

It is important to realize that man in Asia is, indeed, a hungry creature in search of food.

*Professor and Acting Chairman, Department of Plant Pathology, University of Hawaii.

GEOPHYSICS IN JAPAN TODAY

G. P. Woollard*

In a recent speech† President Thomas Hamilton of the University of Hawaii referred to Japan as "a model for the modernization of Asia," and commented on the fact that Japan accomplished in 70 years the modernization process that took the West some 400 years. He also referred to the fact that economists argue that probably the most important form of capital investment is human capital, and that educated human beings are a nation's greatest asset. Referring again to Japan, he cited the commitment to education there, and the fact that this year over 70 per cent of the youth in Japan will graduate from high school as compared with 65 per cent in the United States.

President Hamilton's thesis was that education has a direct impact on the national economy since educated human beings simply devise more productive economies, and this thesis was supported by the fact that Japan rates third in world industrial output, despite the fact that it has few natural resources and is definitely a "have not" nation.

Although much emphasis is given to applied research in Japan, there is an *a priori* requirement for basic research, and the Japanese have not neglected this aspect in their planning. In geophysics–which in the broad meaning of the term includes geodesy, astrophysics, meteorology, tectonophysics, seismology, hydrology, terrestrial magnetism and electricity, gravitation, volcanology, and oceanography–there has been outstanding work in Japan.

There are many reasons why the Japanese have a keen interest in geophysics. Japan is an island nation with: (1) a large population, largely dependent upon the sea for protein; (2) few natural mineral resources; (3) subject to numerous severe earthquakes and volcanic activity; (4) few sources of fossil fuel such as coal or oil, but sources of geothermal energy; (5) many active geological faults that give continuous differential vertical and horizontal movement of the land surface; (6) numerous typhoons, with wind velocities that at times exceed 200 miles an hour; (7) a long history of destructive tsunami waves; (8) a geographical setting that includes one of the world's deepest oceanic trenches, a major oceanic current, and a major inland sea which separates Japan from mainland Asia.

It was only natural that under these conditions an interest in both physical and biological science as well as in science education developed, once the isolation of the feudal era came to an end and knowledge of Western science and its benefits were brought to the attention of the Japanese people.

The Japanese have recognized science as an intellectual pursuit carrying the prestige once only accorded the arts and as a major factor in the economy of the country. This attitude permeates all levels of society and has much to do with the scientific stature of Japan in the world today.

Japan is probably the leading nation in oceanographic research, having more ships doing research on the high seas for non-military purposes than any other nation. It is the leading nation in the study of earthquakes and it pioneered in the study of tsunamis. It is the only country in which there is complete information on the geodetic effects of earthquakes. There are probably more geophysical research institutes per capita population in Japan than in any other country.

The present paper will be confined to those aspects of solid earth geophysics that are also of interest in the study of the Hawaiian Islands.

Integration of Research Activity in Japan

The integrated nature of solid earth geophysical studies in Japan can best be shown by tabulating the components of the earthquake research program. The primary components can be described as: (1) mapping; (2) analysis; (3) correlation studies; and (4) applications.

Although the Earthquake Research Institute of Tokyo University is the major group in Japan concerned with earthquake research, each Japanese university has an active earthquake research program of its own. Since earthquakes affect all activities in Japan, the Geographical Survey Institute, and other physical science research institutes also have earthquake-study programs as a major part of their over-all programs of investigation.

It was because of a common interest and concern with earthquakes that the present unified and integrated program of earthquake research developed. This pattern can also be seen in many other fields of study in Japan, in particular, oceanography, meteorology, and geodesy. The basic stimulus and support in each case is the pragmatic concern for national welfare, but this has led to the support of basic research and also to the organization and integration of research activity so that there can be a more effective utilization of research results.

Some Basic Problems in Solid Earth Geophysics

Inasmuch as the origin of island arcs is an important scientific problem, Japanese scientists are now devoting considerable effort to obtaining a better understanding of not only geological and geophysical relations in Japan but also of how the Japanese arc fits into the over-all tectonic pattern of the Pacific Ocean basin. As Hawaii also represents an element in this same tectonic framework, it may be of interest to review some of the relations developed to date.

The Tectonic Setting in the Pacific Basin

Japan comprises one segment of a series of island arcs extending from the junction of the Aleutian and Kamchatka arcs southward through the Marianas Islands to the Celebes Islands. These island arcs are all centers of high earthquake activity and of either present or past volcanic activity. In addition, they all have pronounced oceanic trenches on their seaward side, in which the oceans reach their greatest depths. Studies of the associated earthquakes show that their foci are at shallow depth in the trench areas and become progressively deeper beneath the islands to reach depths of the order of 700 km behind the island arcs. An interesting feature is that over the depth-range from 20 to 350 km the foci indicate a plane inclined approximately 35^{o} to the surface. Below 350 km the foci indicate a plane with an inclination of 60^{o}. In the depth-range between 300 km and 450 km, however, there are very few earthquakes. As might be expected, most of the earthquakes occur in the upper zone, where the crust can be expected to be most brittle. The change in inclination of the focal depth-plane and absence of earthquakes in the zone of change can be interpreted in several ways: (1) a major flexure in the crust due to the advance of a crustal wave propelled outward by sub-crustal movement towards the oceans and in association with which there is tensional fracturing at the surface, a neutral axis at about 350 km due to minimal strain and compressure fracturing in the basal portion; (2) contraction of the earth, with the continental block overthrusting the oceanic block to accommodate a change in internal volume; (3) compressional stress on the crust over a zone of downward convection movement.

Although we do not know which, or even if any, of the above mechanisms applies, it is probable that island arcs are just one expression of a global fracture system that is best defined by earthquake activity and volcanism. On this basis it is found that the entire Pacific Basin is ringed by a zone of high seismicity except in its southern portion. On the basis of the relative displacement of the crust noted in association with earthquakes, it is found that horizontal movement predominates over vertical movement and that this movement suggests the Pacific Basin is rotating counter-clockwise relative to the continents.

This spatial dislocation pattern suggested by earthquake data, however, requires further amplification. For example, what is the significance of the zones of weak intermittent seismicity in the open ocean? These in every case can be identified with fracture zones along the axes of broad rises on the ocean floor. In association with these rises, it is found that there is also anomalous heat flow and a distinctive pattern of parallel magnetic anomalies that appear to have a mirror image-pattern on opposite sides of the axial fracture. It has been postulated that this pattern of geophysical anomalies is caused by a spreading of the sea floor away from the fracture zone and that the duplication of pattern in magnetic anomalies on each side of the fracture zone is related to reversals in the earth's magnetic field. Another anomalous effect associated with the crests of the ocean basin rises is that explosion seismic studies indicate an apparent absence of normal mantle material beneath the crust.

It has been postulated that the rises are the surface expression of rising convection currents and that the floor of the oceans is being moved progressively away from the central fracture towards the continents, and may even be rafting the continents along also. Such a picture appears reasonable for the Atlantic Ocean and the Indian Ocean, where the configuration of continental coast lines parallels that of the mid-ocean fracture system on the rises. However, the only similar rise in the Pacific Ocean, the East Pacific Rise, does not lie in the middle of the ocean, but rather in the eastern sector. Furthermore, its axis appears to join with a fracture system defined by the Gulf of Lower California to disappear beneath continental North America. It may be fortuitous, but it is to be noted that the Basin and Range area of the United States is also an area of anomalous mantle seismic velocities, high heat flow, anomalous crustal thickness, volcanism, and earthquake activity.

These observations raise some interesting questions. Was there originally one super continent and one super ocean? Have North America and South America drifted apart from Europe and Africa by crustal spreading from a former intra-continental fracture system now represented by the mid-Atlantic Ridge? Has North America drifted westward over the East Pacific Rise which once lay in a mid-ocean position? Do the extensive island archipelagoes of the southern Pacific Ocean represent remnants of a foundered former continent? Does the alignment of the Emperor Sea Mounts, the Hawaiian Islands, Line Islands, and Austral Islands represent the initial stage of a new mid-ocean rise, or do they represent a fracture system re-

TABLE 1

JAPANESE ARC

	West of Arc (Inland Sea)			Arc	Arc			
Location	+800 mi.	+600 mi.	+400 mi.	0 (S)	0 (N)	+100 mi.	+120 mi. Trench	+210 mi.
Surface Elevation	-3.7 km	0.4 km	-2.6 km	1 km	0.5 km	-2.4 km	-7.2 km	- 5.3 km
Thickness of Upper Crust	2.4	8.1	4.1	21.0	23.0	13.4	2.7	1.7
Thickness of Basal Layer	5.7	11.5	8.1	21.0	0	7.2*	6.5**	5.2
Total Thickness Crust	8.1	19.6	12.2	43.0	23.5	20.6*	9.2**	6.9
Ratio Upper Crust to Basal Layer	0.42:1	0.71:1	0.51:1	1:1	--	1.85:1	0.41:1	0.33:1
Elevation of mantle	-11.8	-20.0	-14.8	-42.0	-23.0	-23.0*	-16.0**	-12.2
Mantle Velocity	8.2 km/sec	7.7 km/sec	7.4 km/sec	8.0+	8.0-	?	?	8.0
Free Air Anomaly	?	+29 mgal	-50 mgal	+150	+150 mgal	+25 mgal	-80 mgal	- 2 mgal
Bouguer Anomaly	?	+60	+150	+30	+94	+200	+387	+395
Heat Flow	2.54 ǂ	2.03 ǂ	1.90 ǂ	2.1 ǂ	2.00 ǂ	1.2 ǂ	+0.86 ǂ	

* Estimated below - 15.8 km level

** Estimated below - 9.5 km level

ǂ Heat flow in micro cal/cm^2 sec

TABLE 2

HAWAIIAN RIDGE

	West of Ridge			The Ridge	East of Ridge		
Location	+250 mi.	+200 mi.	+70 miles	0	+80 miles The Trench	+160 mi. The Rise	+220 mi. The Rise
Surface Elevation	- 4.2 km	- 5.3	- 4.6	- 0.2	- 5.5	- 4.2	-4.3
Thickness Upper Crust*	6.7	2.9	4.1	8.8	2.8	2.6	1.1
Thickness Basal Layer	4.0	6.0	4.3	11.8	5.6	3.0	5.0
Total Thickness Crust	10.7	8.9	8.4	20.6	7.6	5.6	6.1
Ratio Upper Crust to		0.48:1	0.96:1	0.75:1	0.36:1		0.22:1
Basal Layer	1.68:1					0.85:1	
Elevation of Mantle	-14.9	-14.2	-13.0	-20.8	-13.1	- 9.8	-10.4
Mantle Velocity	8.7 km/sec	8.7 km/sec	8.2 km/sec	8.2 km/sec	8.1 km/sec	8.1 km/sec	8.1 km
Free Air Anomaly	+5 mgal	+ 5 mgal	0 mgal	+190 mgal	-100 mgal	+40 mgal	+35 mgal
Bouguer Anomaly**	+334 mgal	+420 mgal	+360 mgal	+205 mgal	+307 mgal	+369 mgal	+372 mgal
Heat Flow	?	?	?	?	0.71 ‡	1.50 ‡	1.30 ‡

* Upper crust includes sediments and material with a velocity 3.0 - 6.2 k/s

‡ Heat flow in micro cal/cm^2 sec

** Bouguer anomaly computed for mean crustal density 2.9 gm/cm^3

TABLE 3

CHILEAN TRENCH

	Offshore	Trench	Coast
Location	+250 mi.	+80 mi.	0
Surface Elevation	- 4.0 km	- 6.0 km	0.0 km
Thickness of Upper Crust	2.3	4.5	2.0
Thickness of Basal Layer	6.3	8.0	26-28*
Total Thickness of Crust	8.6	12.5	28-30*
Ratio Upper Crust to Basal Layer	0.36:1	0.53:1	0.08:1
Elevation of Mantle	-12.6	-18.5	-28 to -30*
Mantle Velocity	8.2 km/sec	8.0 km/sec	8.2 km/sec
Free Air Anomaly	-10 mgal	-223 mgal	+10 mgal
Bouguer Anomaly	+293	+212	+10
Heat Flow	1.62	0.85	?

* Estimated from nearshore data and on shore data back from the coast.

lated to the forces that are obviously resulting in active tectonic deformation around the perimeter of the Pacific Ocean?

How do the trans-Pacific fracture zones fit into this tectonic pattern, and why is their expression so different in the eastern and western Pacific regions? Do the multiple arcs of the Marianas represent features of simultaneous origin or different stages of development and advance of the Marianas Arc?

Just as we in Hawaii have made an all-out effort to learn everything we can about the Hawaiian Islands through a systematic study of the volcanic rocks, their mineral composition, chemical constituents, crustal relations, etc., so have the Japanese undertaken an extensive program of geological, geophysical and geochemical study of not only Japan but of related areas characterized by similar structure and geology.

Recent Japanese Results

The most recent explosion seismic studies of the Japanese island arc and trench show an abrupt change in crustal structure in the slope area between the island arc and trench. The structure beneath the islands is definitely like that associated with a continent but, as shown by the crustal measurements reported for the Sea of Japan at the 11th Pacific Science Congress, this structure is confined to the Japanese islands. In the Sea of Japan the crust differs from that noted beneath the islands and that found in the ocean. In addition, it was found that high heat flow characterized much of the area in the Sea of Japan.

How the crustal relations in Japan compare with those associated with the Hawaiian Ridge and with the continental border trenches off the coast of South America where there are no island arcs can be seen by comparing geophysical sections across the three areas.

Table 1 gives the relations found on a composite cross section extending from the middle of the Inland Sea across Japan and the Japanese trench.

Table 2 gives the relations found on a composite section across the Hawaiian Ridge, trench and rise.

Table 3 gives the relations found in crossing the continental border trench off the coast of Chile.

Table 1 shows that in the Inland Sea the normal thickness of the crust is 8 to 12 km, with a local thickening over the Yamamoto Bank to 20 km. Under the Japanese

Arc the thickness varies from about 24 km in the north to 43 km in the south on Honshu. In the trench the thickness is about 9 km and in the adjacent ocean about 7 km.

By way of contrast, the data of Table 2 show a crustal thickness varying from 8.5 to 11 km west of the Hawaiian Ridge to about 21 km beneath the Ridge. East of the Ridge the crust is about 7.5 thick in the trench area, and about 6 km thick in the area of the rise.

In the Chilean trench area the data of Table 3 indicate a crustal thickness of about 8.5 km in the offshore area, 12.5 km in the trench, and 28 to 30 km at the coast.

The Japanese arc, therefore, is more like an isolated continental segment than is the Hawaiian Ridge, in terms of crustal thickness. In terms of composition of the crust, as expressed by the ratio of upper crustal material to the basal layer, it is more like the Hawaiian Ridge.

If we look at the trench areas, we see that the respective values of crustal thickness in the three areas are 9, 8, and 12.5 km. Therefore, despite the closer agreement in trench depth between the Japanese and Chilean trenches, the Japanese trench actually is more like the Hawaiian trench in crustal thickness. This is substantiated by the Bouguer gravity anomaly values, which are +387, +307, and +212 mgal respectively.

The big difference in crustal structure is in terms of the transition in crustal structure in progressing from the land areas into the respective trenches. In Japan there is no orderly transition in crustal layering such as is found in Hawaii, although the change in crustal ratios is similar: 1.85:1 to 0.41:1, and 0.75:1 to 0.36:1, respectively. In Chile the change is 0.08:1 to 0.53:1.

These studies indicate rather clearly that the mechanism responsible for the trenches on opposite sides of the Pacific are not the same. It is also evident that one can not regard the Hawaiian Ridge as being analogous to an island arc.

Although much additional work will be required before we have an understanding of the tectonophysical relations that are responsible for the morphological features of the Pacific Basin, the work to date has produced significant results. Not only have problems been defined for further investigation, but the values and advantages of both integrated research and international cooperation have been demonstrated. The seismic results off Japan were achieved under the Japanese-American Cooperative Program, those in Chile, in part, under a similar although less formalized program of international cooperation. Hopefully, this mode of operation will provide the basis for attacking all problems of general scientific interest, particularly those involving the international waters of the oceans.

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*Director, Hawaii Institute of Geophysics, University of Hawaii.

†The Snyder lecture delivered at Los Angeles City College, May 18, 1966, "On Understanding Asia."

ROLE OF ASIAN UNIVERSITIES IN COOPERATIVE SCIENCE PROGRAMS

Robert W. Hiatt*

The objectives of my Asian tour in summer 1966 were primarily devoted to checking the effectiveness of University of Hawaii programs in the Asian and Pacific area. Foremost among my interests was an evaluation of our Peace Corps training program in relation to the success of our volunteers now deployed in several Asian countries, as well as an on-the-spot appraisal of the effectiveness of our technical assistance services in various academic fields to the Agency for International Development. As time and occasion permitted, I visited a few of the major Asian institutions with which we have academic associations of one type or another. During these visits it was possible to appraise with reasonable accuracy the level of academic development of these and other institutions throughout the country, as well as to learn about potentially attractive situations which might induce cooperative ventures for our faculty.

Cooperative Science Programs

Because the nature of the word "cooperation" in this context permits widely varying interpretations, I should like to define it for purposes of the comments which follow. Generally, my discussion will embrace the opportunities for facilitation of research in Asian areas by American scientists and other academicians, as well as the scientist-to-scientist type of cooperation where each contributes on approximately the same academic level of sophistication in the solution of scientific or technical problems.

A reasonable understanding of the opportunities for cooperation with Asian scientists and institutions might best be approached by reviewing briefly the principal problems revealed by the United States-Japan Program in Scientific Cooperation, which for several years has been an official activity of the American and Japanese governments. Although each Asian country would vary as regards the exact nature and extent of such problems, basically they remain much the same.

Perhaps the most difficult problem to surmount in the U.S.-Japan Program was the uneven development of scientific fields both within and between countries. To achieve effective cooperation, the developmental level of a scientific field should be approximately equivalent. Equivalence was found to be the exception rather than the rule in most scientific fields considered. This disparity is to be expected, because of the differing nature of the scientific knowledge and technology required to achieve the desired type of development in each country; thus, the developmental level usually reflects the priorities in effort imposed by the social and environmental *milieu.* A significant measure of this disparate development appeared early in the deliberations for planning the U.S.-Japan Program, when it was noted that the numbers of Japanese and American scientists working as guests in laboratories of the host country varied tremendously. Approximately twenty Japanese scientists were working in American laboratories for each American working in a Japanese laboratory. This disparity has been diminished through direct efforts of the planners to select fields in which American scientists would be attracted to Japan. Given the fact that scientific development generally in Japan is unusually high compared with that in most Asian countries, the matter of cooperation on a scientist-to-scientist or an institution-to-institution basis with other countries will not be achieved without concerted effort.

Another area of major difficulty in international cooperation involves seemingly excessive bureaucratic and protocol problems. The development of this or that scientific field in a country frequently depends upon the administrative organization of the government. Although faculty members of Asian universities are slowly increasing the extent of their research effort, the fact remains that most research is conducted by national ministries, thus differing substantially from the United States, where basic research and, to an accelerating degree, applied research are undertaken by universities, although frequently financed extensively by federal funds. Differing organization for research between countries frequently leads to a maze of protocol problems which tend to frustrate and depress a willingness for cooperation on the part of scientists who function in a context of great flexibility characteristic of academic institutions. Although cooperation under conditions of excessive protocol is not impossible, an unusual degree of patience and time is required to gain it.

Underlying all cooperative activities, of course, is the important matter of financial support. Scientific research in the United States has enjoyed an unusually high level of support administered in a manner which gives scientists maximum flexibility. This is not the case in Asian countries, and the matter of reconciling totally different levels of financing for joint programs frequently places practical constraints on effective cooperation.

These major difficulties encountered in the U.S.-Japan Program are not unique, and they will be met again and again in arranging cooperative endeavors with other Asian countries, except that they will be greatly magnified. Thus, effective cooperation scientifically is difficult and requires an unusual degree of patience on the part of American scientists, but understanding the obstacles should help smooth the way for a process which is both necessary and inevitable.

In the developing countries of Asia, institutions of higher education are restricted mostly to undergraduate instruction. Very few have graduate programs of consequence, and very few make any effort to support or encourage research. Teaching loads are generally heavy, and, in several areas, the absurdly low remuneration for college or university personnel must be supplemented, most frequently by holding another job, such as teaching in institutions commonly referred to as "diploma mills," which operate mostly during evening hours. Colleges and universities in the developing countries ordinarily have no special facilities for research. Thus, cooperative projects requiring reasonably well-equipped laboratories would be severely handicapped. Governmental bureaus which emphasize research are by design devoted mainly to applied science, thus reducing further the opportunities for scientist-to-scientist cooperation among academicians. Library facilities in developing countries are universally inadequate for modern scientific research. Although Asian scientists are acutely aware of the inadequacy of their library resources, prospects are dim for funds to subscribe only to the leading journals in the various scientific disciplines.

Most developing countries in Asia have been freed only recently from the constraints of colonialism which, by its very nature, polarized institutional development on the European academic system. Since the administrative organization of most Asian universities and colleges follows closely the European system, and since most of the faculty members have been educated in Europe or in Asia, they are heavily influenced by the system of their experience. It is natural, therefore, that Asian academicians have looked mostly to Europe for cooperative effort. However, an increasing number of the newer faculty members are products of American universities, and these individuals are most enthusiastic about relating more closely to the United States on academic matters. This is a most encouraging situation, for academic development will proceed rapidly once economic conditions permit it. Given adequate financial support, the time required for the phenomenal educational developments in America can be much shortened in Asia.

Notes on the Development of Selected Institutions and Prospects for Cooperation

Korea

Among the many colleges and universities in Korea the most advanced is Seoul National University, which enrolls about 13,000 students. Although the institution is large, its facilities for research and graduate level programs are quite limited. Extensive planning efforts to improve both the academic program and the physical plant are in process under the leadership of an able group of administrators. There is substantial intellectual ferment among the younger faculty, many of which have been educated in the United States. They want to have visiting faculty members for teaching and research, especially from the United States.

One of the real treasures as a resource for research at Seoul National University is the Yi Dynasty diaries, covering a period extending over 500 years, up to the Japanese occupation. This priceless set of 140,000 volumes is shelved in a building unsafe from destruction by fire. University officials expressed great interest in a suggestion that we might solicit foundation funds to microfilm these diaries to insure the safety of the resource and to give scholars greater access to them.

Sung Kyung Kwan University, enrolling about 6,000 undergraduate students, maintains a library exchange program with the University of Hawaii and the East-West Center. Its president has requested that we explore with him means whereby our institutions might benefit from additional cooperative endeavors.

In the process of exploring ways and means of further cooperation with Sung Kyung Kwan University, it became evident that they would like many of their faculty to undertake advanced study at the University of Hawaii and, in turn, would welcome our faculty as visiting professors. A major bottleneck to such a plan is the requirement for external financial support to interchange staff, not only for travel but for subsistence as well.

Aside from the potential attraction of teaching in a Korean university, extensive probing about opportunities for research at Sung Kyung Kwan revealed no available laboratory facilities and a very inadequate library.

These details about problems confronting the prospect of cooperation in any academic field at Sung Kyung Kwan University, an institution which desperately wants closer academic ties with American institutions, are presented as a case study, because they illustrate those characterizing most of Asia's developing universities.

Taiwan

The National Taiwan University enrolls about 12,000 students and offers degrees through the master's level. One of the best-developed universities in Asia outside Japan and India, its faculty is of high quality and many are engaged in research insofar as time and funds are available to them. Great interest in cooperation with American academicians was evident everywhere.

The College of Chinese Culture, which enrolls about 1,500 students, is a new institution founded by Dr. Chang Chi-Yun. The outlook for rapid growth of this institution is especially good, for it seems to attract substantial financial support from both private and governmental sources. Its curriculum is growing extensively, and it will soon become a full-fledged university with graduate programs and several research institutes.

The academic relationships between the College of Chinese Culture and the National War College are unusual, because many of the faculty members hold joint appointments. Moreover, several high-ranking officials in governmental ministries are also part-time members of the faculty of the College of Chinese Culture. The extensive collection of mainland China's literature which is available at the College of Chinese Culture was most impressive, and included many recent journals and current newspapers. Moreover, the close association of the College of Chinese Culture with the National War College makes it possible for research scholars to utilize literature from mainland China available through this unusual source.

Of particular interest to scientists in Hawaii is the development of oceanography in Taiwan, an offshoot from an intensive planning program under way in science and technology, particularly for those sciences relating to the economic development of Taiwan. The oceanographic program will be a joint effort involving the National Taiwan University, the College of Chinese Culture, and the Chinese Navy. An Institute of Oceanography was established in the College of Chinese Culture in 1965. One of the stated primary objectives of the Institute is cooperation with international oceanographic organizations, and it has already undertaken cooperative work in the international study of the Kuroshio current in the vicinity of Taiwan. The Chinese Navy is placing emphasis on oceanography: ten officers have had graduate training in oceanography at the U.S. Naval Postgraduate School in Monterey, California, and it also operates the only oceanographic survey ship in the service of the Republic of China. A central oceanographic facility is planned for the very near future; its director will be Professor of Oceanography Tsu-You Chu, at the National Taiwan University. The functional divisions within the proposed facility will include the physical, biological, and fishery oceanography.

Hong Kong

Great ferment in Hong Kong's educational circles relates to the development of the Chinese University. This University is a new one, and its undergraduate programs will be comprised of a federation of three existing institutions–Chung Chi College, New Asia College, and United College. The Chinese University will consist of a central coordinating staff for all aspects of the new federated institution, which will develop and administer programs at the graduate level. Prospects for rapid growth of this new University are very good, for it will provide instruction predominantly in the Chinese language, as compared with the long established University of Hong Kong, where instruction is conducted in English.

Nepal

A major development in this little-developed and almost unknown country, opened to the outside world for only the last 15 years, is the development of Tribhuvan University, now with an enrollment of about 400 students. Several very small colleges, together with the College of Education and Trichandra College (liberal arts), have been combined to form Tribhuvan University. A new physical plant is being constructed just outside Kathmandu with financial assistance from the United States, Canada, and India. Facilities to support research and advanced instruction are non-existent at present, but several faculty members are enthusiastic about developing facilities for research, and about making time and funds available for this purpose. The government of Nepal currently is placing almost total emphasis on economic development, thus relegating other projects to lower priorities, notwithstanding urgent needs for development in most areas of public concern.

Malaysia

The University of Malaya in Kuala Lumpur is rapidly developing into a major institution. Many new facilities have been built and others are under construction. It is evident that the comparatively high standard of living and economic development of Malaysia, with the exception of the Borneo states of Sarawak and Sabah, should provide both good facilities and competent faculty at the University, thus opening the way for cooperation with American scientists on a basis approaching equivalence.

Potentially one of the best possibilities for scientific cooperation in Malaysia is provided by the remarkable Sarawak Museum in Kuching, developed by Tom Harrison. Appearing almost out of context in this comparatively undeveloped state, the Museum has exceptionally fine collections of native artifacts from an extensive area of Borneo, as well as other source materials on anthropological aspects of these rapidly changing peoples.

Singapore

Higher education in Singapore parallels rather closely that in Hong Kong. The University of Singapore, like the University of Hong Kong, is an English-speaking university. Except for a minimum amount of graduate work in the School of Medicine, almost no graduate work has been developed, and there are no research institutes.

Nanyang University, a new but rapidly developing institution, offers instruction in the Chinese language. Because of the predominantly Chinese population of Singapore, it is possible that Nanyang University will receive an increasing measure of support and become the main locus for cooperative projects with visiting scientists. The Nanyang faculty at present has its greatest strength in Chinese language and literature, but considerable thought has been given to the establishment of an institute for research on contemporary China.

Methods of Developing Cooperation with Asian Universities

Because of the uneven development of Asian universities, methods of implementing cooperative programs must vary among institutions as well as within different academic fields in a given institution. Apart from the simple and effective person-to-person cooperation which usually exists within scientific disciplines, there are other mechanisms which may be employed to develop institutional cooperation more effectively so as to involve a broader segment of the faculty.

For developing universities in Asia, a university-to-university association underwritten by adequate financial support over a sufficient period of time is perhaps the most effective way to aid and accelerate the total development of the Asian institution, as well as to enable the American university to achieve its desired level of cooperation. A university-to-university association would facilitate the implementation of long-range plans in a manner which would make it unnecessary for specific faculty members to give more time to the process than would be personally attractive and beneficial to them. Moreover, it would permit a succession of individuals to benefit from the international experience, because stabilization of the program is institutional rather than personal. For example, the development of a biology department in an Asian institution might become a project assigned to a biology department of an American university. Thus, departmental or institutional objectives can be achieved by utilizing a succession of individuals. An Asian institution could thus achieve its developmental objectives by obtaining the aid of a more developed institution, while simultaneously a succession of American scholars with interests in Asia could be given the opportunity to work and study in an Asian environment attractive to them.

Another mechanism for achieving long-range cooperation between Asian and American scholars, regardless of the state of development of the Asian institution, would involve transporting young Asian scholars to American universities for advanced study and research for a year or two. Upon returning to their home country these Asian scholars would function as permanent contacts for the American institution in which they worked. From the long-range point of view such personalized Asian contacts may be the most effective way to implement cooperation.

A time-tested mechanism for international cooperation is offered by the U.S.-Japan Cooperative Science Program, but it must be remembered that the effectiveness of this system of cooperation depends heavily on an equivalence of scientific sophistication, and thus is not a mechanism capable of wide use in Asia at this time.

In conclusion, I should like to emphasize that cooperative programs with Asian institutions in all areas of intellectual endeavor will be absolutely indispensable in future years. The release of intellectual energy through the expansion of educational opportunities for the immense Asian population will play an overwhelmingly important role in world affairs in the immediate future. It is imperative that we devise ways and means of cooperating with our Asian counterparts. Even though my Asian contacts were brief, I am convinced that most Asians seek and want our cooperation; and that we need theirs.

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*Vice-President for Academic Affairs, University of Hawaii.

WATER POLLUTION

Ernst S. Reese*

Water pollution: Is it inevitable, like death, and do we just have to live with it, or can we do something about it? This subject is exceedingly pertinent today because of the Water Pollution Control Regulations recently adopted by the state of Hawaii, the pending water quality standards currently being set for the state, and because, in my opinion, we of the academic-professional community have been as apathetic as the rest of the community toward the problem of water pollution.

There are a number of reasons for concern about water pollution in Hawaii. Let me quickly list them, and then take them up for further comment:

1. General apathy and lack of public interest and concern, perhaps due to ignorance, in spite of the newspapers.
2. An astonishing lack of concern, call it apathy, on the part of the academic-professional community.
3. Difference of opinion among the so-called "experts."
4. Resistance and obstructionism on the part of our business-industrial community, with the exception of the

Hawaii Visitors Bureau, which seems not to be concerned at all, one way or another. There has been little cooperation from the military, and in fact the Navy even wishes to treat Kaneohe Bay as an industrial harbor like Pearl Harbor.

5. The high cost of corrective action. To stop pollution is simply going to cost a lot of money.
6. The ultimate political nature of the decisions leading to curtailment and final solution of the problem of water pollution.

These do not add up to an impressive set of persuasive reasons for any politician to fight for legislation to control water pollution.

Let me elaborate on these points.

1. Let us examine public apathy. This can only be altered by a combination of enlightened aggressive leadership and intelligent news coverage. It is up to us, as members of the Academy, to help to provide a measure of both. Of course, a stinking polluted stream or bay will also arouse the public, but by then the damage has been done, and we either must live with the stinking stream or spend huge sums of money to try to restore it.

2. What about lack of concern on the part of the academic-professional-scientific community? Perhaps it relates to the fact that we all think we are too busy. Let me illustrate. Recently, over coffee, three colleagues and I discussed why one should take an active part in some aspect of community affairs. They criticized me for my role in the water pollution controversy. If I was so concerned, they asked, why didn't I actually start doing some research in this area.

The answer, of course, is that one's path of action is never clear, the decisions are always clouded and difficult. One often must decide among alternatives: to do nothing and stay in the Ivory Tower, to drop everything and start research in the area of water pollution, or to become involved as intelligent, interested citizens by writing letters, attending public hearings, just simply talking. Most of us do the first, that is, do nothing. We don't want to, or can't, drop everything in order to get involved in directly pertinent research. But we should accept the third alternative: get involved in a constructive way.

3. What about the differences in opinion among the so-called "experts?" Here there are two fundamental misunderstandings. First, pure clean water means different things to different people. To the sanitary engineer water is "pure" when it is colorless, odorless, and free of any pathogens. However, in the opinion of the aquatic biologist, such water may not be fit for anything to live in. Indeed, anyone who has kept animals in water from big city water systems knows that such water must be left to "condition" before even goldfish can be kept in it. Water may be heavily loaded with fertilizer substances which do not affect either taste, sight, or odor but, biologically speaking, such water may ultimately harbor a green scum of algae which chokes off all other forms of life, and in a pond, bay, or lake anaerobic conditions may develop at the bottom.

The second misunderstanding is that most of the work on water pollution and most of the existing data dealing with levels of dissolved oxygen and the like are for *fresh* water. Salt water is very different than fresh water, and an engineer simply cannot apply fresh water standards to salt water ecosystems.

Besides these two fundamental misunderstandings, the overall lack of knowledge, in marine situations and especially in tropical marine ecosystems, adds to the confusion and provides room for doubt and innuendo. Even where a considerable body of information is available—for example, for Lake Mendota in Wisconsin, which has been studied perhaps more than any other body of fresh water—efforts to carry out "controlled pollution" have been disastrous. I am told that Lake Mendota is badly polluted, especially during the late summer months when warm temperatures, high level of fertilizer substances, and maximum solar radiation combine to turn the Lake's surface green with a scum of algae.

To further illustrate the lack of knowledge, consider two possibilities. First, levels of dissolved nutrients, such as phosphates and nitrates, may not be indicative of the amounts of these substances in the ecosystem. Large amounts may be tied-up in the standing crop of phytoplankton. Essentially nothing is known on this point. Second, nutrient substances *per se* may not be the factors controlling the eutrophication of the ecosystem. The most important factors may be still unknown trace substances, which may have their origins on land, and hence there may be an unsuspected relationship between eutrophication and drainage from an adjacent land area.

Finally, there are a few persons among us who simply argue that pollution will occur anyway due to uncontrollable causes, such as run-off of lawn fertilizers and insecticide sprays. This is true unfortunately. But it has not been demonstrated that this alone will cause serious water pollution. Besides, it only makes sense that we must treat the "patient" as best we can; we *must* try to curb the known and controllable sources of pollution, such as sewer outfalls. We must do this, if for no other reason than to "buy time" to retard or slow down pollution. Time is on the side of technology, and soon it will become commercially feasible to convert most of the pollutants, which we are currently throwing away, into usable products. Most certainly, organic wastes can be reclaimed for use as either feeds or fertilizers. Pilot studies on this aspect of the problem are underway throughout the country.

It should be emphasized, therefore, that the differences of opinion between experts here in Hawaii is based largely on a lack of understanding of the marine ecosystem by persons trained primarily in two quite different areas. The differences are not pertinent to the problem of the pollution of marine waters. Here we must take action on the basis of the best information that is available. Mistakes will have to be corrected as they become evident. But to sit back and say "why bother?" is really wholly irresponsible.

4. In my opinion the business-industrial community has taken an obstructionistic attitude toward trying to establish legislation with respect to water pollution. This impression was gained by attending the various public hearings called during the past year, first by the state department of health in establishing the Water Pollution Control Regulations, and subsequently those called by Mr. Dodge on the establishment of water quality standards. Surprisingly, the Hawaii Visitors Bureau representing the tourist industry has not participated in these hearings or taken any interest in the problem of water pollution in Hawaii. This is surprising because it is not outside the realm of possibility that one day Waikiki Beach would have to be closed because of water pollution. The closing

of beaches is occurring today in a number of fashionable Mediterranean resorts during the late summer months. It has also been disconcerting to observe the attitude that the military, particularly the Navy, has taken. This is all the more surprising since the federal government, acting through the FWPCA, has instigated state action throughout the nation.

One would like to think that industry would realize the inherent long-term danger in environmental pollution and would take a leading and cooperative role in helping to develop legislation and procedures for curbing water pollution. Instead, "big business" seems to wait until "big government" comes along and makes business do something. Then of course the cry will go out that government is overstepping its rights. And yet, here locally our big business could play an important role in working with our state government to develop a constructive program which would keep the influence of federal government to a minimum. So far there has not been much evidence of this kind of cooperation. However, now that Mr. Dodge has proposed a temporary sub-class of water usage (subclass I, receiving waters for agricultural waste waters containing soil particles), we can be optimistic that the sugar industry, in particular, will not violate this 5-year period of grace and trust, and will aggressively seek solutions to their water pollution problems.

5. The fifth point deals with the high costs of correction. Obviously, here again we are faced with a decision of alternatives: either the community is willing to spend the money, or it can look forward to living with pollution—which may mean loss of business and property values, as well as represent a health hazard. The choice should be a simple one. However, I am not sure that any city and county officials are willing to agree that, for example, $5 million should be spent to save Kaneohe Bay. This figure is based on estimates published in the Honolulu Advertiser in September 1966, by Acting Chief Engineer W. T. Matsumoto, for extending sewer outfalls from the existing Kaneohe sewage plant and the plant being constructed in Kahaluu. The outfalls would have to be extended into the sea outside of Kaneohe Bay. It is my opinion that such outfalls represent the only solution to the pollution problem in Kaneohe Bay. There must also be better control on bulldozing large tracts of land which are left exposed to soil erosion for long periods of time. Silting of the reefs, resulting from severe soil erosion, has a tremendously detrimental effect.

The imminence of the danger is made clear when one realizes that the existing Kaneohe sewage treatment plant serves about 4,000 homes and dumps about 1.5 to 2 million gallons of treated sewage into the bay each day. In February 1967, the Honolulu Star Bulletin reported that the City and County of Honolulu was planning to expand this plant to take care of another 6,000 homes. This additional sewage, plus an unknown amount from the nearly completed Kahaluu plant, will certainly lead to an eventual destruction of Kaneohe Bay as one of the state's prime recreation areas.

Let us look more closely at costs. Even if the cost of construction of the outfalls should reach 10 million dollars, all of this money need not come from the city and county. For any pollution-abatement project which is approved by the FWPCA, the federal government will pay 55 per cent of the costs, the state is obligated to pay 25 per cent, and the city, only 20 per cent.

The question can be raised: Is it worth the expense? Perhaps a counter-question is appropriate here: Can you put dollar-and-cents evaluations on natural beauty and outdoor recreation—on fishing, boating, waterskiing, skindiving, and the like? But if you wish to think in terms of dollars and cents, think of the value of the bay in terms of boating and fishing hardware, or its potential for tourists as the only place on this island where glass-bottom boats can take visitors to see coral gardens, or the opportunities derived from the research facility at Coconut Island, the University's Hawaii Institute of Marine Biology. Think of the money being spent to develop a number of beach parks on the bay and of the real-estate value of bay-shore properties.

6. Finally, of course, there is the political question. Ultimately the politicians are going to make the decision. Too often we complain bitterly about the decisions they make. But how often do we make our feelings and ideas on the subject known to them in advance, in a constructive way? Too often, I think, the politician gets only letters of a negative sort; if one cares enough to complain, then one should also care enough to write a constructive letter. If a man gets a number of sincere letters expressing concern and making helpful suggestions as to courses of action to take on a problem, he will be influenced by these letters and take a greater interest in the problem, knowing that his constituency is also interested. Hopefully, he will participate in developing legislation to solve the problem. It might seem like a cliche to say that for enlightened and responsible government you must have enlightened and responsible citizens, but it really is as simple as that. I am suggesting that we in the academic-professional-scientific community have *not* been living up to our side of the bargain. We, too, must become responsible members of the community.

What specifically do I think we should do here and now? Each of us should consider getting involved, getting concerned. If you feel that water pollution is important to the welfare of this community, then write letters or give some talks, or even just discuss it with your family and friends. Try to combat the apathy. If you are really concerned, or if you can create concern in a group or club to which you belong, then attend public hearings at which you can make statements. Letters to your elected representatives may insure that they too will attend the hearings. You can be sure that various special interest groups will make statements, probably seeking special considerations, some way to maintain the *status quo* a bit longer. You will probably hear lawyers from industry and sanitary engineers from the Navy say that costs are too high or that the standards are not "realistic." But how many persons or representatives of groups will get up to say that they support the standards, that they feel that water pollution must be stopped in Hawaii? It will be interesting to know the choice of this Academy as an organization, or of its members as individuals.

Let me conclude with a few words on developments in Hawaii regarding water pollution in the past year.

First, and extremely important, are the Water Pollution Control Regulations (Public Health Regulations, Chapter 37) which were adopted by the state department of health on May 20, 1966. These regulations were "hammered out" under the very capable leadership of Dr. Leo Bernstein, then director of health, and B. J. McMorrow, executive officer, Environmental Health Division, during a series of public hearings. These regulations provide precise definitions of "water pollution" and "wastes":

(a) "Water pollution" means

(1) Such contamination, or other alteration of the physical, chemical or biological properties of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or

(2) Such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the State,

as will or is likely to create a nuisance or render such waters unreasonably harmful, detrimental or injurious to public health, safety or welfare, including harm, detriment or injury to public water supplies, fish and aquatic life and wildlife, recreational purposes, and agricultural, industrial, research and scientific uses of such waters.

(b) "Wastes" means waste materials of any kind, whether treated or not, and whether animal, mineral or vegetable, and whether liquid, gaseous, radioactive, or solid, including sewage and industrial wastes, but excluding storm water runoff, which cause any waters of the State to be polluted.

The regulations also provide for a "Master," appointed by the director of health, who will establish uses and standards of quality for all waters of the state, both fresh and salt, "such as to protect the present and prospective best use of each water area."

There are four permanent classifications of marine waters, based on best use, from waters set aside for research, fish culture, and conservation, to waters best used as commercial harbors. The degree of pollution allowed in each area changes accordingly. A temporary class is also proposed to allow the continued discharge of agricultural waste waters in certain areas for a period of five years. It is hoped that by that time technological advances will permit curtailment of this form of pollution. A series of basic standards have been proposed, along with a number of specific water-quality criteria. These include: bottom and reef deposits, coliform bacteria, acidity, nutrient materials, dissolved oxygen, dissolved solids, and turbidity.

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*Associate Professor, Department of Zoology and the Hawaii Institute of Marine Biology, University of Hawaii.

DIMENSIONS OF NATIONS

Abstract

R. J. Rummel*

During the last decade, developments in data availability, data collection procedures, methodology, and computer technology have caused a revolution in research in the field of international relations. The study of international relations is now moving very rapidly from an intuitively-based and journalistically-written type of approach to a science based on empirical findings, systematically organized according to some technique of analysis and of rigorous theory expressed in the language of mathematics.

The Dimensionality of Nations Project, which began in 1962 with a National Science Foundation grant, reflects this revolution. Various methods, like factor analysis and mass data analysis through computers, have been employed by the project in an attempt to define and measure the major dimensions of nations.

This attempt has involved two phases. The first phase has been concerned with delineating the major attribute-dimensions of nations. The dimensions to emerge so far are economic development, size, political system, density, Catholic culture, foreign conflict and domestic conflict. These dimensions are replicable and reliable, in that they have been found in other studies by different investigators using different data for different years.

The second phase of the project has tried to measure the dimensions of behavior *between* nations. In the first phase, we were concerned with the attributes, you might say the personality, of a nation. In the second phase, we are concerned with the sociology of national behavior: the interaction patterns between nations. The findings so far are that perception, transactions, international organizations, official conflict behavior, ideology, and diplomacy are major dimensions defining this interaction.

A theory has been developed, called a *social field theory*, which can interrelate the two phases of the project. The theory is that the attributes of nations form a linear vector space distinct from a linear vector space defining the behavioral patterns of nations. The attribute vector space is connected to the behavioral vector space by the distances between nations. Within the attribute space, we can define Euclidean distance vectors. These distance vectors act as force vectors within the behavioral space of nations. The location of a pair of nations on their behavior dimensions is a resolution vector of the distance between these nations in the attribute space defined by their attribute dimensions.

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*Visiting Professor of Political Science, University of Hawaii.

THE IMPACT OF COMPUTERS ON SCIENCE

Richard A. Barkley*

By way of introduction, let me tell you a story which is probably too good to be true. The Prussian Army is said to have classified its officers into four categories: brilliant and lazy, brilliant and energetic, stupid and lazy, and stupid and energetic. The brilliant and lazy were the most valuable, because they knew what should be done and got others to do it; they made the best generals. The brilliant and energetic knew what should be done and did it; they made good staff officers. The stupid and lazy were of no particular value, but they could be put to work fairly safely. Finally, the stupid and energetic, who applied their energy to making mistakes, were considered dangerous and had to be weeded out.

Let's see what counterparts to the four categories of Prussian officers we can find in today's world of science. Let me be a bit generous and say that my scientific colleagues are all brilliant and lazy, although actually quite a few of them are very energetic. At the other extreme, the computer is the epitome of stupidity and energy, as you may already know if you have done any computer programming, or have tried to straighten out an account which a badly programmed computer has tied into knots. This brings us to the brilliant and energetic category, where I will place computer programmers. Their job is to teach computers to behave as if they were brilliant, without sacrificing too much of the computer's energy. As to the stupid and lazy, there is some evidence that they may have helped design certain computers, which are no longer on the market.

Scientists have been around quite a bit longer than computers, and I suspect they have not changed very much since the first computers came on the market in 1950.[1] Science at its best is a highly personal and individual activity which makes use of intuition as well as logic to arrive at new concepts based upon insufficient and conflicting data. This process is very poorly understood, but it does seem to demand creativity of an order well beyond that of which present computers are capable. But science is more than new concepts. New concepts must be tested by formulating hypotheses which are capable of being supported or disproven through experiment. Experiments must then be designed and carried out to test these hypotheses. And data must be collected, reduced, analyzed, and applied to the problem. Finally, if the results are adequate, the entire sequence must be written up for publication. Once this is done, the research scientist turns back to the first step and repeats the cycle, while the applied scientist and then the engineer pick up the thread which was spun by the research scientist and weave it into the fabric of technology.

How much direct influence has the computer had on all of these procedures? At the highest creative level, none at all. Formulating hypotheses, the next step, could probably be done today in fields like organic chemistry—which are well-structured—by a properly programmed computer, using the tools of symbolic logic. Design of experiments is quite commonly done with the aid of computers, and in many cases the experiment itself is performed under the control of a computer which reduces and analyzes the data during the experiment. As examples, I am thinking of studies of the structure of complex protein molecules with X-ray crystallography, some of the elegant experiments of high-energy physics, and the very public experiments conducted by NASA on the moon. There are even computer programs which will perform mathematician's "experiments," by proving mathematical theorems,[2] much as you and I were asked to do when we studied Euclid's geometry in school. As to writing up the results, at our Laboratory, for some publications we do use graphs prepared entirely by a computer-driven plotter. I know of no instance where a journal publication was written entirely by a computer, although some papers may read as if they were.

It is in applied science, however, and even more so, in engineering, that today's computer comes into its own. It is a powerful tool for performing exacting and tedious jobs, such as the computations involved in designing bridges, ships, and aircraft. Engineering drawings are prepared by computer in many shops. Meteorologists use forecasts prepared entirely by computers for the Northern Hemisphere. The computer does the job in an hour or two. I doubt that such numerical forecasting computations could ever be done manually, because of errors which occur when people do the calculations; but if it could, it would take a large group of technicians more than a year.

Engineers, then, make the most extensive use of computers, followed by the applied scientists. On the whole, scientists engaged in basic research tend, I think, to make the least use of computers, although there are a large number of important exceptions. It is no accident, however, that some of the outstanding exceptions occur at MIT, where basic researchers work side by side with applied scientists and engineers.

The relative degree of creativity and originality required in engineering, applied research, and basic research is only part of the reason for these differences in the impact which computers have had on physical science. Another related reason can be phrased in a rather outrageous but instructive way: the basic researcher is in the business of making mistakes, while the engineer is in the business of avoiding them. Applied science lies somewhere between.

The engineer's interest in avoiding mistakes is obvious. He tries to deal in certainties, using the best understood materials and techniques, in the best possible way, to make sure that his building will stand, his ship will float, and his airplane will fly. He is also interested in doing all this at minimum cost. For him, mistakes can be expensive; for his clients, they can be fatal.

The basic researcher's interest in making mistakes is less obvious, but quite real. Instead of dealing with certainties, he deals with, and tries to explore, the unknown. And he does this mainly by a process of elimination. Any number of explanations can be advanced when one tries to explain new phenomena; the researcher's job is to devise experiments which eliminate as many false guesses as possible.[3] He sets up hypotheses, preferably of the "either-or" type, and then tries to design an experiment that will determine conclusively which of the alternatives is mistaken. It is this kind of controlled mistake I referred to when I said that basic research is in the business of making mistakes. It does so in order to learn from them.

From this rather unusual point of view, the computer's virtue and major flaw is the fact that it makes almost no mistakes at all. This is ideal for the engineer, which explains why he likes to use computers. A tool which does not make mistakes is just as useful to the scientist, of course, and he uses computers as often as he can to save himself time and trouble. But, unlike some engineers, he is not in partnership with his computer, in any sense of the word. At least, not yet.

Which brings me to the major theme of my talk today. I believe that the true impact of computers on science—basic research, if you prefer—will result from our ability to make the computer behave as a partner instead of as a tool, as an active participant instead of as a sort of electronic slide rule. [4]

Let me give you some examples of this type of partnership as it exists today. Many of the theories of physics can be stated in extremely general and powerful terms by means of mathematical equations. Because these equations are so general, one set of equations can be used to examine a large range of problems. The equations of hydrodynamics, for example, describe every possible type of motion which a fluid can undergo; the transmission of sound or pressure waves; the pulsations of a raindrop as it forms in a cloud, falls through the air, and finally hits a surface with a splash; the response of the sea surface to a storm, including the movements of waves from the time they are generated until they reach Waikiki to break up in foam. These equations can also describe all the movements of the atmosphere, or, if we include the effects of gravitational attraction in the proper manner, they can describe the vast fluid movements of a galaxy. Unfortunately, although these difficult equations are capable of doing these things, we do not know enough about the methods of solving them to obtain solutions for any but the simplest cases in the classical analytical manner. Nor do we always know enough about the physical systems which the equations represent to be sure that our mathematical solutions are correct. It has been known for a long time that we can solve equations by brute force numerical calculations when more elegant methods are lacking, but the brute force required is usually so great that it might have taken years and years of manual computation to arrive at a solution. But now we have just the kind of help required for this job: a patient, vastly accurate, and extremely fast machine, the computer.

An experiment conducted by Shannon and Fromm of the Los Alamos Scientific Laboratory showed a beautiful example of such a brute force solution to the equations of hydrodynamics.[5] Every detail of water flowing over a cliff was examined, its speed at every point in space and time, the internal pressure distribution, even the details of the turbulence at the bottom were examined by making the computational resolution much finer than the structure of the turbulence—at considerable extra cost in increased computer time. Similar solutions have been obtained for drops of water splashing on water, for breaking waves, for the transfer of heat from an obstacle to water flowing past it, and a number of other related problems.

There are two points to note: First, every variable is under control in such a computer experiment. One could, for example, change one number in a program and thus solve this problem for the case where there is no gravity, as in a satellite, or for the case where gravity is 10 or 1,000 times as great as it is here on earth. Try that in the laboratory! Or, make another change in a single number, and one could change the viscosity or density of the fluid from that of water to that of gasoline, tar, or any other possible or impossible fluid.

The second point to note is the fact that such computer experimentation, which is called "modeling," [6] is exorbitantly demanding for the scientist and for the programmer. For the scientist, because he has to know what he is doing, to a degree which is almost incredible; and for the programmer, who has to get every instruction, every comma and decimal place, every last detail, exactly right. My assistant and I have worked, sporadically, on a similar fluid flow program for something over a year, and I speak from painful experience. Not only do the equations have to be exactly correct, and in terms the machine can use efficiently, but every detail of the boundary and initial conditions has to be worked out, and the program has to be completely consistent internally. Simply stated, the waterfall problem had to be set up in such a way that the amount of water entering equals, to perhaps 6 decimal places, the amount accumulating inside the frame plus the amount leaving.

Perhaps I have belabored the point somewhat, but I wanted to make it as clear as possible that the computer promises to force us to refine our thinking processes to a degree which itself amounts to a revolution.

A concrete example: Kepler set out in 1601 to compute the orbit of Mars.[7] He bet that he could do it in one week. It took him the better part of four years. And 900 pages of his notebook are devoted to the calculations. About three years ago, Gingerich set up Kepler's procedure for solution on a computer. It took a month or so to get the problem programmed, and eight seconds to solve it. In the process, Gingerich found that Kepler had begun his work by making mistakes in three out of his eight initial values. He also found that the computer solved the problem in nine iterations, whereas poor Kepler had to go through 70 iterations before he got consistent values. Why? Because he made mistakes, which produced errors in his answers, which had to be smoothed out by several added iterations each time. Fortunately, Kepler had chosen his method well, so that it was able to converge on the correct or nearly correct values. It is interesting to speculate about the results if anyone less meticulous than Kepler had tackled the problem. The moral, if there is any, is that being human, we make mistakes, and that there must be quite a number of human mistakes buried in the bones of present-day science which we know nothing about. In the case of the viscous fluid flow program, I can testify that it is literally impossible to check the computer's results by hand, because it is impossible to perform the required several thousand calculations without making errors of the most trivial kind, but entirely significant enough to ruin the manual results. They will never agree exactly with those obtained by the computer except by merest chance.

In fields which are less mechanistic than hydrodynamics, it is still possible to perform experiments with a computer. Holling, for example, uses such experiments to study predator-prey relationships.[8] He does this by breaking down the patterns of behavior of his idealized animals into well-defined units, expressing by a simple equation the way in which each part of the total behavior-pattern responds to changes in other factors. He allows the computer to keep track of these parts, and adds them together under various sets of rules, to synthesize a total behavior-pattern. To simplify somewhat, consider a predator which starts to search for food when it gets hungry, detects its prey at some given average distance, has some postulated probability of catching an individual prey organism in each attempt, takes a certain period of time to eat its prey, and then another period of time to digest it and become hungry again. Each step–digestion, search, chase, capture, eating, and digestion again–takes an amount of time which varies with such factors as the prey density, the relative size of predator and prey, and the probability of capture per attack. All of these can be programmed, under a variety of assumptions, and the total time for each cycle can then be calculated. Under certain assumptions, even this simple model predator can show considerable changes in behavior in response to changes in prey density, which can be held fixed, or allowed to drop with predation, or to decrease due to natural mortality plus predation, and so on. In Holling's case, one can even say that the computer program *is* the theory. Backed by appropriate experiments–which the model helps define, by the way–such models can be powerful tools for increasing our understanding of the world around us.

To summarize, man-machine partnerships can help to supplement man's creative abilities by helping him to explore his problems in depth, from various angles, weighing alternatives in terms of their consequences, at vastly greater levels of complexity and detail than ever before. Conventional uses of computers as tools will most certainly continue to grow, particularly in the more applied areas of science. But the real impact is yet to come, and it should see man concentrating on what he does best, freed by the computer from the obstacles and drudgery of mental labor.

What can we expect will come of this? First, let us look at our prospective partners, and then at our problem areas, to see how we might put them together.

In studying a typical modern computer center layout, we note that the heart of the computer, its central processor and memory is only a small part of the whole. All the other units–magnetic tape drives, card-reader and punch, printer, typewriter, and video screen–are input/output devices.

Man is rapidly becoming the single dominant factor in his environment, which he understands only in a fragmentary way. With the power of large computer complexes, large libraries immediately available for reference, and with field data collected in the light of preliminary model experiments, our knowledge of first, second, and higher order interactions may make it possible to consider entire complexes of problems together. When a farmer fertilizes his fields, he may do so knowing that x pounds of fertilizer per acre may produce optimum yields this year, but suboptimum yields for two following years, a 25 per cent decrease in the population of one plant pest, increase in the rate of development of one species of weed but inhibition of three other species; that it would create a requirement for certain feed supplements for the animals he plans to feed with his crop, and, with more accurate weather forecasts, or even partial control of weather, he can even select from a choice of optimum dates for his operation. Hundreds of thousands of similar decisions, transmitted (without information which the farmer regards as privileged) to central files, and correlated with other pertinent data, would result in much improved crop forecasts, stabler market prices for crops and animals, changes in published figures for demand for transport six months hence, and even in changes in the timing of traffic lights at proper times of the year to allow for changes in traffic resulting from the flow of farm products to the market. Far from being rigid, this system could be revised on a daily basis, allowing for a variety of emergencies and unforseen circumstances.

Such a system would respond to individual requests for information and action. In planning a trip, for example, one could specify the starting and end points, and allow the system to present a set of optimum routes and timetables, complete with reservations–all of which could be changed hour by hour if need be. Work could be performed anywhere, with the results transmitted anywhere else, to wait until they are needed, or to call for immediate attention if that is what is required.

In short, the impact of the computer on science, and on man's daily world, will almost certainly be greater than the cumulative impact of everything which has gone before, from the industrial revolution to the discovery of atomic power, because of the generality, speed, and accuracy of the computer. The only real limit in sight is that imposed by man's wisdom and imagination, because in the last analysis, nothing can be done by any computer which has not originated in man's mind. And the computer will impose a discipline of its own on man's thinking, which will be stretched and given new perspective by the man-machine partnership.

Wise legislation will doubtless be needed to protect our rights and our privacy, and we may even see a new lay priesthood arise from those who can communicate with machines, a priesthood sworn to silence, to keep from revealing what they, like doctors or lawyers, may learn in the performance of their duties.

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*Oceanographer, Bureau of Commercial Fisheries Biological Laboratory, Honolulu.

EARLY BRONZE IN NORTHEASTERN THAILAND

Abstract

Wilhelm G. Solheim, II*

This report is the first announcement of unexpectedly early dates for the working of bronze in Southeast Asia. Various artifacts indicating the local working of bronze were discovered in a stratified site in northeastern Thailand in early 1966. This excavation was made in the site of Non Nok Tha, about 50 miles northwest of Khon Kaen, during the third season of the Fine Arts Department of Thailand–University of Hawaii Archaeological Salvage Program in northeastern Thailand, supported by grants from the National Science Foundation of the United States.

The local working and use of bronze, unaccompanied by any indications of iron, is shown in Layers 20 through 13 at Non Nok Tha. Two carbon-14 dates from Layer 19, from two different squares, are 4,120±90 B.P. (GaK 956) and 4,275±200 B.P. (TF 651), or corrected dates of 2,290±90 B.C. and 2,325±200 B.C.

Heretofore it has been considered that "Dongson" bronze was the first bronze working in Southeast Asia, variously dated at around 300 B.C. by Karlgren or between 750 and 1,000 B.C. by Heine-Geldern. The origin of the use of bronze in Asia has been considered to be in Shang China at around 1,500 B.C. These two new dates would indicate that bronze was being worked in northeastern Thailand 800 or more years earlier than previously was thought for all of East Asia, and would make it as early there as in the Harappa Culture of the Indus Valley in India.

*Associate Professor of Anthropology, University of Hawaii.

SCIENCE AND NEWS

Helen Altonn*

Trying to hurdle the barrier of communications that separates the layman and the scientist is not an easy task. Many scientists know and care little about newspapers and the demands of writing for mass readership. Many science writers know little about science. Confronted now with an incredible burst of scientific knowledge and technical progress, permeating all corners of society, scientists and science writers must find a common meeting ground.

There are many highly competent, skilled scientific writers, equally at home in the realm of science or newspapers. But the bulk of reporters wrestling with science news are like me: reporters who fell into it accidently, many of us are doing it part-time.

We are, nevertheless, anxious to do the best possible job, to be fair, objective, and accurate. We are curious and interested, seeking to enlighten and–yes, even entertain–the public, with scientific events and endeavors.

The challenge of translating the explosive developments of science in recent years is mostly that of the newspapers, news magazines, and wire services. TV also sheds some light on science, but it is still mainly an entertainment medium. The importance of telling the public what you are doing–what is happening in science–cannot be over-emphasized.

I like to think that I am writing for a slightly larger audience than the scientists themselves, that just a few persons who know nothing about science might be drawn to an occasional scientific story–just for fun, if not for information.

People should know about the scientific findings and technological changes influencing and altering their lives. They should know how their money is spent by government, whether for education or science. How well they are informed is a responsibility of mutual concern to scientists and the communications media–primarily, the press.

It has been, I'm afraid, an uphill battle for the science writers. Fortunately, most scientists now realize that the progress of science depends on an understanding, sympathetic public. In the final analysis, it is the public that dictates the direction of the grand projects, such as conquering cancer, traveling to the moon, or even digging a mohole.

It seems very strange that newspapers are bombarded with material, calls, and people coming into our office, all wanting to get something in the paper. They come, that is, from all parts of the community, except science. Rarely does a scientist offer me a story. Those who do, approach with temerity. Yet, I cannot recall ever being flatly rejected when I have pursued a science story. I have been welcomed warmly, encouraged, and led by the hand by many scientists. This is not to say that I have always landed my story. I have been turned away for a variety of reasons, some understandable and some not.

I never cease to be flabbergasted, for instance, when I am asked to hold up a story because the local publicity might jeopardize a federal grant.

Although I have never encountered it directly, I also understand some scientists prefer to have their work appear in a scientific journal rather than in the newspapers.

Victor Cohn of the Minneapolis Tribune, raises the point that scientific news sources are being choked off in certain government agencies. He cites examples of controlled news and outright censorship. And he adds that universities are not above news-managing. He reports that at three major universities he ran into rules where no professor could speak to a reporter without administrative clearance.

I have yet to experience this situation at the University of Hawaii, or at any other government agency in Hawaii concerned with science. And I hope I never do, for it is the most flagrant violation of freedom of the press, freedom of speech, and academic freedom. I am quite aware, however, that politics has penetrated even the ivory tower of science. Where the legislature or Congress may be involved in obtaining and accounting for scientific funds, all of the facts of a story may not be accessible to a reporter.

The Mohole is a prime example of the kind of science story marking our time—overlapping government, politics, and economics, as well as basic science and engineering. With so much at stake, at so high a price, there is bound to be a considerable flurry of activity and decision-making behind closed doors. We do not condone this. We feel, as citizens, as well as reporters, that we are entitled to the truth. We feel we have a vital and a valid function as a public watch-dog.

Science writers have witnessed some of the historic events of the past quarter-century. Still much of what science writers across the nation do tends to be frivolous. We skim the froth from the surface of scientific effort, disregarding the more complex, more valuable, basic research. Virtually no attention is given to the life sciences and social sciences. Cohn says "we are not truly covering science and technology and its huge, terrifying and inspiring impact. We are missing too many of the big stories of our time for daily preoccupations with trivia."

The Star-Bulletin has three reporters dipping into science—one purely for medicine, another for space. And all non-medical, non-space scientific things fall onto my desk. So far we have gotten along pretty well—the scientists and I. But occasionally it's a struggle to the last word.

First of all, we have a language problem. And secondly, we don't always see eye-to-eye on what constitutes a news story. What a scientist feels is crucial information may well be—for a technical journal. But not for popular consumption. Needless to say, if the story cannot be presented in terms the reader can understand, there is no point in wasting valuable newspaper space.

Now, what about the question of sensationalism? Some scientists apparently shun newspaper reports of their work, fearing it will be sensationalized. But much of science today is sensational! Why must we serve it to the public in a wrapping of colorless ponderous words? I do not mean that we should distort a story, or blow it out of proportion. Simply, that we should put it in its best dress.

Reporters often have little time to comprehend and compress a mass of complicated material into a news story. They work within space limitations. Mistakes do occur in such a process. They are not always the writer's fault. A story moves through dozens of hands, from the reporter to the city desk, across the copy desk, and then to the composing room where it ends in type. Changes may be penciled in along the way, in an attempt to clarify. They may occur inadvertently, through typographical errors. Often stories are cut, once in a while, hacked to death, to fit available space.

There is danger, at the outset, in reducing intricate research matter into layman's language. The use of general, rather than specific, terms may significantly alter the tone and interpretation of the work. Because of this, I try to double-check my copy with scientists when time permits. I have been surprised at how few changes they suggest. When we do clash over the handling of the material, we usually are able to work out a compromise. I cannot recall ever having to spike a story because of differences that could not be smoothed out.

You have probably heard that newspapers aim their writing at an eighth-grade readership level. Way back when, that was the case. But this is certainly an antiquated standard now. I know simply from the Hawaiian Science Fair that today's eighth-graders are much sharper than I am about science. We must bear in mind that science education has galloped ahead as rapidly as science itself. We cannot, must not, write down to the public. Nor can we afford to be casual and offhand in using the tremendous flood of new scientific terms—and even some of the old ones.

Frank Carey, prize-winning Associated Press science writer, observed, "I think our function and our duty is to inform the public as to what's going on in the world of science and medicine—and to make sure we cover all the bases. This includes tackling and trying to interpret as objectively as possible all the issues involved in the big scrapes such as smoking and health, fluoridation, medicare, and fallout from nuclear tests."

There is something more we can do, he adds. And that's the transmission of some of the excitement, drama—yes, even the beauty and wonder—of science and research to the reader.

The newspapers in Hawaii are anxious to bring the scientists and public together. We must try to keep the people of our state aware and informed of scientific developments. This is our challenge. And our obligation.

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*Science writer and reporter for the *Honolulu Star Bulletin.*

THE INTERNATIONAL HEALTH PROGRAM OF THE COLLEGE OF HEALTH SCIENCES AND SOCIAL WELFARE

E. Voulgaropoulos*

The term "international health" suggests the most varied of all activities. If we consider, however, that international health activities are those which involve participation by individuals, groups, or agencies from more than one country, we find that those earliest recorded were in the days of ancient Greece and Rome. Interest in international health rose in the late 19th century and became pronounced particularly after World War II.

The international health activities of the University of Hawaii involve the four autonomous components of the

College of Health Sciences, the School of Medicine, the School of Public Health, the School of Nursing, and the School of Social Welfare. In addition, close cooperation is maintained with the Institute of Technical Interchange of the East-West Center, which is heavily involved in the training of overseas personnel.

Through the International Health Committee, which is composed of one member from each of the abovementioned units, an attempt is being made to coordinate and guide the development and implementation of the University's international health activities. Each of the schools has developed separate international health programs within the overall guidelines, which often involves participation of several or all of the Schools.

The purpose of the international health program at the University of Hawaii is three-fold:

1. To serve as an academic center of regional significance for training and research in health and related fields for the communities of Asia and the Pacific.
2. To serve as an agency for the planning, consultation, and implementation of various health programs in the communities of the Pacific and in the countries of Asia.
3. To provide a pool of international health experts to contribute further to the development of these communities and countries.

The international health program of the School of Public Health is deeply committed to a dual philosophy of training and service, and offers unusual opportunities in both of these areas.

The School offers education and training of several types. Academic work in the School of Public Health is presented only at the graduate level; students holding baccalaureate degrees and with a background in health-related fields may qualify for admission. Students in international health are required to complete courses in such subjects as public health organization, administration, epidemiology, environmental health, and biostatistics. Their studies also include special classes and field work in international health.

The faculty of the School is complemented by consultants and guest lecturers from Hawaii and the mainland. Visiting professorships bring international health professionals from Asia and the Pacific. A full exchange program will be arranged eventually, with resident faculty from the School going as visiting professors to schools abroad.

An important concept running throughout all the activities of the international health program may best be termed "manpower cycling." In this planned program, qualified persons are trained, learn in-service, acquire further experience, render professional service, and ultimately train others. Students, being matured experienced persons already committed to and involved in public health careers, become an integral part of the manpower cycle and participate actively in the program projects. Thus they further their education with *in situ* experience and render professional services as well.

To meet the professional and educational needs of public health workers in developing nations who require training but who have had the previous academic opportunities, the School offers a program to admit carefully-selected people with such backgrounds on a provisional basis. On completion of the course they will be granted a certificate of attendance, depending upon their performance. Students are considered individually and every effort is made to meet their needs.

Training for people in the Peace Corps and in the Agency for International Development has been undertaken to prepare health workers and others for programs in Viet Nam and the Trust Territory of the Pacific. Other training projects are under consideration for Western Samoa, Tonga, and other parts of the Pacific.

Facilities for cooperative affiliations in other countries where faculty can be assigned for individual research or for supervising the training and research of students are being developed in a number of Pacific and Asian countries. This research of faculty and students, insofar as possible, is planned in those subjects which could lead to practical and realistic solutions of health problems in developing countries. These activities will be closely related to the objectives of the international health program and in many cases can be implemented by its operating arm, the Field Programs.

Field programs of the School of Public Health are carried on in cooperation with the School of Medicine, School of Nursing, and the East-West Center. At present several programs are underway. The Post-Graduate Medical Training Program for the Ryukyu Islands is designed to develop and conduct a post-graduate medical education and research program for house-officers and physicians in hospitals located in the Ryukyus, accomplished by means of advice, instruction, and technical assistance.

Although there are baccalaureate opportunities in Okinawa, those interested in advance education must study abroad. Most prefer to pursue medical studies in the cultural hierarchy of Japan, but the strongly competitive residency policies in Japan rarely accommodate the Okinawa physician. The Okinawan student returns to the Ryukyu Islands as a qualified general practitioner but ill-equipped to establish in-country programs and facilities. Such programs within the country are necessary to interrupt the chain of exportation of the islands' most promising physicians and educators. At the Central Hospital of Okinawa, departments of obstetrics, pediatrics, pathology, internal medicine, surgery, and surgical specialties are being developed and directed by qualified American specialists. Other personnel in the departments are Ryukyuan physicians, most of whom have received their medical training and degrees in Japan. As the Ryukyuan physicians develop familiarity with departmental administration and gain accreditation in academic management, they will replace American specialists and assume the direction and leadership of their own operation. At such a time, the American contingent would disappear from the program. Although this program requires the participation of professional members from the entire College of Health Sciences, it is directed primarily by the medical school.

The Peace Corps Health Program for the Trust Territory of the Pacific has been designed to cope with problems in transportation, communications, and food-protection. Micronesia is a world of atolls and tiny islands separated by a vast sea. These conditions in many ways impede the promotion of health in the community. The international health program of the School of Public Health is providing professional support and program planning-training-implementation and evaluation in public health for 110 Peace Corps volunteers in Micronesia. These volunteers are engaged in a number of activities which complement the work of the Trust Territory department of health. Registered nurses, licensed practical nurses, X-ray technicians, laboratory technicians, and pharmacists work primarily at the six district hospitals. Seventy-one health generalists are working with Micronesian health aides in the outer-islands areas of each district. A census and sanitary survey is being conducted throughout the Trust Territory by Peace Corps volunteers in the Trust Territory department of health. Its purpose is to ascertain a true health profile of the region, and provide the first accurate population data from which to attack health problems properly. Screening will then be undertaken in tuberculosis, leprosy, filariasis, and the various intestinal diseases, and projects will be implemented in environmental sanitation and health education.

A similar program is presently underway and in the planning phases for Western Samoa, Tonga, and the Gilbert and Ellice Islands.

For the Nepal Health Survey, a project undertaken in cooperation with the Bishop Museum of Honolulu, the Dooley Foundation, and His Majesty's Government of Nepal, the School of Public Health's epidemiology section has provided technical planning, guidance, and analysis of the nation-wide survey conducted in that country. Investigations were conducted at three district levels, the environment or community, household and family patterns, and personal medical examinations, including mass chest X-ray, blood, urine, and stool examinations. Collection of data from a random selection of comparable villages throughout the country has been completed and the analysis of the findings will indicate the major existing health problems in Nepal and recommend measures of prevention and control.

The School of Medicine, in addition to directing the above-mentioned Okinawa project and in conjunction with the Pacific Biomedical Research Center, is conducting a wide range of research activities involving the analysis of natural products from the Pacific and Asia which may be of pharmaceutical significance. The study of genetic malformations in certain island communities is underway.

The first medical school class, which will begin in the fall of 1967, will include the first Micronesian student from Palau to be accepted in an American medical school. Members of the faculty of the schools of medicine, public health, and nursing have made and will continue consultative trips to areas of the Trust Territory, Okinawa, and Western Samoa. An increasing number of students from Asia and the Pacific are being trained at the School of Nursing and the School of Social Work. The East-West Center, particularly the Institute of Technical Interchange, brings to Hawaii each year hundreds of health workers from Asia and other areas, such as the Trust Territory, South Pacific, American Samoa, and Western Samoa for further short-term study and orientation in Hawaii and parts of the mainland involving various departments and schools of the College of Health Sciences. In addition, the Institute of Technical Interchange sponsors seminar tours for Hawaii and mainland health experts to the Pacific and Asia for in-country training activities. The international health program at the University of Hawaii is growing.

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*Associate Professor of Public Health, University of Hawaii

Student Abstracts

TOXIC VENOM IN THE WANA

Because very little is known of the *wana* and because of personal interests, I have been working on a project to determine the location of the toxic venom in the *wana*, a sea urchin (scientific name *Echinothrix diadema*). It is 3-5 inches in diameter with spines banded in pale yellow or white alternating with green or black. Primary spines are large and blunt; secondary spines are thin, long, and hollow, with acute barbed tips which penetrate easily into the flesh. Verrill, Earle, Taft, Philip, and Brady believed that spines on the upper part of the urchin secrete the venom, but this has not been demonstrated by anyone.

Using the known data as a base, I set up my experiment to try to determine the location of the toxin. My experimental procedure consisted of crushing the secondary spines of the *wana*, making an alcohol-water solution of the extract, and injecting 0.125 ml of the solution into the abdominal cavity of a white mouse. Three trials were made with the solution; for a control, a white mouse was injected with the same concentration of the alcohol-water solution without the extract.

According to my observations, the three mice injected with the extract reacted in about the same way, while the mouse injected with the control solution showed no noticeable reaction. The mice injected with the extract rubbed their abdomen on the floor, then in about an hour hardly moved; but when they did they dragged their right hind leg. A few hours later the mice seemed very weak and died 13-15 hours after the injection.

Since the three mice injected with the extract died and since the mouse injected with the control solution did not die, I concluded that some material harmful to mice, possibly the toxin, is located in the secondary spines of the *wana*. But because I am limited in medical background, and because the number of trials is yet small, this project has merely become the preliminary step to solving a complex problem.

Wayne Toyofuku
Waimea High School, Kauai

SOME BIOLOGICAL AND PHYSICAL ASPECTS OF THE PEARL HARBOR MANGROVE SWAMP

This study of the Pearl Harbor Mangrove Swamp is an attempt to define the biological and physical aspects operating in a mangrove habitat. The dominant tree in this two-acre intertidal forest is *Rhizophora mangle*. Waikele Stream and many fresh and brackish water arteries, approximately one to two yards wide and a foot deep, form a network of "irrigation" ditches in the swamp area.

Four stations were established and field observations of physical and biological aspects were made weekly for six months.

Cores taken near each station showed that the substratum was composed of extremely fine-grained mud. The soft upper layer, made up of silt deposits from the Waikele Stream currents, was approximately three feet deep. Foraminifera tests were found below this depth.

The mangrove swamp was divided into zones according to tidal penetrations. During low tides, the swamp's surface was uncovered except for trapped water. During high tides, most of the swamp was under two feet of water. Salinity tests showed that the swamp was dominated during high tides by salt water from Pearl Harbor and during low tides by fresh drainage water.

The distribution of plants and animals in the mangrove habitat was the result of food-availability closely associated with the topographical features of the swamp. Birds frequent the fresh and brackish water arteries where fishes and oysters make their permanent home. A food web was constructed of species found in the mangrove swamp.

The fact that only a few species of plants and animals are found in this unique habitat is attributed to the recent establishment of the mangrove forest, which is about 35 years old.

Donald Masutani
Waipahu High School, Oahu

A STUDY OF USING ORGANIC MATTER AS AN ELECTROLYTE

In 1911 a British researcher reported that a noticeable current was produced when he immersed platinum electrodes into a "cell" consisting of yeast, glucose, and oxygen. Electricity also is measurable in plants and fish. My experiment is an attempt to study the feasibility of using the electrical energy supplied by rice, potato, and flour.

Twenty grams of washed rice grains were put in a test tube in distilled water, with copper and zinc as electrodes. A potential of 1 ma,0.7 volt was measured a few days later. Through a period of five months the graph (power as function of time) showed that rice and flour have the same characteristic in power output. The power rose quickly then slowly decreased as time increased. However, the potato cell behaved differently: the power rose at first then slowly decreased and stopped

Since the cells produced electrical energy, the solution must have been ionized. To prove that this is true, the rice cell was charged with a 12V battery. A potential of 27ma, 1 volt was measured. The fact that two of these cells could provide power for a radio was demonstrated in class. Temperature also affected the output of the cells.

One of the advantages of this type of cell is its ability to restore electrical energy after it is discharged.

This experiment led to the study of the possibility of using the cell as a calorimeter to compute the heat-energy evolved by rice, potato, flour, etc.

(References: Life Science Library (ENERGY), Life in the Universe, Bionics, McGraw-Hill Encyclopedia of Science and Technology.

How Man Lam
McKinley High School, Honolulu

THE REACTION OF *TILAPIA MOSSAMBICA* FRY TO VARIOUS ARTIFICIAL AND LIVE MODELS OF THE MOTHER

Since *Tilapia mossambica* is a maternal mouthbreeding cichlid, the eggs are carried in the mouth cavity for protection. After the eggs hatch and the fry become free-swimming, the fry will leave the mouth. However, they will rush back into the mouth if danger threatens. This "innate" instinct of *Tilapia mossambica* fry is the subject of my investigation.

When panicked by danger, *Tilapia mossambica* fry may mistakenly rush to other species of fish resembling the mother and may try to enter their mouths. The experiment is based on this mistaken identity. Artificial models and other species of fish were put into an aquarium at different intervals. The aquarium contained 150 *Tilapia mossambica* fry without the mother.

The experiment showed that the *Tilapia mossambica* fry will mistakenly attach themselves to the mother-substitutes. The responses of the fry are greater with increasing resemblance of the substitutes to the mother.

The experiment also showed that, in great probability, the mother warns her fry of approaching danger.

Wayne Okamura
Jarrett Intermediate School, Honolulu

NECROLOGY

The Academy records with sorrow the death of the following members during the year:

William H. Chun
John Zell Gaston
J. Robert Jacobson
Max Levine
Madorah E. Smith

MEMBERSHIP MAY 1967

Abbott, Agatin T.
†Abel, Marjorie G.
Adachi, Mitsuo
Adams, William M.
Ahearn, Gregory A.
Ahn, Ruth Y.
Ah Nee, Roy
Aizawa, Herman M.
‡Akamine, Ernest K.
Akamine, Frank S.
Akamine, Ralph N.
Akana, Mildred
Akau, Thelma I.
Akiyama, Hisano
Akiyama, Richard H.
Aldrich, W. W.
†Alexander, William P.
Alexander, William P., Jr.
‡Alicata, J. E.
Alkire, William H.
‡Allison, Samuel D.
Amioka, Shiro
Amioka, Toshiko W.
Anbe, Doris H.
‡Anderson, Earl J.
Anderson, Eleanor S.
Anderson, Elisabeth K.
Anstruther, Peter R.
Anzai, Katsui
Appleton, Vivia B.
Apt, Walter J.
Aragaki, Minoru
Araki, James T.
Aratani, Katherine
Arkoff, Abe
Arnemann, William A.
‡Arnold, H. L., Sr.
‡Arnold, H. L., Jr.
Asato, Yukio
Ashlock, Peter D.
Au, Stephen
Au, Steve
Aust, Ruth Ann

Babbitt, Howard C.
Bailey, Donald
‡Baker, Gladys E.
Baker, Glenn F.
Baker, R. J.
†*Baldwin, Helen Shiras
*Baldwin, Robert I.
†Ball, James H.
‡Ballard, Stanley S.
Ballie, David W. Jr.
Banko, Winston E.
‡Banner, Albert H.
Barba, Ramon C.
Barkley, Richard A.
Barkley, Sharon Rose
Barnes, I. Lynus
Barrow, Terence
†Bartholomew, Duane P.
Bartko, Bohdan
Bartz, Ellwood L.
Bassett, David R.
Bassett, Miyoko I.
†Batkin, Stanley
†Bean, Glen T.
‡Beardsley, John W., Jr.
Beech, Linda
Behrmann, Theodore M.
†Belshe, John C.
Bender, Byron W.
†Bennett, James G.
†Bennett, Thomas S.
†Bennett, Truett V.
†Benson, Homer R.
Berk, Morton
†Bernatowicz, A. J.
Berrett, Delwyn G.
‡Bess, Henry A.
Bess, Mrs. Henry A.
*Best, Etta Wright
‡Bianchi, Fred A.
Bilger, Leonora N.
†Bishop, Brenda
Blakely, Dudley Moore
Blevins, William J., Jr.
Block, Barry
Boardman, Mrs. Eugene
†*Bonk, William J.
†Bonn, George S.
Bosseau, Don L.
Bovee, Clifton W.
Bowen, Robert N.
‡Bowers, Neal M.
Bowers, Rohma L.
Bowles, H. E.
*Bowman, Hannah K.
Boyd, Robert E.
Boyden, Webster
*Bracher, George
†Brewbaker, James L.
‡Britton, John R.
Broadbent, Frank W.
‡Brock, Vernon E.
Brodsky, Maurice L.
†Brown, Myrtle L.
†Brown, Thomas C.
Bruce, Frank J.
Bryan, Edward C.
‡Bryan, E. H., Jr.
*Bryan, L. W.
Buchanan, Miriam S.
Buck, Alan C.
Buddenhagen, Ivan W.
†Bunton, George W.
Burden, J. Alfred
†Burgess, C. M.
Burks, Jesse B.
‡Burr, George O.
Bush, William M.
‡Bushnell, O. A.
†Butchart, David H.
*Buttles, W. William

*Caldwell, Paul J.
Campbell, Harriet A.
Campbell, John Frisbee
†Campbell, Robert L.
Candida, Sister M.
†Canty, Daniel J., Jr.
*Carlsmith, Donn W.
*Carlson, Norman K.
Carlstead, Edward M.
†Carr, Albert
Carr, Elizabeth B.
*Carter, A. Hartwell
*Castle, Northrup H.
Catts, Ann B.
†Caver, C. V.
Chang, Clarence F.
Chang, Clifford
Chang, Hon Chong
Chang, Hon Gipp
Chang, Jen-Hu
*Chang, Leon M.
Chang, Randolph K. C.
Chang, Raymond M.
Chang, Sau Yee
†Chang, Walter Y. M.
Chao, Ru Kwa
‡Chao, Tsun Tien
Chapman, Gregory
Chapman, Peter S.
*Chapson, Harold B.
Chapson, Kenneth P.
†Char, Donald F. B.
†Char, W. S.
Charnell, Robert L.
Cheever, Austin W.
Chikasuye, Richard S.
Childs, Louise S.
Ching, Gerald H. S.
Ching, Lammy Y. L.
Ching, Lilly
Ching, Rosalind D.
Chinn, Edward
Chiu, Arthur N. L.
Chiu, Wan-Cheng
Chock, Alvin K.
Chock, Jan S.
Chong, Donald Y. F.
Chong, Mabel T.
Chong, Ruth Seu Jin L.
*Chow, Matthew
Choy, H. P.
Choy, Oliver
Christenson, Leroy D.
Christofferson, Jay P.
†Christofferson, Jeanne L.
‡Chu, George W.
Chu, Philip T.
*Chuck, Harry C.
*Chuck, Mrs. Harry C.
Chun, Edwin Y.
Chun, L. T.
Chun, Raymond C. K.
Chun, Raymond K.
Chun, Wallace K. C.
Chung, Chin Sik
Chung, May E.
Chung, Robert G. H.
Chun-Hoon, Arthur
Chun-Ming, Archie
†Clagg, Charles F.
Clagg, Harry B.
Clark, David
†Clark, H. B., Jr.
Clark-Wismer, V. G.
‡Clements, Harry F.
Clopton, Robert W.
Cloward, Ralph B.
†Clutter, Robert I.
‡Cobb, Estel
†Coburn, Richard K.
Colby, Edward W.
Colegrove, Catherine
‡Coleman, Robert E.
Compton, Fred K.
Conklin, Delone A.
Contois, David E.
Cooil, Bruce J.
Cook, Jerome A.
Cook, Owen J.
Cooke, Richard A., Jr.
Cooksey, Lewis C.
Cooksey, Virginia T.
Cooley, Joan
Cooper, John W.
Corboy, Philip M.
‡Cornelison, A. H.
Cottington, Frances
Cottrell, Bobby R.
‡Cox, Doak C.
‡Cox, Joel B.
Cox, Marion Louise
Cox, Marjorie L.

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*Member, Hawaii Division, Hawaii Academy of Science.
†Member, American Association for the Advancement of Science.
‡Fellow, American Association for the Advancement of Science.

Cox, Nancy A.
‡Cox, Richard H.
Craig, Robert S.
Crawford, Carolyn
Cropper, Arthur G.
‡Crowell, David
Crowell, Doris C.
Crozier, Virginia
Curtis, Walter
‡Cushing, Robert
Custer, Charles C.
†Cutting, Windsor C.
Cutting, Mrs. Windsor C.

Dalton, Patrick D., Jr.
Dangler, Edgar W.
Davis, Clifton J.
‡Davis, Dan A.
Davis, Hugh L., Jr.
Davis, Rose
†Davis, Walter E.
†Dawe, John H.
Defibaugh, Betty Lou
Degener, Isa
‡Degener, Otto
†de Harne, Maurice A.
Deibert, Austin V.
†deJesus, Cesar B.
de la Pena, Ramon S.
Demanche, Sister Edna L
Denison, Harry L.
Devaney, Dennis M.
De Waele, Jules
Diamond, Aaron L.
Digman, John
Dobson, George L.
Dodge, Frederick A.
Doi, Asao
Doi, Mitsugi
†Dole, Arthur A.
Dolmseth, Bruce A.
†Doolittle, S. E.
‡Doty, Maxwell S.
Doyle, Sadie J.
Druecker, C. T.
‡Dull, Gerald G.
Dung, David K. H.
Dusendschon, R. C.

Ebisu, Joan F.
Ebisuzaki, Jean Shizuno
†Eckles, Lucius E.
†Edgar, Katherine J.
‡Edmondson, C. H.
Egami, Ronald T.
Ego, Kenji
Ego, Winifred T.
Eguchi, George
Eguchi, Koichi
‡Ekern, Paul C.
†Eller, Willard H.
Emery, Byron E.
Emory, Kenneth P.
†Enright, J. R.
Ernstberg, John C.
Estoque, Mariano A.
Ewart, George Y.
Ewing, George M.

Fairbairn, Eileen
Fairweather, Donald
Fan, Pow-foong
Fankhauser, Adolph
‡Farden, Carl A.
Farge, George A.
Fargo, Jean
Feden, Robert H.
Feiteira, Thomas M.
Feldwisch, W. F.
Felton, George
Fernandez, Leabert R.
Ferraro, Maria G.
†Fine, Jules
Fink, Bernard D.
Finlayson, J. Bruce
*Fisher, Gary M.
*Fiske, Richard S.
Flagg, Harry M.
†Fleming, James F.
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Fong, Rose S. Y.
Fontenelle, Wayne P.
‡Forbes, Theodore W.
‡Force, Roland W.
Forster, William O.
‡Fosberg, F. R.
‡Fox, Richard Howard
Fox, Robert L.
Freeman, Gilbert C.
Friese, Paul H.
‡Frings, Hubert W.
Fronk, Clarence E.
Fujimoto, Giichi
Fujinaka, Patricia S.
Fujino, Kazuo
Fukuda, Donald
‡Fukuda, Mitsuno
Fukui, Iris
‡*Fukunaga, Edward T.
†Furumoto, Augustine
Furusawa, Eiichi

†Gaines, Henry
†Garis, George B.
Garnett, Emily O.
Gay, Frank E.
Geandrot, Judith Ellen
†Gebauer, Paul
George, Peter T.
George, Robert P.
†Gibson, Robert M.
‡Gilbert, Fred I.
Gilbert, James C.
†Gilbert, Perry W.
Giles, Frederick L.
Gillett, George
Ginandes, Shepard
Glaisyer, A. R.
Glick, Clarence E.
Glover, Mary A.
Glover, Myrtle H.
†Go, Mateo L. P.
Godfrey, Mary Lynne
Goebert, H. William, Jr.
Golden, P. J.
Goo, Albert T. B.
Goo, Fannie C. C.
Goo, Velma Y. L.
Goodhue, William W.
Gooding, Reginald M.
Goodman, Richard
Gosline, W. A.
Goto, Carolyn E.
Goto, Eleanor Y.
Goto, George
‡Goto, Shosuke
Goto, Y. Baron
Gouveia, Sandra L.
‡Gowing, Donald P.
Grace, George W.
Graefe, Volker
Graham, Richard
Gramlich, Edwin P.
*Greenwell, Amy
Greenwell, Wilfrid A., Jr.
‡Gressitt, J. Linsley
Grossman, Dyer
Groves, Gordon W.
†Gustuson, Donald I.
Gutches, Aleen A.

†Haas, Walter R.
Habeck, Dale
*Haddon, J.E.
†Haertig, E. W.
Haff, Alexander O.
Hale, Ralph W.
Halperin, Sidney L.
†Halpern, Gilbert M.
†Halsted, Ann L.
Halunen, A. John, Jr.
Hamada, Dorothy K. I.
Hamamoto, Susan T.
†Hamilton, Richard A.
Hamilton, Mrs. Richard A.
Hammond, Dale A.
‡Hamre, Christopher J.
‡Handy, E. S. C.
Harada, Glenn K.
Harada, Masato B.
*Haraguchi, Samuel M.
†Haramoto, Frank H.
†Harbinson, John A.
‡Hardy, D. Elmo
†Hargrave, Vernon E.
Harrell, John C.
Harry, J. V.
‡Hartt, Constance E.
Hartwell, Alfred S.
Harvey, Robert R.
Hashimoto, Godwin T.
Hathaway, Joseph C.
Hatlelid, F. H.
Hayashi, Toshiichi
Haywood, G. S.
Heald, Edward W.
Heder, Guy W.
Heighton, Robert H., Jr.
Heinecke, Ralph M.
†Heisterkamp, Chas., III
‡Helfrich, Philip
Hendershot, J. M.
Hendrickson, Geo. A.
Henke, Louis A.
Henry, George W.
Herrick, Colin J.
Herrick, Raymond B.
Hewetson, John
‡Hiatt, Robert W.
†Hicks, Kenneth W.
Higa, Carol
Higa, Stanley Y.
Highland, Genevieve A.
†Hilker, Doris
†*Hill, David P.
*Hind, Robert L., Jr.
†Hindle, William H.
Hine, Richard B.
Hinrichsen, Erik C.
†Hirai, Pamela Yooko
Hirasuna, Noboru
Hirokawa, Kay M.
Hirokawa, Sueko
Hironaka, Clifford
Hitch, Thomas K.
Hiu, Dawes N.
Ho, Peter
Ho, Richard K. B.
Hobson, G. C.
Hoffman, Brother Joseph L.
†Hohl, Hans-Rudolf
Hohu, Martha Poepoe
Holladay, Natalie
Hollenberg, George J.
†Holmes, John R.
Holmes, Wilfred J.
†Holmes, William John
Holt, Ernest G.
Holtwick, Chester B.
Holzapfel, Eugene P.
Holtzmann, Oliver
Honda, Howard H.
Honl, L. A.
Honnert, Brother Henry
Hoover, Lawrence M.
Horio, Shigeru Richard
Hormann, Bernhard L.
Hoshino, Helene M.
Hoskins, Charlotta M.
‡Hosoi, Kiyoshi
†Howard, Alan
Howell, Milton M.
‡Hsiao, Sidney C.
Hubbard, Howard
†Hudson, Loring G.
Hunt, Wilfred E.
*Hunter, James E.
Hunter, Robert G.
Huntsberry, Elizabeth S.
Hurdis, John W.
*Hutchison, Frieda M.
‡Hylin, John W.

Iaconetti, William E.

Iha, Thomas H.
Ihara, Violet K.
Ihrig, Judson L.
Iida, Kumizi
Ikawa, H.
†Ikeda, Richard M.
*Ikeda, Warren
Ikezaki, Francis M.
Inouye, Joyce C.
Inskeep, Richard G.
Iritani, Roy I.
†Irwin, P. St. C.
Ishii, Mamoru
Ito, Shikiko
Ito, Takeo
Iversen, Robert T. B.
Iwanaga, Isaac I.
*Iwane, John Y.

Jackson, Dean C.
Jacobson, W. N.
Jasinski, Casimer
Jasinski, Doris R.
Jenkins, Donald A.
Jenkins, Mrs. Donald A.
Jensen, Walter L., Jr.
†Jim, Robert T. S.
Jim, Yun Soong
Jinbo, Laraine S.
Jiracek, George R.
Jiracek, Margaret T.
Johnson, Harold M.
Johnson, Jack
Johnson, Joseph M.
†Johnson, Nels E.
†Johnson, Rockne H.
Johnson, Rubellite Kinney
Johnston, Fred T.
Jones, Everet C.
Jones, Thomas S.
Jones, William Philip
Jordaan, Jan M., Jr.
Joyce, Charles R.
†Joyeuse, Rene

*Kadota, Shizuto
Kaeppler, Adrienne L.
*Kagehiro, George
Kaihara, Yasuto
Kainuma, Richard T.
Kajiwara, Jane M.
Kajiwara, Jonathan T.
Kamai, James, Jr.
†Kamemoto, Fred I.
‡Kamemoto, Haruyuki
Kamsat, Abraham Ng
†Kanashiro, James Z.
Kanehiro, Y.
Kaneo, Norman K.
Kaneshiro, Francis T.
†Kanna, George A.
*Kasamoto, Sadaichi
†Kato, Kenneth N.
Kato, Susumu
Katsuki, I.
Kauahikaua, Shigeno

Kauffman, Gerald J.
Kaufmann, Alma
Kaufmann, George
Kaulukukui, Felice W.
†Kawahara, Lloyd T.
†Kawano, Henry
Kawaoka, Wallace S.
‡Kay, Alison
Keala, Betty Ann
Keane, Madeline S.
Keeler, Joseph T.
Keesling, Charles B.
Keiser, Irving
Kekauoha, Willard K.
Kelley, Richard R.
Kellner, Jack S.
Kellum, Marimari
Kelly, Marion
Kendall, Robert
Kenessey, George E.
Kent, Martha J.
Kern, Charles I.
Kernaghan, Betty A.
Kernaghan, Warren A.
Kerns, Kenneth R.
†Kibby, Sydney V.
Kim, James
†Kim, John H. C.
Kim, Kathleen C.
Kim, Moses K.
Kim, Youtaik
Kimura, Judy T.
Kimura, Nagato
†Kinch, D. M.
King, Maurice V.
King, Will N.
Kinney, Teru
Kinzie, Robert A., III.
*Kishimoto, Richard H.
Kiuchi, Marian
Klein, Douglas Pyner
‡Klemmer, Howard
†Klopf, Donald
†Kobayashi, Clifford K.
Kobayashi, Herbert M.
Kobayashi, Lloyd Y.
Koehler, Ilse M.
‡Kohn, Alan J.
Kohn, Marian A.
‡Koike, Hideo
†Kojima, Evelyn S.
†Komives, Gregory K.
Kondo, K. C.
‡Kondo, Yoshio
Kong, Raymond F.
Kong, Ronald A. K. W.
Konoshima, Sumiye
†Kopf, Kenneth
†Kortschak, Hugo P.
Kosaki, Thomas I.
Koshi, James H.
Kotomori, Amos S.
Kotomori, Susan N.
Kozuki, Haruko
‡Krajina, Vladimur J.
Krakowiak, Thomas S.

Kramer, Herman P.
‡Krauss, Beatrice H.
‡Krauss, N. L. H.
Kudar, John C.
Kuninobu, James T.
†Kunisaki, John T.
Kurashige, Wilfred H.
Kushi, Harold S.
Kuwahara, Iwao
Kuwahara, Toshio
Kyselka, Will

Lafferty, Felix J.
Lam, Fred K.
†Lam, Frederick M. K.
Lam, Margaret M.
Lam, Robert L.
‡Lamoureux, Charles
Langford, Stephen A.
LaPlante, Albert A., Jr.
Larm, Edwin
Larsen, Ivar J.
Latham, Richard C.
Lau, Howard K. S.
†Lau, L. Stephen
*Lau, Nit Lin
Lau, Thomas H. T.
Lavin, Ralph Mathew
†Lavoie, Ronald L.
Lawton, Richard R.
†Lebra, William P.
Lee, Alavana G.
Lee, Alexander E.
Lee, Bernard C.
Lee, Chung Tim
Lee, Philip J. W.
‡Lee, Richard K. C.
Leedham, Eleanor
Leffingwell, Roy J.
Leigh, Mazie
Lembeck, Jay
‡Lenney, James F.
Lennon, Kenneth
Leong, Roderick
Leslie, Gerrie Allen
Lichter, Martin H.
Lichter, Rowlin L.
‡Lichton, Ira J.
Liese, Grover Julius
Liljestrand, Howard
‡Limber, Wayne S.
Lind, Andrew W.
Linsenmeyer, Roy F.
Linsley, Earle G.
†Littleman, Marian
Liu, Phoebe K. F.
†Livingston, William H.
*Lodge, R. H.
‡Loh, Philip C. S.
†Long, Charles R.
Longley, C. P.
Loo, Mabel N. K.
Loo, Stanley Y. T.
Look, Robert K. T.
Look, William C.
Loomis, Harold G.

†Lord, Edith
*Loucks, Burton J.
*Loucks, Ruth B.
Louis, James L.
Louis, Lucille
Low, Elvin G. W.
Low, Frank Y. F.
Lowrey, John J.
Lucas, J. T., Jr.
Luke, Herbert K. N.
Luke, Walter
Lum, Betsy K. S.
†Lum, Kwong Yen
Lummis, Wilbur S., Jr.
Lundy, Charles R.
†Lyman, Clarence
*Lyman, Orlando H.
Lytle, Hugh

†Ma, Gabriel W. C.
Ma, Pearl
Maas, Mariella
‡Macdonald, Gordon A.
Maclean, Burton A.
MacNaughton, Boyd
‡Magnuson, John J.
Mahaffy, Steve R.
Majoska, Alvin V.
†Mamiya, Richard T.
Manar, Thomas A.
‡Manchester, Curtis A.
‡Mangelsdorf, A. J.
†Manghnani, Murli H.
Manhoff, Milton
Manhoff, Mrs. Milton
‡Mapes, Marion
*Mar, Thomas M.
†Maretzki, Andrew
†Maretzki, Thomas W.
Marie, Sister Amata
Mark, Nora W.
†Marks, Robert H.
‡Marr, John C.
Marshall, Donald C.
Martin, Joseph P.
‡Mason, Leonard
Masuda, Matsuko
Masuda, Morris M.
*Matayoshi, Mary
Matsui, Adelina V. de Souza
Matsui, Jane R.
Matsui, Jiro
Matsui, Masato
Matsui, Tetsuo
Matsumori, Donald M.
Matsumoto, Futaba
†Matsumoto, Hiromu
Matsumoto, Walter M.
Matsumura, Hugh T.
Matsunaga, Frederick M.
Matsushima, Richard A.
Matthews, John L.
May, Robert C.
Maynard, G. Lafayette
McAlister, William C.
†McCarthy, Mor J.

McCleery, Walter L.
McClendon, Nancy E.
McCoy, Floyd W., Jr.
McGuire, Thomas R. L.
McMorrow, Bernard J.
*McNicoll, Irene
†Meeks, Carol Ann
Mehrer, Roxann
Melcher, Larry R.
Mendiola, Ella W.
Meng, Florence L.
†Meredith, Gerald M.
†Midkiff, Frank E.
Miki, Caroline M.
Miles, David H.
†Miles, John W.
Millard, R. D.
Miller, Bruce A.
Miller, Carey D.
Miller, Gaylord R.
†Miller, Harvey A.
†Miller, Jacquelin N.
†Miller, P. T.
†Miller, Robert C.
Milnor, John C.
†Mink, John
Mirikitani, Isami
Mise, Frances
Mitchell, Donald D.
*Mitchell, J. A.
Mitchell, Shizuko
Mitchell, Wallace C.
Miura, Shigeru
Miyahara, Edward J.
Miyahara, Richard I.
Miyamoto, Kay
*Miyamoto, Robert M.
Miyasaki, Yuzo
Miyata, Motoyasu
*Mizuire, Shizuto
†Moberly, Ralph, Jr.
†Mobley, Ross D.
Moeller, Maximilian
Moikeha, Sanae N.
Moir, W. W. G.
Molyneus, A. V.
Moo, Eva W.
*Moody, Dick Lee
Moore, Richard D.
Moore, Richard E.
Morgan, Andrew L.
†Morgan, Wm. A.
Morisako, Jiro
Morita, Helen E.
Morita, Kiyoichi
†Moritsugu, Toshio
Mosher, Allan W.
Moyers, Jarvis L.
†Mueller-Dombois, Dieter
†Muir, Barry S.
‡Mumaw, Charles
Murakami, Janice
Murakoshi, Donald
Muraoka, Miles C.
Murata, Florence M.
Murata, K. J.
Murchison, A. Earl
Murnane, Thomas J.
Muronaka, Karen K.
Myers, William A.
Mytinger, Robert E.

Nagai, Fay Y.
†*Nagao, Wallace T.
Nagasako, Kengo
Nagy, Albert M.
Nakae, Haruko N.
Nakagawa, Edward K.
†*Nakagawa, Susumu
†Nakamoto, Goichi
†Nakamura, Eugene L.
Nakamura, Paul S.
*Nakamura, Robert M.
Nakamura, Royden
Nakashima, Howard G.
†Nakasone, Henry Y.
†Nakata, Setsuko
Namba, Ryoji
Naquin, Walter P.
Natoli, William J.
‡Naughton, John J.
Nelson, Myrtle H.
*Nesting, K. E.
Neufeld, C. H. Harry
Newhouse, Jan
Nickell, Louis G.
Niimi, Arthur Jun
Nishi, Masao
Nishibun, Joe
‡Nishida, Toshiyuku
Nishihara, Mitsuo
Nishijima, Satoru
Nishijima, Theodore T.
Nishimoto, Karen M.
Nishimura, Hazel
Nishioka, Yoshimi A.
Niyekawa, Agnes M.
*Noda, Kaoru
Nonaka, Tatsuo
Nordfeldt, Sam
Nordyke, Robert A.
Norris, Roger A.

Oakes, William F.
*Oakley, George D.
Oda, Ethel
Oda, Tadashi
O'Dea, Katherine
Oishi, Noboru
Okada, Edward S.
Okada, Floyd H.
Okazaki, Kyuro
†Okihiro, Michael M.
Okubo, Sakiko
‡*Okumoto, Pete T.
Oppenheimer, Hannah L.
Orazen, Micheline M.
Oren, Joseph
Orenstein, Otto
O'Rouke, Sister Marcella M.
Orr, Kathryn J.
Osell, Frederic S.
†Oshiro, Hideo
†Osmun, James W.
Osterback, Arthur
‡Otagaki, Kenneth K.
Otsu, Tamio
Ouchi, Sugao
†Oyama, Stanley N.
†Ozawa, Theodore Y.

Paik, Young K.
Palafox, A. L.
‡Palmer, Daniel D.
Palmer, Leonard A.
†Palumbo, Nicholas E.
Pang, L. Q.
Pararas-Carayannis, George
Paraz, Alvin A. C.
*Paris, Irvine H.
†Pasby, Brian
Paskowitz, Dorian
Patterson, R. Reginald
Patzert, William C.
Paulita, Sister M.
‡Payne, John H.
Pearson, Richard J.
Pebley, Roscoe S.
†Pedley, Blanche A.
Peiler, Alice W.
Pell, Charles G.
‡Pemberton, C. E.
Penhallow, H. Chadsey
Peters, Charles W.
Peterson, L. Kenneth
Philipp, Perry F.
Piianaia, Abraham
Pinkerton, F. J.
Pinkerton, O. D.
Pirie, Peter
†Plucknett, Donald L.
Pong, Harriet Y. P.
‡Poole, Charles F.
Pottenger, Francis M., III
Poulson, Don E.
*‡Powers, Howard A.
‡Price, Saul
†Puaa, Annie K.
Pynchon, Joseph H.

Quaintance, D. C.
‡Quate, Larry W.

‡Rakestraw, Norris W.
Ramage, Colin S.
Randall, John E., Jr.
Rathburn, William B.
†Rautenberg, Virginia A.
‡Reese, Ernst S.
Reichert, Frederick L.
Reppun, J. I. Frederick
Resig, Johanna M.
Rhodes, Leon J.
Rice, Patricia Smith
Rich, Jon
*Richards, Herbert, Jr.
Richardson, B. Allen
Richert, T. H.
†Riggs, Mary E.
Rigler, Robert G.
Ringer, John W.
Rinkel, Murice O.
Rixon, Alan
Roberts, John C.
†Roberts, Joyce O.
Robinson, Frank E.
*Roman, Helen L.
Romanowski, Roman R.
Rosaire, Sister Domenic
Rose, John C.
†Rose, Stanley J.
‡Rosen, Leon
Ross, Ernest
†Ross, Serge
†Roth, Alexander
Rothschild, Brian J.
*Ruddle, Annabelle
Russell, Albertine Dials
Rutschky, Charles W., III

†Sadler, James C.
Sage, William H.
Sahara, Tamotsu
St. John, Harold
Saito, Shiro
Sakamaki, Shunzo
Sakata, Seiji
Sakimoto, Richard Y.
Sakimura, Bertha H.
‡Sakimura, K.
†Sandberg, Floyd A.
‡Sanford, Wallace G.
Sanford, Mrs. Wallace G.
‡Sarles, William B.
*Sarvis, E. S.
†Sasaki, Teruo
Sasser, James S.
Sato, Esther
Saukkonen, Marjatta
Sax, Gilbert
Sayer, John T., Jr.
‡Scheuer, Paul J.
Schock, Robert C.
Schoenberg, Erling
Schoenberg, Olive
Scofield, Violet Y.
Scott, Arlen M.
Scott, John H.
Scully, Niall M.
Seckel, Gunter R.
Seeley, DeLos A.
Seki, Melvin H.
†Semura, Jack
Semura, Jeanne I.
Seto, Dudley S. J.
Sexton, Harold M.
Shackleton, Ernest F.
†Shaw, Thomas N.
Sher, S. A.
†Sherk, Kenneth W.
Sherman, G. Donald

Sherman, Minnie J.
Shigenaga, Elizabeth M.
*Shigeura, Gordon T.
Shikada, Ichiro
Shim, Nellie C.
Shim, Walton K. T.
Shimabukuro, Seiji
Shimoda, Jeanette M.
Shinn, James S.
Shinseki, Iris H.
Shiramizu, William T.
†Shiroma, George T.
Shiroma, Helen
Shitabata, George J.
Shklov, N.
Shoemaker, James H.
Shomura, Richard S.
Shutler, Richard, Jr.
Sia, Calvin C. J.
‡Sia, Richard H. P.
Silva, James A.
Silver, D. T.
Simmerer, Ernest R.
Simmons, E. Lee
Simpich, Frederick Jr.
Sinclair, Gregg M.
Singer, David
Singer, Sylvia
Sinoto, Yosihiko M.
Siu, James K. M.
Slattery, Mabel
‡Sloan, Norman R.
Sloan, R. Varian
Sloane, George E.
†Smith, Douglas R.
Smith, Esther M.
Smith, Jimmie B.
Smith, Ronald Q.
Snell, M. Helen
Snoddy, Alice
‡Snyder, Laurence
Soehren, Lloyd J.
Sokolowski, Thomas J.
Soong, Theodore K. C.
Sowers, J. Mark B.
Spalding, P. E.
Spalding, Philip E., Jr.
Sparacino, Candie
Sparaga, Albert
Sparks, Robert W.
Spiegelberg, Carl H.
Spiller, John H.
Spillner, Erich C.
Spoehr, Alexander
‡Sprague, Lucian M.
Spring, Bro. Thomas
Srinivasan, V. V.
†Standal, Bluebell R.
Stanford, George
Stanley, Richard W.
*Stearns, Alvan C.
Stecker, Susan G.
Steffan, Wallace A.
Steffee, Elizabeth
Steiger, Walter R.
Steinberg, Danny D.
Steinberg, Miho
‡Steiner, Loren F.
Stephens, Betty Jane
‡Stephenson, John R.
*Stevens, William H.
Stice, Gary
Stokes, Darrell Robert
†Stone, Benjamin C.
†Strange, William E.
Strasburg, Donald Wishart
Street, John M.
Strode, Walter S.
Struhsaker, Jeannette W.
†Stuhler, Louis G.
Su, Judith M.
Su, Tu-Jen
Suehiro, Amy
Sugihara, Clarence Y.
Sugiki, Shigemi
Sugimoto, Wallace H.
Sunn, Franklin Y. K.
*Sutherland, Mark M.
*Sutherland, Zelie M.
Suzuki, George
†Swindale, L. D.
Sylvester, Joseph R.

*‡Tabrah, Frank L.
Tada, Yoshio D.
Takagi, Yoshie
Takahashi, David
†Takahashi, Francis T., Jr.
Takaoka, Mary Ellen M.
Takasaki, Kiyoshi J.
†Takata, Michio
Takayama, Al K.
Takazawa, Futoshi
Takenaka, Yasuo
†Tam, Richard K.
Tamashiro, Amy
Tamashiro, Jane S.
‡Tamashiro, Minoru
Tanada, Yoshinori
Tanaka, Edith H.
Tanaka, Kazushi
*Tanaka, Shuichi
Tanaka, Tokushi
Tanaka, William T.
†Tanimoto, Ralph H.
Taran, George
Taras, Edward
*Taylor, James Monroe
†Taylor, Ronald C.
Terayama, Hajime
Teruya, Kazuo
‡Tester, Albert L.
Theaker, M. L.
Theiler, Sister Carla Marie
Thomas, Charles W.
Thomas, Ernest H.
Thomas, Sister John
Tien, David T. H.
Tilden, I. L.
Tinker, Spencer W.
Titcomb, Margaret
*Togashi, Teruo
Tokimasa, Nami
Tom, Benjamin C. K.
†Tom, Edward S. H.
Tom, Richard L.
†Tomita, Theodore
Tompkins, Edmund A.
*Tong, Alfred S.
Tong, Fook Hing
Tong, Wing You
Topping, Donald M.
‡Townsley, Sidney J.
Tsukano, Hazel
Tsukano, Lucille T.
Tucker, Jerome L.
‡Tuthill, Leonard
Tuttle, Daniel W.
Tyau, Henry T. Y.
Tyau, Jennie Y.

†Uchida, Clara S.
Uchida, Richard N.
Underwood, Edward B.
†*Urasaki, Harry M.
†Urata, Rokuro
Urata, Ukio
Uyehara, George K.

Valier, Louis A.
Van, Louise F.
Van Degrift, Paul D.
VanDreser, Lyle M.
‡Van Weel, Pieter
‡Van Zwalenburg, R. H.
Vaughan, Nohealeimamo K.
Veeck, William L., III
Vernon, Mabel D.
†Vitousek, Martin
Vollrath, Harvey M.
Voss, William J.

Wade, Arla W.
Wadsworth, Harold A.
Waite, Verne C.
Wakatsuki, Helen
†Walker, Daniel A.
Walker, Hastings H.
Walker, Ronald L.
Wallace, Arthur F.
Wallace, Gordon D.
Wallace, Jean
Wallis, Samuel R.
Wallrobenstein, Paul P.
†Walsh, Gerald E.
Walsh, Wm. M.
‡Waring, Gerald A.
Warner, H. H.
‡Warner, John N.
‡Warner, Robert M.
Warshauer, Frederick B.
†Watanabe, K.
†Waterhouse, John T.
*Waters, William A.
Watson, Leslie J.
Waugh, John L. T.
†Waxman, Sorrell H.
Weaver, Herbert
*Weeks, John D.
Weller, D. M.
Wells, Clinton H.
†Wendt, Dorothy
Wenig, Riva P.
Wenkam, Nao S.
*Wennerlund, Appoline B.
*Wentworth, C. K.
*Wentworth, Juliette
‡Whang, W. Y.
Whiton, Nat
Wiemer, Robert D.
Wilcox, Kingston S.
Wiley, Frank
Will, Lester J.
†Willers, Ernest H.
Willett, Edwin D.
Williams, Raymond M.
Williamson, Mrs. Elmer
Wilson, Nixon A.
Wilson, Warner
Wimbush, H. Mark
‡Wismer, Chester A.
Withington, Paul
Wittermans, Tamme
†Wolbrink, Donald H.
*Wold, Myron L.
†Wolff, Robert J.
Wolynec, Christina
Wong, Erwin L. S.
†Wong, James T. S.
Wong, Kenneth Y. H.
Wong, Paul L.
†Wong, Robert T.
*Wong, Ruth O. T.
Wong, Sau Hoy
Wong, Sau Ki
†Wong, Wayne W.
Woodruff, Charlotte
Woolford, Ercell C.
Woolford, H. A.
‡Woollard, George P.
Wootton, Richard T.
Worth, Robert M.
Wright, John Cotton
Wright, Joyce
†Wyrtki, Klaus

Yamada, Edward Y.
*Yamamoto, Akira
Yamamoto, Earl S.
Yamamoto, Michael Tatsuso
Yamamoto, Tatsuji
†Yamamoto, Thomas I.
Yamane, Richard N.
Yamashiro, Kathryn
Yamauchi, Hiroshi
†Yamauchi, Shoyei
Yamaura, Teruko S.
Yanagihara, Iichi
Yancy, Clifford D.
Yang, Dianne S. W.
Yatsuoka, Mabel
Yee, Alvin
†Yee, Daniel
Yee, Shirley K. H.

Yen, Douglas
Yim, Bernard J. B.
Yokoyama, Henry
Yoneda, Saburo
Yonemoto, Carol Ann S.
Yoshida, Howard O.
Yoshimoto, Carl M.
Yoshimura, Carol M.
Yoshimura, Maxine T.
Yoshinaga, Ernest K.
Yoshioka, Tad T.
Yoshizaki, Helen K.
Yoshizawa, Shozo
Young, Charles H. U.
Young, Edith H.
Young, George S.
†Young, Hong Yip
†Yuen, Clara K. S.
†Yuen, Heeny
Yuen, Lois K. C.
Yuen, Marion K. C.
Yuen, Quan Hong
†Zane, Lawrence F. H.
Zimmerman, Steven T.