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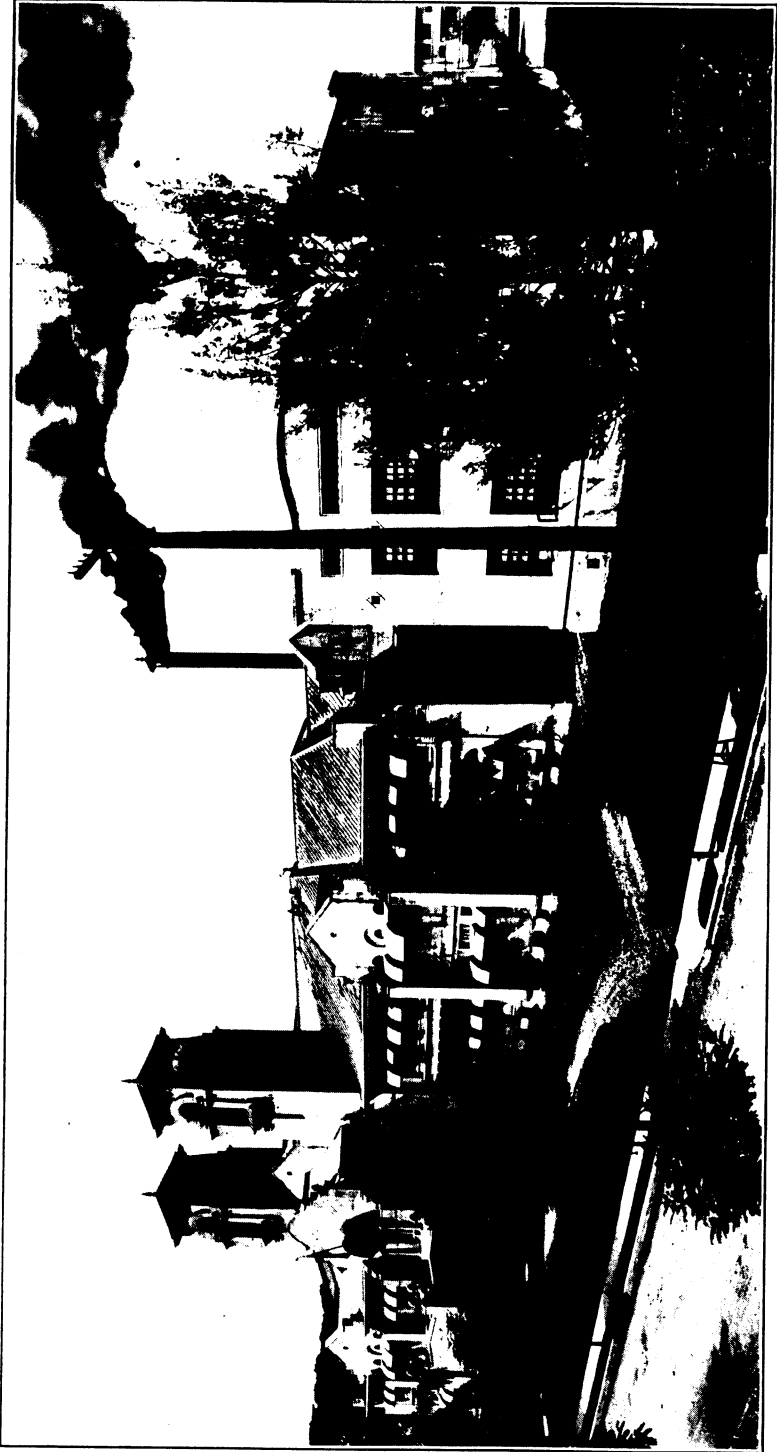












MAIN BUILDING AND EAST WING, BUREAU OF SCIENCE, MANILA.

# TWENTIETH ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

ELMER D. MERRILL  
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1921



MANILA  
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P.T.

*Science*

## TWENTIETH ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE,

MANILA, *December 31, 1921.*

SIR: I have the honor to submit the following report covering the operations of the Bureau of Science for the fiscal and calendar year 1921.

At the beginning of the year I was in the United States on leave, returning in February and reporting for duty on March 2. During my absence Mr. R. C. McGregor was assigned the duties of Acting Director, a position he filled very satisfactorily during the period of his incumbency, from July 15, 1920, to March 1, 1921, inclusive.

In spite of the financial stringency existing during the year, and in spite of the fact that the Emergency Board found it necessary, in connection with the general retrenchment policy of the Government, to cancel our funds for the purchase of equipment and to reduce several other items, amounting in all to ₱47,500, the work of the Bureau has progressed in a fairly satisfactory manner. We have been able to handle the routine demanded of us, and have also been able to produce a reasonable amount of research work. Appeals to the Emergency Board for urgently needed funds for the prosecution of essential work were courteously received, and special funds were granted covering the cost of the continued manufacture of tikitiki extract, over-ages on traveling expenses, and toward the end of the year our outstanding obligations on purchase of equipment. For the first time in the recent history of the institution all authorized positions were filled, this being possible through the policy pursued by the Council of State in granting additional special contracts for technical men.

During the year special reports were prepared on the condition of the Bureau of Science and its needs for the Wood-Forbes Commission, at the request of the Council of State; on a plan for

development of the institution for the next five to ten years; and on possible economies to be effected.

While during the past year the technical personnel has been stronger and somewhat more numerous than for several preceding years, the fact should not be lost sight of that in certain divisions the technical staff should be increased by providing additional positions and securing the services of additional technical men for research problems.

For some years past there has been a tendency to increased routine and decreased research. Neither should be developed at the expense of the other. The term "routine" is perhaps unfortunate, for much of this work involves a high degree of technical training and ability on the part of members of our staff charged with the work, especially in connection with advice and assistance extended to various individuals, corporations, and other Government units regarding industrial, technical, and public-health questions with which we have to deal.

There has also been a tendency to increase the manufacturing aspect of our work, which is unavoidable, especially in the operations of the serum laboratory and in the manufacture on a large scale of tikitiki extract for the treatment of beriberi and of the chaulmoogra-oil derivatives for the treatment of leprosy. These manufacturing projects demand space and make inroads on the time of our technical personnel in devising means to supply the demands and in supervising the manufacturing processes. Our chief handicap in this is that, for operating these purely manufacturing processes, we are entirely dependent on funds secured by appropriation, while all income derived from sales reverts to the Insular Treasury as Government revenue. From the very nature of these cases we are obliged to operate on a commercial scale, yet we are not allowed to place these operations on a business basis. The sales income from operations such as these should be made available as revolving funds for reinvestment in supplies, materials, and labor, any surplus remaining to be turned in as Government revenue. This is merely a simple business proposition.

#### THE NEW SERUM LABORATORY AT ALABANG

The serum laboratory of the Bureau of Science was moved to Alabang the latter part of March and actual operations in the manufacture of serums and vaccines were commenced early in April. It is conveniently located on the Manila-South Road, 25 kilometers from Manila, on the rising ground overlooking Lake Bay. While the plant is not yet perfect, owing to certain small



details of construction not having been finished, it compares very favorably with similar institutions abroad so far as its general equipment is concerned. For its specific purposes, which are really the function of a Pasteur institute, the serum laboratory is admirably located, and in the immediate future we should be able very radically to increase our output of serum and other biological products. For the establishment and equipment of the serum laboratory at Alabang great credit must be given to Dr. G. Apacible, ex-Secretary of Agriculture and Natural Resources, who consistently supported our plans for establishing this institution on a sufficiently large scale so that the products manufactured may be available in ample quantities to meet all demands. It is the only institution of its type in the Philippines, and its products serve the entire population of the Archipelago.

The standard products manufactured in the serum laboratory include the following: Antitetanic serum, antidyenteric serum, normal horse serum, vaccine virus, cholera vaccine, typhoid and paratyphoid vaccine, dysentery polyvalent vaccine, bacillus coli vaccine, gonococcus vaccine, staphylococcus albus and aureus vaccine, streptococcus vaccine, and the materials necessary for the Pasteur antirabies treatment.

From the time the serum laboratory was transferred to the Bureau of Science in 1903 up to the year 1918 the quarters assigned to it were wholly insufficient to warrant any great development of the work. It was originally located on the grounds of the San Lazaro Hospital, but in 1906 was transferred to the grounds of the Bureau of Science. The laboratory space available in Manila was inadequate and, being in close proximity to the power plant of the Bureau of Science, was very poorly located for the purpose intended. Little space was available for animals, and up to 1916 but a single stable was available for housing all of the animals carried by the serum laboratory. Until proper space was provided in 1916, but six horses for the purpose of producing serums and a small number of calves for the purpose of manufacturing vaccine virus were maintained. With these strictly limited facilities it was, of course, absolutely impossible for the serum laboratory to supply serums, vaccines, and other biological products on a scale sufficiently large to meet all demands.

In 1916-1917 a small concrete laboratory was erected, giving us a separate bleeding room and two small isolated rooms for certain phases of the work in which the chance for bacterial con-

tamination had to be reduced to a minimum. Space was also provided where smallpox vaccine could be prepared under proper conditions.

In 1918, on account of the outbreak of smallpox in the Philippines and the necessity on the part of the Bureau of Health to carry on a comprehensive vaccination campaign, the demand for smallpox vaccine was radically increased; in fact, so radically that it was impossible for the serum laboratory to supply it in sufficient quantities to the Bureau of Health. In order to provide adequate stable space for our animals an appeal was made to the Emergency Board, and an allotment was granted for the erection of an additional stable. At the same time the whole question of the location of the serum laboratory was discussed, and the allotment of funds so urgently needed for construction purposes in 1918 was granted on the condition that immediate steps be taken to move the serum laboratory to some point outside of the City of Manila. The stable constructed in 1918 was so planned that it could be used for a general testing laboratory after the removal of the serum laboratory.

In 1918 the Philippine Legislature appropriated ₱200,000 for the purpose of establishing a modern serum laboratory at some point outside of the City of Manila. When this appropriation was asked for it was planned to establish the serum laboratory at some point in the immediate vicinity of Manila. Some time previous to this date the Bureau of Agriculture had moved its stock farm from Alabang, Rizal Province, to Nueva Ecija Province, and was utilizing only a part of the plant at Alabang in its hog and poultry projects. It was decided to transfer from the Bureau of Agriculture a part of the Alabang property, including the concrete building originally constructed for the purpose of manufacturing rinderpest serum, the large stable, the quarantine stable, and the accompanying residences, together with about 70 hectares of land, and to establish the serum laboratory at Alabang, thus making some practical use of the large investment already made in Alabang.

The main building of the serum plant at Alabang is the concrete laboratory building originally erected by the Bureau of Agriculture, modified to meet the demands of a serum laboratory where products can be manufactured on a large scale. This contains the general offices, laboratories, bacteriological workroom, filling room, sterilizing and wash room, bleeding room, storeroom, refrigerating room for finished products, and a large refrigerator for unfinished products. To this building

was added a small wing to contain the refrigerating machinery. Near this laboratory was erected a concrete power house, which is equipped with duplicate power units, consisting of semi-Diesel engines and dynamos, compressed-air and vacuum machines, and a boiler for the purpose of producing steam for sterilization.

About 300 meters below the main laboratory is a separate toxin laboratory, which has been thoroughly equipped for its specific purpose; this contains an inoculating room, an incubator, a large autoclave, and sundry other equipment. The manufacture of toxins must be maintained entirely separate from other activities of the serum laboratory on account of the possible danger of contamination of serums and other products. The large stable, originally constructed for the Bureau of Agriculture, has been repaired and contains ample space for as many as two hundred horses. The old quarantine stable of the Bureau of Agriculture has been modified for maintaining animals used for the production of vaccine virus. This is located at some distance from the main stable and provides space for thirty animals. It is further equipped with a large, screened operating room. Another, smaller building turned over by the Bureau of Agriculture has been modified for the purpose of serving as a small-animal house, giving ample space for breeding the necessary guinea pigs and rabbits which are essential to the work of the serum laboratory.

An artesian well, originally drilled by the Bureau of Agriculture, has been repaired and equipped with a duplex, electrically driven pump. The water supply is ample and is pumped into concrete tanks located about 300 meters from the well and at an elevation of about 100 meters above it. From these tanks the water is distributed to the entire plant, power house, laboratories, stables, and residences. The roads originally constructed by the Bureau of Agriculture have been placed in excellent condition.

On account of the isolated location at Alabang it was necessary to provide living quarters for the resident staff. Two residences, formerly the property of the Bureau of Agriculture, have been thoroughly renovated and two additional ones constructed for housing the technical staff. At the same time a small barrio consisting of light-construction houses has been provided for the other employees. All of these houses are supplied with water and with electric lights.

The live stock maintained at Alabang has been gradually increased in number, until in the early part of the year we had about sixty head of horses for the purpose of manufacturing serums, as well as the necessary number of cattle for manufacturing smallpox vaccine. Most of our horses have been maintained at Alabang for over a year past, having been moved out of Manila as soon as the necessary repairs were made to the stables and corrals at Alabang. In Manila, on account of the very limited space available on the grounds of the Bureau of Science, our live stock had to be maintained entirely on purchased forage. At Alabang the stock can be maintained largely on forage available there, in the rainy season from the grass growing naturally in the pastures, and during the dry season from grass grown in the series of paddies below the large stable which are irrigated by the waste water from the power plant. The actual saving in the cost of forage will largely offset the expenses of running the power plant at Alabang.

Up to the present time, owing to the limited facilities available in Manila, the Bureau of Science has never been able to produce certain essential serums in sufficient quantity to meet all demands. A notable example of this is antidysenteric serum, the demand for which invariably increases at the beginning of each rainy season. We have at times been obliged radically to restrict the sale of this product on account of the lack of reserve supplies, and at times have been unable to supply all that the Philippine General Hospital needed. With the ample space now available at Alabang, not only for laboratory and manufacturing purposes but also for the maintenance of the necessary live stock, the Bureau of Science should be able to produce all standard types of vaccines and serums in sufficient quantities to meet local demands.

#### NEW TESTING LABORATORIES

With the transfer of the serum laboratory to Alabang, it became possible to rearrange the testing laboratories in the concrete out-buildings then vacated, and for the first time in the history of the Bureau of Science the testing machinery is assembled as a convenient working unit. The concrete stable, which was originally planned for use as a testing laboratory when the serum laboratory should be moved, has been transformed into a materials-testing laboratory, divided into four rooms. The largest of these is the cement laboratory and is equipped with the necessary apparatus, such as brass gang molds, moist-air closets,

and molding and work benches to test one hundred samples of cement daily. There are five machines for testing the tensile strength of cement-mortar briquettes, and the tank space for storing specimens is ample to accommodate numerous test pieces in connection with research work. The next room is a physical testing laboratory housing road-metal-testing machinery, a mechanical siever, a 600-pound, tensile-strength-testing machine, and a Freas electric oven. Adjoining is a small chemical laboratory which, when piped with compressed air, water, gas, and vacuum, will be used for the analysis of cement, steel, iron, and nonferrous alloys; it is also intended to equip this room for metallographic investigations. The last room is used as an office for computing data. The neighboring concrete building, originally constructed as a bleeding house, now houses the large and small materials-testing machines, the heavier road-metal-testing machines, liquid air machine, etc. The transfer and reinstallation of the machinery has involved considerable work, which was done by our own force under the direction of our chief power engineer, Mr. J. Guerrero. The small wooden building formerly occupied by the cement-testing laboratory has been turned over to the manufacture of tikitiki extract and the chaulmoogra-oil derivatives, involving extensive installation of stills, etc., which was also accomplished by our own force.

#### PASTEUR ANTIRABIC TREATMENT

The antirabic treatment has been given free as in past years, the serum being prepared in our serum laboratory and the treatment given at the Bureau of Science by Dr. Santos T. Rivera. In May there were several cases of hydrophobia in Manila, with a resulting increase in the demand for treatment, the maximum being in that month when about 70 individuals were being treated. The total number of individuals treated in Manila was 526, while 350 treatments were sent to provincial points in response to requests received through the Philippine Health Service; this Service has coöperated by directing all persons bitten by dogs, cats, etc., to apply to the Bureau of Science for the Pasteur treatment. In a number of cases the animals' brains examined by Dr. W. H. Boynton presented the characteristic Negri bodies indicative of hydrophobia. Since the Pasteur antirabic treatment was initiated in the Philippines by the Bureau of Science in 1911, a total of 3,408 individuals have been given the treatment, either at the Bureau of Science or at provincial points. The last two years showed radical

increases in treatments as the accessibility of the treatment became better known. From 1911 to 1919 the maximum number of treatments was 453, in 1919, which increased to 771 in 1920, and to 876 in 1921.

#### INDUSTRIAL FELLOWSHIPS

In 1920 data were supplied to your predecessor regarding the general proposition of industrial fellowships as developed by the Mellon Institute of Industrial Research of Pittsburgh, Pa. Secretary Apacible approved the general plan, a tentative contract form was drawn up, and preliminary arrangements were made for entering into similar arrangements between the Bureau of Science and local industrial, commercial, and agricultural units. No fellowships were arranged however, during 1921, although at the end of the year advances were made by the Philippine Sugar Centrals Agency with the view to establishing such a fellowship for the benefit of the Philippine sugar industry. It is hoped that this can be consummated early in 1922 and that other similar fellowships can be arranged.

#### CENTRALIZATION OF SCIENTIFIC WORK

The Bureau of Science was organized for the specific purpose of avoiding duplication of scientific work by Government agencies. Properly to prosecute scientific work and to determine the most practicable and efficient routine methods involves ample library facilities, thorough laboratory equipment, competent technical personnel, and adequate financial support. The objects for which the Bureau of Science was organized have been attained and in an efficient manner. There has been little duplication of effort through Government agencies, and as a result a vastly greater output of productive work than could have been possible had the present work of the Bureau of Science been scattered in several independent units. The success of the idea has been appreciated by the French authorities in Indo-China, and the organization of the Institut Scientifique in Saigon is in part modeled on that of the Bureau of Science. During this year, on request from the Governor of Ceylon, full data regarding the organization of the Bureau of Science were supplied to him, as it has been proposed to organize a similar institution in Colombo in the interests of economy and efficiency. These data are of distinct interest at the present time and are pertinent to the question as to whether the Bureau of Science shall be maintained as such or merged with another institution.

## COÖPERATION

It is difficult to express in terms of words how close and how essential to the public service as a whole is much of the work of the Bureau of Science. Much of our work is done in coöperation with other Government units, and it is the policy of the institution to coöperate to the greatest possible extent with all Government units needing the services or the advice of our technical personnel. Naturally, we are in very close touch with the Philippine Health Service through the activities of the serum and biological laboratories; in fact, a large part of the work in these units is definitely planned in the interests of the Philippine Health Service. With the Bureau of Agriculture effective coöperation is in force in reference to the work in plant pathology, entomology, plant-quarantine service, plant industry, soil analysis, fertilizers, etc. In plant pathology four employees of the Bureau of Agriculture work full time in our laboratories in coöperation with our own force; this type of coöperation is highly efficient and might very well be extended to entomology. Close coöperation is maintained with the Bureau of Forestry through our botanical work in reference to the classification of Philippine timbers; most of the work on the series of publications on minor forest products recently issued by the Bureau of Forestry was actually accomplished in the herbarium of the Bureau of Science. With the Bureau of Public Works active coöperation is in force through our work in the inorganic chemistry and the testing laboratories, covering an investigation of structural materials, especially cement and concrete, roofing materials, etc.; coöperative comprehensive series of exposure tests with different types of roofing materials are now planned. With the Metropolitan Water District active coöperation is being prosecuted on two lines: first, a geologic examination of the possible dam sites on Angat River, together with the geologic work on the tunnel sites, this work being done by the division of mines; and, second, a comprehensive biological and chemical examination of the Angat River water, this being done in our biological and chemical laboratories. With the Bureau of Commerce and Industry coöperation has been effected in compiling data on economic plants, etc., by the part-time employment of Mr. Marcelo Adduru between the Bureau of Commerce and Industry and the Bureau of Science. With the University of the Philippines coöperation is carried on by certain courses and lectures given by members of our staff, some courses in testing, library work, etc., being given

wholly or in part at the Bureau of Science. Members of the University staff interested in research work in the field covered by the Bureau of Science are given staff appointments with the Bureau in order to give them access to supplies, equipment, records, etc. With the Philippine General Hospital special arrangements have been approved for doing the necessary photographic work for that institution, other than X-ray work, and the same arrangement has been made in connection with the work of the Committee on Leprosy Investigation.

With the United States Army authorities coöperative work was completed on a survey of the intestinal diseases prevalent at Fort Mills, Corregidor. With a group of Japanese fishermen coöperative work was done in locating possible fishing grounds where fish could be secured in commercial quantities and shipped to Manila packed in ice. Laboratory space and library facilities have been supplied to Dr. R. E. Dickerson and to other geologists employed by the Richmond Petroleum Company; to Mr. E. H. Taylor in connection with his work on Philippine herpetology; and to Mr. A. S. Hitchcock, of the United States Department of Agriculture, in connection with his field work on Philippine grasses. Funds have been supplied by Messrs. Dickerson and Taylor to enable us to carry on field work in zoölogy, and by Mr. Oakes Ames to assist us in prosecuting field work in botany. In botany close coöperation is maintained with the Bureau of Forestry in connection with the botanical work necessary in the classification of commercial timber trees, this coöperation having been initiated in 1902. With institutions outside of the Philippines systematic work in botany has been done for Nanking University, Nanking, China; the Canton Christian College, Canton, China; College du Protectorat, Hanoi, Indo-China; the Botanic Garden, Singapore; the Forestry Departments at Kuala Lumpur, F. M. S., and at Sandakan, British North Borneo; and with the Smithsonian Institution, Washington, D. C. Through arrangements approved by the Peking Union Medical College and the Rockefeller Foundation, Miss Hartley Embrey was authorized to spend two months at the Bureau of Science for the purpose of carrying on investigations of local food products, especially in reference to the vitamine values of currently utilized foods. The matter was first brought up by Dr. Victor G. Heiser. Miss Embrey has worked as a volunteer, her traveling expenses from Peking to Manila being paid by the Bureau of Science, while the Woman's Club of Manila



generously placed ₱500 at my disposal for covering incidental expenses. Throughout the time Miss Embrey was engaged on this work Miss Sylvia Sleeper, of Manila, worked as a volunteer assistant.

#### PEKING MEDICAL CONFERENCE

In connection with the dedication of the buildings of the Peking Union Medical College, at Peking, China, and the accompanying medical conference held under the auspices of the Rockefeller Foundation, September 15 to 22, 1921, we were able to send an official delegate in the person of Prof. Frank G. Haughwout, although our travel funds were then exhausted. This was accomplished by raising the necessary amount of money by private subscription, first among the technical staff of the Bureau of Science, then among business men interested in medical-survey work, and lastly through a generous donation of the required balance by the Rotary Club of Manila. Our representative at this congress doubtless had some influence in deciding certain representatives of the Rockefeller Foundation and certain attending delegates to visit Manila after the conference in order to get some first-hand knowledge of the existing health conditions here and the need of further investigations. It is hoped that some coöperative work by the Rockefeller Foundation through our biological laboratory will be the result of this visit.

Unfortunately, due to lack of funds, no official delegate representing the Bureau of Science could be sent to the Fourth Congress of the Far Eastern Medical Association held at Batavia, Java, in August, 1921, or to the Press Congress held in Honolulu.

#### DIETARY STUDIES

Through an arrangement suggested by Dr. Victor G. Heiser, of the International Health Board, Miss Hartley Embrey, of the Peking Union Medical College, was brought to Manila in November for two months' work on this subject, Miss Embrey volunteering her services, the Bureau of Science paying her actual traveling expenses. In this connection the Woman's Club of Manila supplied a fund of ₱500 to cover incidental expenses in connection with Miss Embrey's work.

The problem was the working out of a cheap, practical, and nutritive diet for Filipinos based on available foods with the view to the prevention of such diseases as beriberi and scurvy. Numerous feeding experiments were carried on in testing the anti-scorbutic vitamins (water-soluble C) in native fruits and vegetables.

A careful study was made of coconut press cake, which was found to be rich in protein and further was found to contain antineuritic vitamins (water-soluble E) which prevent beriberi. Under Miss Embrey's direction combinations were made of coconut press cake, mongo beans, and low-priced vegetables, and thirty-two palatable recipes were worked out. The results are to be made available in a series of press bulletins which are to be given very wide distribution at the 1922 Carnival and Industrial Fair in coöperation with the Woman's Club of Manila. The Woman's Club will maintain a booth for the preparation of the foods and their free distribution.

Material in bulk has been prepared for a further series of feeding experiments to be carried on by Miss Embrey after her return to Peking. The necessary data have been secured and are now being compiled for a series of popular bulletins on detailed diets by provinces, based on the common food products available in each province.

In November Miss Embrey made a short trip to the Culion Leper Colony for the purpose of investigating the diet there which was found to be very deficient. A request was sent by the Governor-General to the Rockefeller Foundation asking for an extension of time for Miss Embrey which was granted, and during January and February, 1922, she will make an intensive study of dietary conditions at the Culion Leper Colony. During November and December Miss Sylvia Sleeper, of Manila, worked as a voluntary assistant to Miss Embrey.

#### SPECIAL REPORT FOR THE WOOD-FORBES MISSION

Under date of April 18, 1921, I submitted to your office at your request a general report on the present condition of the Bureau of Science together with comparative data covering the periods 1909-1913 and 1914-1920, these data being prepared especially for the information of the Wood-Forbes Mission. Some of them are pertinent to this report.

The average number of technical employees in the Bureau for the period 1909-1913 was 35, all of whom, or practically 100 per cent, were men trained to do research work and who accomplished research as evidenced in their publications. At the same time they carried on a large amount of routine work. In contrast to this, the average number of technical men for the period 1914-1920 was 25, a reduction of approximately 29 per cent. At the same time there was a gradual reduction in the quality of our technical force, so far as individuals trained to do research work was concerned, until in 1920 approximately

30 per cent of the technical staff were employees who, while able to accomplish routine work under technical direction, were not trained to undertake research problems. The net result was that research, often badly needed, has been reduced to a minimum in most divisions, while routine work either has not decreased at all or has vastly increased.

An examination of the averages of routine work accomplished by divisions for the two periods in question shows a slight decrease in chemistry and in miscellaneous items, while in the division of mines, if we ignore the large amount of special work on gold refining accomplished in 1919, the average has remained approximately the same. In the biological and serum laboratories the averages for the routine work have increased from approximately 60,000 and 5,850,000, respectively, for the period 1909-1913 to approximately 261,000 and 8,000,000, respectively, for the period 1914-1920.

The annual appropriations for all purposes for the period 1909-1913 averaged ₱350,287 and for the period 1914-1920, ₱513,775. Of this increased amount, ₱200,000 was for the construction of the new serum laboratory at Alabang; so that, disregarding this amount, the average annual increase for all other purposes was ₱134,916. The comparison, however, is not entirely fair, as up to 1913 all income of the Bureau of Science was used for the needs of the Bureau, in addition to the amounts appropriated each year. From 1914 to date all income has reverted to the Insular Treasury as Government revenue. The actual income from all sources averaged ₱82,072 for the first period, as compared with ₱139,874 for the second period, an increase of about 70 per cent.

In summarizing this report, I called attention to the fact that the Bureau of Science is an institution in many respects radically different from other units of the Government service. Briefly, it was established for the purpose of centralizing in one institution the purely technical work of the Government in order to avoid unnecessary duplication of technical equipment, books, and technical personnel. The institution has been eminently successful, and from its inception its growth was rapid, and so far as its diverse activities are concerned all major lines of work now carried on were in operation at the beginning of the period under discussion. In 1909, the institution was well established and had attained an enviable reputation abroad as a research institution of the highest standing. It reached its maximal development in 1913.

The chief factor affecting the technical personnel of the Bureau of Science was the policy adopted in 1914, which resulted in the resignation of fourteen of our technical men during that year. Those who left at that time could not be replaced locally, as there were, and still are, comparatively few highly trained technical men in the Philippines, and even when technical men were present, their services were frequently not available on account of the inadequate salaries authorized. The World War was another factor that cannot be ignored. During the time the United States was engaged in war, it was absolutely impossible to secure the services of technical men in the United States. Another very important factor was, and still is, the inadequate salaries for technical men. Man after man, both Americans and Filipinos have left the service to accept more lucrative positions elsewhere.

The year 1918 showed the lowest ebb in our technical personnel, with but eighteen men, which number was steadily increased to twenty-two in 1919, twenty-nine in 1920, and thirty-three in 1921. To maintain the prestige of the institution additional support and additional technical personnel for research work are essential. A start has been made, but not a sufficient one to place the institution on the plane of efficiency and productiveness reached in 1913.

#### SPECIAL CONTRACTS

The present method of contracting for technical employees is highly unsatisfactory. New men can be brought from the United States under ordinary Civil Service rules on two- or three-year contracts, but special-contract employees can be secured only on one-year contracts renewable each year subject to legislative appropriations. So long as there is no revision in the Civil Service salary schedule the only possible way by which we can secure the services of certain technical men is by special contracts. Provisions should be made whereby a contract can be granted for a term of years in order that our employees on this basis can be assured of definite tenure of office, assuming of course that their services are satisfactory.

#### PENSIONADO STUDENTS

At the present time we have eight pensionado students in the United States; namely, Dr. Onofre Garcia, Dr. Antonio Garcia, Mr. Ramon Abarquez, Mr. Leopoldo A. Faustino, Mr. Antonio Alvir, Mr. Pedro Sengson, Mr. Salvador Fernandez, and Mr. Vicente G. Lava. During 1921 two pensionados returned; namely, Dr. Crisanto Pañganiban, veterinarian, serum laboratory, who

arrived on March 2, 1921, and Mr. Ramon Feliciano, organic chemist, who returned on June 1, 1921. Mr. Ramon Abarquez was granted additional time of six months from August, 1922. Drs. Onofre Garcia and Antonio Garcia are expected to return in September and October, 1922, respectively, and Mr. Leopoldo A. Faustino in December, 1922. No new pensionado students were appointed during 1921. The absence of these men has been a distinct handicap as this has reduced our productive force by eight men. On their return, however, their services, due to their specialized training, will be of very much greater value than would otherwise be the case.

#### LEGAL WORK

Certain important laws have been drafted by the personnel of the Bureau of Science covering fertilizer control, and insecticide and fungicide control, which should be enacted for the mutual protection of the farmers and legitimate manufacturers and importers in the Philippines. Comments and recommendations have been made on numerous other proposed laws appertaining to fisheries, the control of illegal fishing, mining, the problem of leasing Government lands for exploration and exploitation of crude oil, etc.

#### SYMPOSIUM

In August there was commenced a symposium, meeting at the Bureau of Science in the evening, once every two weeks, for a discussion of the whole subject of the origin and relationships of life in the Philippines. These meetings have been regularly attended by the members of our staff as well as by members of the University of the Philippines staff and other residents of Manila interested in geology, palæontology, ethnology, zoölogy in its broadest sense, and botany. The subject has been considered from the broadest possible angle, and a large mass of data has been compiled on geology, palæontology, ethnology, botany, and zoölogy bearing on the general subject. The data remain to be correlated and prepared for publication. The meetings are still being continued and will be continued until the subject is exhausted. The distribution of living plants and animals in the Philippines and the indicated relationships of the fauna and flora of the Archipelago with the fauna and flora of other regions can only be explained by taking into consideration all possible factors, including palæontological and geological data, evidence of previous land connections, etc. The discussions have largely

served to classify numerous points in reference to the origin of the primitive peoples of the Philippines, their probable paths of migration into the Archipelago, as well as similar data in reference to zoölogical and botanical relationships.

#### BIOLOGICAL LABORATORY

*Personnel.*—There have been few changes in the personnel of this division during the past year. Dr. A. W. Sellards, of the Harvard Medical School, was appointed on a one-year contract and reported for duty on July 28, 1921. There were no new appointments in the junior personnel.

*Routine.*—As usual, a very large amount of diagnostic work was done for the Philippine Health Service in connection with the control of communicable diseases. At the same time a considerable amount of similar work was done for the public in general, private physicians, and for such institutions as San Juan de Dios, St. Paul's, Mary Chiles Christian, St. Luke's, and Mary J. Johnston Memorial hospitals. One phase of routine work demanding considerable attention has been in connection with medico-legal cases and with the biological examination of drugs and foods intended for human consumption.

*Special work.*—The work in reference to the immunity of Filipinos to diphtheria infection and the significance of diphtheria carriers has been completed. This was initiated in the preceding year. We find that young Filipino children show as much susceptibility to diphtheria as do the children of other races, but from the age of ten years upward they show a greater proportion of immunity to diphtheria than do those of other countries. We have also found that a certain proportion of Filipinos carry in their throats diphtheria bacilli that are not virulent according to laboratory tests; the value of these tests has been confirmed by observations made in one public institution where carriers of this form were located on previous examinations and no measures taken to disinfect their throats; yet no clinical diphtheria developed in the period of over one and one-half years after the examinations were made, although carriers were found in the institution in subsequent surveys.

In coöperation with Doctors Avellana and Nicolas, Doctor Gomez made a thorough examination of the children born in the Culsion Leper Colony of leper parents with the idea of securing data in regard to the incidence of the disease among them, the manifestation and localization of the initial lesions, and the incubation period, the latter being practically the age of the child

when the first lesions develop. Work on this problem is to be continued.

On account of finding filarial infection among the inmates of the provincial prison at Iloilo, a general survey among representative groups of the general population is being undertaken with the view to determining the extent of filarial infection in the Philippines.

A large amount of time has been devoted to coöperative work with the Philippine Health Service in leprosy investigations and in the treatment of lepers both at the San Lazaro Hospital and at the Culion Leper Colony. On each leper-collecting trip under the auspices of the Philippine Health Service a member of the staff of the biological laboratory has been detailed for the bacteriological work.

Under the auspices of Doctor Sellards an investigation of yaws was undertaken with the object of determining the underlying factors bearing upon the control and upon the eradication of this disease. This work was done in coöperation with the Philippine Health Service and the Philippine General Hospital, most of the cases being secured from Parañaque. In connection with this work the Philippine Health Service opened a clinic at Parañaque for the special treatment of yaws. Selected cases are being studied with the view to determining whether or not they present any immunity after treatment with salvarsan.

In coöperation with Doctor Leiva, of the College of Medicine and Surgery, Doctor Sellards is carrying on an extensive investigation of amœbic dysentery with the view to improving the methods of treatment of this disease. Contrary to current opinion and contrary to the findings of other investigators, these investigators have shown definitely that experimentally infected animals are of distinct value in testing the efficiency of certain drugs in reference to the treatment of amœbic dysentery. In addition to investigations of the emetine treatment, satisfactory results have been obtained with preparations of *Castela nicholsoni*, a native of the southern United States and Mexico belonging in the family Simarubaceae. A considerable quantity of *Harrisonia perforata*, another representative of the same family occurring in the Philippines, has been secured and experimental work is now in progress with the view to determining whether or not it possesses similar curative properties. It is planned to undertake similar work with other native representatives of this family, as material can be secured.

In coöperation with Maj. J. E. Ash, of the Army Medical Corps, Professor Haughwout completed a dysentery survey at Fort Mills, the work having been initiated in November, 1920, and completed in February, 1921. A preliminary report has been submitted to the military authorities, and the final report is being worked up for publication by the investigators. During the course of this investigation many important data were collected, and the findings have proved to be of great value to the military authorities. As a direct result of this work, the entire problem of intestinal diseases on Corregidor was cleared up, and since the work was completed admissions to the station hospital under the diagnosis of dysentery have practically ceased. In coöperation with Major Ash, an extensive series of studies on the incidence and distribution of intestinal parasites among food handlers in the United States Army is being carried on; also a study of parasitism among American school children in Manila and vicinity, and, further, a series of studies on the incidence of intestinal parasitism in the adult American and European population of Manila.

Toward the end of the year Professor Haughwout made a preliminary survey of the employees of the Benguet Consolidated Mine at Antamok and at the same time secured considerable data regarding the typhoid situation in Baguio.

In September Professor Haughwout attended the dedication exercises and medical conference of the Peking Union Medical College, his participation as a representative of the Bureau of Science having been made possible through funds secured by private subscription in Manila supplemented by the necessary balance which was granted by the Rotary Club of Manila. On his return to Manila and at the request of Dr. Victor G. Heiser, of the International Health Board, he consulted with the British health authorities in Shanghai regarding an alleged epidemic of amœbic dysentery in that city. He was able to supply them with certain constructive criticisms and suggestions, and was definitely requested to return to Shanghai some time during the coming year for a more intensive study of the situation.

Very satisfactory relations have been maintained with other workers in parasitology in the United States and Europe, and local material has been supplied to several of them. In this connection Dr. M. M. Metcalf, of Oberlin, Ohio, who has been engaged on an intensive study of the Opalinadae, a family of ciliated parasitic protozoa, has arranged to send to the Bureau of Science a set of paratypes of somewhat more than one hundred



thirty species. In exchange for this courtesy such material as is available in this group in the Philippines will be forwarded to him for study.

The work of the two branch laboratories, one at Cebu and one at Iloilo, has on the whole been satisfactory. However, arrangements should be made either to increase the number of these laboratories, or to transfer this provincial work to the Philippine Health Service.

The routine work of the biological laboratory is well indicated by the table appended to this report.

#### SERUM LABORATORY

*Personnel.*—There has been no change in the personnel in the laboratory. Dr. Crisanto Pañganiban, a pensionado, returned from the United States where he was engaged for two years in serum work in the Health Laboratory, New York City, and resumed his duties in the laboratory on March 28, 1921.

The operations of the serum laboratory of the Bureau of Science for the present year have been mostly of a routine nature. The ultimate transfer of the serum laboratory to Alabang, Rizal, was commenced early in March and was completed by the end of the month. The transfer of apparatus and instruments necessary for serum work and their installation at the new place were accomplished in such a way that regular work was not interfered with in the least. The operation of the plant from the time the transfer was made up to the present date has been satisfactory and without interruption, due principally to the fact that the suggestion of the staff that a sufficient stock of fuel, lubricating oil, and ammonia be secured was carried out. Therefore, the power plant could be run continuously, so that the electric power for the water supply, for the cold-storage machinery, and for the incubators so essential for serum work was always available.

During the year the purchase of horse feed was reduced considerably, and as a consequence the majority of the serum animals had to be pastured. There is no doubt that the horses roaming at large came in contact with infected carabaos and through this fact surra, a disease of horses and carabaos, was transmitted to the live stock kept for serum purposes. The outbreak was first reported in August, 1921, by the veterinarian in charge of live stock. Upon thorough microscopic survey of all animals fifteen horses and mules were found to harbor in their blood the trypanosome causative of surra. Daily examination of the blood of all animals was made, and the follow-

ing measures were taken to eradicate the outbreak: All live stock was examined microscopically, and those animals that were found positive for parasites were segregated and destroyed as quickly as possible. No animal of any kind was allowed to leave the premises, and no animal was allowed to enter from the outside. Negative animals were examined daily, and those found positive microscopically were immediately segregated to be destroyed; while others, although microscopically negative but clinically suspicious, were segregated from the negatives as well as from the positives. Smears made from blood on the positive cases were submitted to Dr. W. H. Boynton, pathologist of the Bureau of Agriculture, for confirmation of diagnosis.

On consultation with Doctor Boynton the measures recommended by him were continued, and on September 23 it was possible to report that for the past four weeks there had been no new cases of surra found among the animals used for serum and vaccines. In all forty-one horses and mules were destroyed on account of the disease in question. Besides the horses and mules certain carabaos were found to be afflicted with surra. The carabaos on hand at that time were all used animals; that is, they were used previous to the outbreak for the preparation of smallpox vaccine and yielded the usual amount of this product. They were kept on hand longer than necessary for our purposes, awaiting arrangements for their disposal by sale. All these animals were killed, and their meat was utilized for the preparation of toxins to be used in manufacturing serum.

At the time surra appeared at Alabang, the horses and mules were pastured on account of the scarcity of feed. Several of them, however, were tied permanently in the shed, partly because they were being bled for serum and partly for the reason that they were intractable and a danger to the rest of the live stock. It is interesting to note that none of the horses that were tied in the shed became infected, in spite of the fact that they came in daily contact with the rest of the live stock and in spite of the fact that the fly *Tabanus striatus*, which it is claimed is responsible for the transmission of surra, was repeatedly found in the shed. There is no doubt that a similar occurrence can be avoided in the future, provided that a sufficient food supply for the horses is secured so that they can be fed in the stable during the daytime and pastured at night only, when there is less chance of contracting surra, due to the absence of insects.

Efforts are being made to supply an adequate amount of green forage for our serum animals by bringing into cultivation

the series of old paddies below the large stable. Para grass is being extensively planted, and the paddies are irrigated by the waste water from the refrigerating plant and the main laboratory. Ordinary sugar cane and the so-called Japanese cane have been planted extensively to supply food for the small animals, chiefly guinea pigs and rabbits. Several varieties of spineless cactus have been received from the United States Department of Agriculture and planted at Alabang with the view to supplementing our forage in the dry season.

Investigations are under way in connection with the purification and concentration of serums with the view to the adaptation of these methods to practical purposes. Considerable attention has been given to the preparation of dried vaccines and serums, because the dried products are much more practicable for use under the climatic conditions existing in the Philippines than are the standard liquid products, as no ice or cold storage is necessary in shipping the dried products. Our output of dried products is limited by the drying space available; more ovens should be supplied. In the Manila office a comparative study of the antiseptic value of various oils, with special reference to the treatment of tuberculosis, is in progress. At the same time a study of the immunity resulting from vaccination with cholera vaccine is also in progress.

With the transfer of the serum laboratory to Alabang, the Manila office is maintained only as a distributing office, the actual administration of the Pasteur antirabic treatment and the preparation of certain autogenous vaccines being carried on in Manila in connection with the biological laboratory.

The amounts of products manufactured and dispatched both to the Government and through private sales are indicated in the following table:

*Comparison of serum and vaccines bottled and disposed of at the Bureau of Science in 1919, 1920, and 1921.*

Product.	1919	1920	1921	Increase.	Decrease.
Antitetanic serum ..... units.	5,244,000	4,616,000	4,412,000	-----	204,000
Antidysenteric serum ..... cc.	67,740	73,740	63,040	-----	10,700
Normal horse serum ..... do.	6,810	18,150	15,750	2,600	-----
Vaccine virus ..... units.	9,465,417	4,494,204	3,278,599	-----	1,215,605
Cholera vaccine ..... cc.	-----	-----	557,974	-----	-----
Gonococcus vaccine ..... ampules.	2,864	3,460	5,913	2,453	-----
Other vaccines ..... do.	7,715	271,466	62,978	-----	208,488
Autogenous vaccines ..... treatments.	57	79	64	-----	15
Pasteur treatments ..... sets.	453	771	1,072	301	-----
Wassermann reactions ..... -----	331	1,236	786	-----	500

## BOTANY

*Personnel.*—There has been no change in the personnel in this division, the work being carried on with a distinctly reduced force in comparison with the force employed some years ago. The chief work of the division is carried on by me in addition to my duties as Director. Most of the work has been of a systematic nature.

*Exploration.*—Field work has been done on behalf of the Bureau by Messrs. Ramos and Edaña, chiefly on Mount Calavite in Mindoro and in Lepanto Subprovince, Luzon. All material collected has been identified and incorporated in the general herbarium. Considerable material has been received through the Bureau of Forestry, while ample collections have been submitted by various residents of the Archipelago for identification.

*Systematic work.*—The manuscript on the systematic enumeration of Philippine plants, which has been in process of completion for several years past, has been brought up to date, and fascicles 1 and 2 of volume 1, including the gymnosperms and the monocotyledons up to the Orchidaceae, and volume 2, fascicle 1, dicotyledons from the Casuarinaceae to the Nepenthaceae, inclusive, have been sent to the printer. The work on the general introduction is well advanced and should be practically finished in the near future.

*Identifications.*—All Philippine material received has been identified and incorporated in the herbarium. Work on extra-Philippine material has claimed a great deal of time and attention. The entire Bornean collection made by Mr. Ramos in 1920 in British North Borneo, comprising approximately 1,000 numbers, has been worked up and the new forms have been described, approximating three new genera and over one hundred new species. The first set has been incorporated in our herbarium, a second set mounted and returned to the Forestry Service at Sandakan in accordance with the terms of our agreement, and the remaining duplicates have been distributed to various botanical institutions in Europe, America, Asia, Malaysia, and Australia on our exchange account. Collections approximating 450 numbers made by Mr. J. F. Rock in Burma, Siam, and Assam for the United States Department of Agriculture, and submitted by the Smithsonian Institution for identification have been studied and reported. About 110 specimens of Sumatran plants have been identified for Dr. H. S. Yates, formerly of this Bureau. A collection of about 296 Bornean plants made by Maj. J. C. Moulton, of the Raffles Museum, was

submitted by Mr. I. H. Burkill; in addition, identifications were made of a considerable number of Sumatran plants also submitted by Mr. Burkill. Preliminary identifications were made of over 1,000 numbers of plants from the Malay Peninsula and Siam, submitted by Dr. F. W. Foxworthy, of Kuala Lumpur, F. M. S., in 1920. Over 2,600 numbers collected by Mr. G. W. Groff, Prof. K. K. Ts'oong, Mr. C. O. Levine, and Mr. F. H. McClure in southern China, Hainan, Indo-China, and Siam were named for the Canton Christian College. Two hundred identifications of Indo-China material were made for Prof. A. Petelot, of the College du Protectorat, Hanoi, Indo-China. A collection of 380 numbers of Chinese plants from Nanking University, Nanking, China, was examined and numerous identifications were made. Bornean collections received from Mr. A. D. E. Elmer the latter part of the year, approximating 150 numbers, have been identified, as well as 312 numbers received from the Forestry Service at Sandakan, British North Borneo. A few identifications of Hainan plants were made for Miss Margaret M. Moninger, of Kacheck, Hainan.

The only material submitted during the year that remains unreported is approximately 2,300 numbers of Dr. O. Warburg's collections from the Philippines, Java, Amboina, Celebes, the Moluccas, Formosa, and Indo-China, made in 1885-1889. This large collection was received from the Berlin Botanic Garden for identification late in the year and is not yet entirely mounted and hence is not available for study. The work will be completed early in 1922.

From extra-Philippine sources, then, over 6,200 identifications have been made during the year, with 2,300 still remaining to be completed. The material received for identification will all be incorporated in our collections.

*Herbarium.*—Accessions to the herbarium from all sources during the year have totaled 14,068, bringing the number of mounted sheets up to approximately 226,400, of which about 125,000 are Philippine, the remainder extra-Philippine.

*Exchanges.*—The accumulated duplicate material, including both Bornean and Philippine specimens, has been made up into sets and distributed on our general exchange account to numerous institutions in the United States, England, France, Holland, Germany, India, Malaysia, China, and Australia. Including fungi and the higher plants, a total of 33,995 specimens has been forwarded. In the same period, aside from approximately 6,200 specimens received from neighboring countries in tropical Asia

for identification, including India, Burma, Siam, the Malay Peninsula, Sumatra, Borneo, Indo-China, and China, about 2,413 specimens have been received in exchange from the Botanic Garden, Singapore, the Botanic Garden at Buitenzorg, Java, the United States National Museum, the Brisbane Botanic Garden, the Sydney Botanic Garden, and the Arnold Arboretum. The largest individual collection received was a magnificent series of duplicates of Warburg's Malayan and Philippine collections, approximating 2,300 numbers, from the Berlin Botanic Garden, received too late in the year for accessioning.

*Loans.*—Mounted specimens in various groups approximating 400 sheets were loaned to specialists in other countries, including Orchidaceae to Mr. Oakes Ames and Dr. R. Schlechter, Asclepiadaceae to Dr. R. Schlechter, Triruridaceae to Dr. J. J. Smith, *Lycopodium* to Dr. W. Herter, and *Panicum* to Mr. C. A. Backer.

At the same time large quantities of duplicate material were sent for identification to certain specialists; notably fungi to Dr. H. Sydow, fungi to Mr. C. G. Lloyd, mosses to Dr. V. F. Brotherus, orchids to Mr. Oakes Ames, and asclepiads to Dr. R. Schlechter. Duplicates sent for identification approximate 1,400 specimens.

*Publications.*—In addition to several papers submitted to the Philippine Journal of Science, listed elsewhere, an extensive manuscript on Bornean plants has been prepared and submitted to the Royal Asiatic Society, Straits Branch, at Singapore, for publication in the Journal of that society. My bibliographic enumeration of Bornean plants, comprising 637 pages, was issued as a special number of the Journal of the society in September, 1921.

*Medicinal plants.*—The work on medicinal plants has been prosecuted under the direction of Dr. Leon Ma. Guerrero, as in previous years, and many additional data have been compiled. Doctor Guerrero has published in the Philippine Census Report an extensive consideration of Philippine medicinal plants. Our chief needs in this line at the present time are a competent pharmaceutical chemist for isolating and studying the active principles of our promising and more or less unknown medicinal plants, and the coöperative work of a physiologist to study the effects of the drugs on animals with the view to adapting promising new principles to the practice of medicine.

#### PLANT PATHOLOGY AND MYCOLOGY

The personnel of the plant-pathology and mycology laboratories has continued during the past year as in 1920, the work

being in charge of Mr. H. A. Lee. The Bureau of Agriculture has also continued its coöperation as in the past, detailing four assistants for experience and study in these laboratories. The organization of the work has continued as in 1920, specializing on agricultural and industrial mycology with some attention to systematic mycology; due to lack of personnel, little or no attention has been given to medical mycology.

*Agricultural mycology.*—This work has continued as in the past under the headings of diseases of abacá, diseases of sugar cane, diseases of rice, diseases of tobacco, and routine determinations and correspondence. By an arrangement made with the Bureau of Agriculture, the work of these laboratories in connection with the Plant Quarantine Service is at present purely advisory.

Of the diseases of abacá most attention has been given to what is known as abacá heart rot. This disease has been previously described by Reinking as a bacterial one. Our work shows that a fungus of the genus *Fusarium* is uniformly associated with the disease. Results from over four hundred inoculations with this fungus upon healthy plants show that the disease was produced in more than 75 per cent of the cases. Control punctures without the fungus have given negative results almost uniformly. The fungus has been compared with one of the same genus, *Fusarium cubense*, which causes banana wilt; we have shown that the differences are very slight and that undoubtedly the *Fusarium* of abacá heart rot is of the same type as that of banana wilt, although possibly a subspecies or a variety. Considerable evidence has accumulated pointing to prevention of the disease by improvement of air drainage or ventilation in abacá plantations. There are also slight differences apparent in the degree of suceptibility of some of the abacá varieties, which may lead to effective control of the disease by the use of resistant varieties. A paper on this disease is now in progress of preparation.

The efforts of the past year have been mostly devoted to work on sugar-cane diseases. At the beginning of the work in our laboratories only the most obvious of the cane diseases were known and such knowledge as existed regarding the prevention of such diseases was largely academic. During the past year we have shown the presence of the following diseases on cane, hitherto unreported from this country: Fiji disease; mosaic disease; pineapple disease; downy mildew; banded sclerotial disease; ring spot; *Pestalozzia* leaf spot; helminthosporiose;

yellow leaf spot; red rot leaf-killing disease, caused by the fungus *Colletotrichum falcatum*; red rot of the leaf sheath, caused by the fungus *Sclerotium rolfsii*; wilt; pokkah bong; and red vascular disease. The information on the presence of these diseases is of course of more than academic interest, since these data have a direct connection with the plant-quarantine work and are continuously in use in routine determinations and correspondence.

Fiji disease, the most destructive disease known on sugar cane in any country, has been found, not only in Luzon and Mindoro, but also in Negros. Investigations on this disease have incidentally determined the exact channels by which it was introduced into the Philippines and disseminated. The disease may entirely eliminate a crop, although much more frequently losses of 25 to 10 per cent or, in newly affected plantations, even less are observed. The transmission of the disease by seed cuttings has been very clearly shown by our experiments, and such experiments have also shown that the disease may be minimized by seed selection. Further work on this disease is in progress in coöperation with Prof. Colin G. Welles, of the College of Agriculture, University of the Philippines.

Downy mildew, known previously only from Australia and Formosa, has appeared in two localities in Luzon. In both cases it is apparently of recent introduction. In one locality the disease has been entirely eradicated and as yet no recurrence has taken place. In the other locality, energetic steps are being taken by the planters, with our coöperation, to eliminate it entirely. The prospects are in favor of the entire eradication of the disease from this country. Observations on this disease show that, whereas affected canes are stimulated to greater growth, their sucrose content is reduced to half or even less. Affected cane of a ratoon crop, however, is not stimulated but is severely stunted. The Japanese canes, such as *uba* and *tigbao mestiza*, are most easily affected.

Experiments on sugar-cane smut have corroborated previous investigations showing the transmission of this disease from crop to crop by seed cuttings and points. Dissemination was also shown to be effected in the immersing in water of healthy points mixed with diseased points. Field observations have shown that ratoon crops are much more severely affected than plant crops. This condition has given rise to an experiment which has shown that infection of cane plants may take place to some extent through the cut surfaces exposed on the stubble.



Considerable knowledge is also now available concerning resistant varieties. The Cheribon canes, Caledonia canes, H-109, D-1135, and Badilla have never been observed to be affected.

In our investigations on sugar-cane diseases we have been greatly assisted and encouraged by the Calamba Sugar Estate and the Pampanga Sugar Mills. Acknowledgment and appreciation should also be extended to the Experiment Station of the Hawaiian Sugar Planters' Association for encouragement and assistance as well as for the gift of a complete set of the very valuable publication of that station, the Planters' Record.

Investigation of tobacco diseases has been along the lines of securing disease-resistant varieties of tobacco. The work on the rice diseases has been in the main identification of the great number of fungus diseases of rice prevalent here. The serious disease of rice that we have been calling sterile head, which occurs in the Mountain Province, has so far given no results in our work to determine the cause. However, varieties of rice entirely resistant to the disease have been observed.

During the year over five hundred routine determinations of plant diseases have been made and correspondence concerning them sent out.

*Industrial mycology.*—Some routine work was done on a fungus spotting of crêpe rubber. Some work has also been done on the molding of leaf tobacco in the camarins and on the molding of cigars in storage. Recommendations in all such cases involve circulation of air and ventilation, and suggestions have been given for providing these results. Control of moisture conditions is also essential. The utilization of sunlight as a fungicide has been frequently referred to. On leather and rubber products deterioration due to fungi may frequently be minimized by judicious applications of pulverized sulphur.

The most important problem in industrial mycology during the past year has been the determination of the cause of abacá deterioration and methods of prevention. It has been shown in this laboratory that fungi, bacteria, and other microorganisms are constantly associated with deteriorated abacá. These microorganisms have been isolated and in many cases have been shown to be capable of vigorous solution of cellulose. Preparations of sections of deteriorated fiber have also shown the presence of these microorganisms under the microscope, and the cells of such fibers very badly dissolved and disintegrated. The cause of the deterioration thus seems very clearly indicated, although we wish further opportunity to prove this point by

carefully controlled reproduction of such deterioration by inoculation experiments.

The deterioration of abacá fiber by microorganisms is favored by imperfect drying after stripping and by damp, humid conditions in the bodegas and in transit. Such being the case, prevention of the deterioration may be effected by more careful drying after stripping, better storage and transportation conditions, and better ventilation and air circulation in bodegas. A promising field of research is the determination of a gas that will act as a disinfectant and bleaching agent on the fiber without weakening it.

Under industrial mycology would also be considered the frequent recommendations we have made to prevent the deterioration of glass. Glass in the Tropics is attacked by fungi. In this way, valuable optical glass and objectives are frequently ruined. Suggestions for the prevention of injurious molds are: The exposure of the glass objects to strong sunlight at given periods; maintenance of the glass objects under dry and well-ventilated atmospheric conditions; and occasional careful and judicious polishing of the objects with alcohol.

*Systematic mycology.*—The work has included numerous routine determinations of species, the collection of material for the work of specialists on certain classes of fungi, and the distribution of specimens of Philippine fungi. During the past year over 2,000 duplicate specimens have been distributed to mycologists in other countries, while about 1,400 such specimens have been received in exchange. Some attention is now being given to the collection and naming of Philippine fungi for distribution. Some work in this laboratory has been done in identifying for the public the edible and the poisonous forms of fungi. The equipment of the mycological laboratories at the present time is probably unexcelled west of Washington, D. C. The library facilities for this work are also probably unequaled in the Far East.

Recommendations for the year would include the increase of the mycological reference literature on the fleshy forms of fungi; that is, the edible and the poisonous fungi. The equipment could be slightly bettered by a few small acquisitions of apparatus. The present weak point in the work is the inability to get into the field, an essential for agricultural mycology. With the increase in revenues of the Government during the coming years, it is recommended that a light automobile be acquired for this important branch of the work.

*Medical mycology.*—This very important work should be given consideration. For this branch of the work, it is essential that a medical man with graduate work in mycology be added to the personnel. If such a man cannot be obtained, coöperation between a man of medical training and the present personnel should be arranged. The important lines of investigation in medical mycology are: Fungus diseases of the skin, alimentary disturbances due to fungi, and food poisons.

#### ENTOMOLOGY

During the first four months of the year Mr. Charles S. Banks was in the United States on leave of absence, returning to duty on May 2, 1921.

While in the United States he did some work at the American Museum of Natural History, in New York City, and at the United States National Museum, in Washington, in the classification and identification of a small collection of rare insects taken by him in September, 1920, for that purpose. While in New York he was also able to carry on considerable propaganda work among the possibly interested regarding investment of capital in the silk industry in the Philippines. As a representative of the silk interests of the United States is coming to Manila early next year, this visit may prove the wisdom of his work while there.

*Routine.*—The routine work of this division is constantly increasing and calls have been had for the identification of many kinds of insects injurious to a great variety of objects, both for private individuals and for the various offices and bureaus of the Government. Many reports on specific insects and their injuries have been made both orally and in writing to interested parties, and wherever possible suggestions for combating the specific pest have been made.

*Accessions.*—Through collecting and rearing of insects and through gifts or exchanges about 15,000 insects have been added to the collection since May, 1921. In many cases these consist of duplicates which can be used in exchange now that world conditions have settled down to somewhere near normal and material can be forwarded with safety. Many interesting and valuable life histories have been worked out for insects hitherto unknown, and this material has also been added to the collection and notes made for future publication as time permits. The actual number of accession cards written has not been very great owing to lack of technical personnel to whom to entrust this important work.

*Exchanges and identifications.*—Material has been sent to the United States National Museum, the Hawaiian Sugar Planters' Experiment Station, the American Museum of Natural History, the Dresden Zoölogical Museum, and the Brooklyn Academy of Arts and Sciences, and we hope to receive not only valuable exchanges from these sources, but also identifications of material. Dr. L. O. Howard, of the United States Department of Agriculture, and his staff have very generously determined much of our material.

*Donations.*—Many private persons have brought in specimens for our collection, and in this connection the specimens of rare insects donated by Father Francisco Sanchez, S. J., deserve particular mention.

*Publications.*—Several papers have been submitted for publication in the Philippine Journal of Science, while popular articles have been prepared for the local press on mosquito control, the house-fly situation in Manila, insects injurious to sugar cane, coconut insects, and the possibilities of silk culture in the Philippines. There is in course of preparation a treatise on Philippine house insects, which it is hoped to have illustrated and made available for general distribution in order that it may serve as a textbook in the schools of the Islands, as well as a guide to householders in general in combating pests that do damage in the home or that are capable of transmitting diseases.

*Plant Quarantine Board.*—Being a member of the Plant Quarantine Board, the entomologist has attended its meetings, aided in the preparation of drafts of proposed laws, drawn up rules, and most important of all identified many miscellaneous insects intercepted by Bureau of Agriculture inspectors.

*Silk culture.*—The silk industry should some day be one of the leading sources of revenue to the Filipino people, and with this end in view we have continued our silk-culture work in order that we may have strains of thoroughly acclimatized eggs for distribution to those desirous of starting the work on a commercial scale.

*Mosquito and fly work in Manila.*—While the entomologist is no longer connected with the mosquito extermination in the City of Manila, he is frequently consulted by those having this work in charge as to the best methods of carrying on the work, and he has made several trips around the city with the chief of the mosquito brigade to see the conditions and suggest improvements in this as well as in fly work.

*Entomological exploration.*—Owing to lack of funds no trips have been possible during the year, but there is great need for further field work on coconut, coffee, citrus, sugar-cane, cacao, rice, corn, and tobacco insects, always presupposing the existence of sufficient personnel for carrying it on.

*Personnel.*—All the entomological work of this division falls on the shoulders of one man, with no technical help of any kind, and it is impossible, in any country as large as this, that even routine work can be done effectively by a single person. Additional personnel is urgently needed.

#### FISHERIES

During the early part of the year Doctor Herre was engaged in arranging and preparing for a fisheries exhibit at the Magallanes Exposition. Previous to the exposition a collector was sent to Calapan, Mindoro, for the purpose of securing an assortment of brilliantly colored reef fishes to amplify the stock in the aquarium.

Shortly after the close of the exposition a trip was made to Laguna and Batangas Provinces where investigations were made of Lake Cayman and Lake Sampaloc in order to ascertain the results of planting black bass and carp in these lakes several years ago. The results were negative for both. On this trip an investigation was made of Pansipit River near its source in Lake Taal. As a result of the investigation of the fisheries of this river, a bill was prepared and submitted to the Legislature for the purpose of preventing the destruction of spawning fish during their migration. It was found that due to the methods used in Pansipit River it was practically impossible for any migratory fish to reach Lake Taal from salt water, the result being that the fisheries in Lake Taal have become very badly depleted. In connection with the same trip, investigations and observations were made on the local methods of fishing, and trips were made with local fishermen. Later another trip was made to Batangas for further investigation of fishing methods, and while on this trip the Provincial Treasurer furnished transportation to Layia where the submarine gardens, or coral reefs, were investigated with the purpose of determining whether or not it would be possible to secure stock for the aquarium more economically from Layia than from Puerto Galera. It was found that the submarine gardens at Layia were less accessible than those at Puerto Galera.

Investigations were made in Bataan Province in connection with the possibility of establishing a fish-canning industry at Orion. A cannery is already in operation there for the purpose of canning pineapples. The plant is equipped to handle fish, but has never operated with fish owing to local conditions. The fishing industry was investigated along the Bataan coast from Limay to Abucay. A considerable amount of time was devoted to securing information regarding the activities of a group of Japanese fishermen who were catching fish by methods new to the Philippines and bringing them to Manila packed in ice. The Japanese interests coöperated fully in this work, supplying transportation and partial subsistence, and otherwise aiding by collecting numerous specimens, in return for assistance rendered them. The investigations were carried on in the vicinity of Romblon, Sibuyan, Cresta de Gallo, Maricaban, Culion, Busuanga, and elsewhere. Through this coöperative work we were able to assist the fishermen in solving various local problems, and were further able to assemble a considerable amount of information regarding fishing grounds in the Philippines, and at the same time to add a large amount of valuable material to our collections.

In April an extensive trip was made to Cebu, Bohol, Butuan, and the region in the vicinity of the lower Agusan River, Cagayan de Misamis, and to Bukidnon, Lanao, Zamboanga, and Sulu Provinces. In Bukidnon data were obtained in reference to the feasibility of stocking the mountain streams with fish. Advice and assistance were also given to the agricultural school authorities near Linabo in connection with the construction of fish ponds. A general investigation was made of the fish and fishing industry in Lake Lanao, but no black bass were detected there, although bass were planted in Lanao some years ago. Lake Dapao was visited, especially in connection with the possible establishment of carp there; carp were planted there several years ago, but none were found on this trip. Extensive collections were made in the vicinity of Kolambugan in Pangil Bay and in the fresh-water stream flowing into Pangil Bay. In Zamboanga additional collections were made and data supplied to the local authorities in reference to stocking the pond at the hydroelectric plant with fish. Various points in and about Sulu were visited and investigated, and at the request of Governor Moore a trip was made to Sitanki, Bongao, and Siasi. The general local methods of catching, salting, and drying fish were observed, as well as special methods of preparing squid, shark

fin, and trepang. At Bongao and at Zamboanga additional information was obtained concerning the sponge and the black-coral industries. In Jolo information and advice were supplied to individuals about to engage in the cold storage and shipping of fresh fish from Jolo, which saved them considerable financial loss. At Dumaguete arrangements were made for securing collections from that point.

Preservative and collecting tanks were assigned to Mr. Eugenio Fénix, of Alaminos, Pangasinan; Mr. Alejo Arce, of Camarines Sur; Mr. H. R. Montalban, of Iba, Zambales; Capt. F. L. Link, of Jolo; and Prof. J. W. Chapman, of Silliman Institute, Dumaguete; through their coöperation much material of special value to our collections was obtained.

Through coöperation with Mr. E. H. Taylor, Dr. R. E. Dickerson, and the California Academy of Sciences, funds have been made available to pay all or part of the expenses of field work carried on by Mr. G. Lopez in Romblon, Sibuyan, Culion, the Batan Islands, and elsewhere, through which coöperation we not only secured many rare specimens, but also greatly extended our knowledge of the distribution of individual economic species in the Philippines.

A great deal of time and energy have been spent in answering correspondence and in supplying individuals with information and advice regarding commercial matters in connection with the local fishing industry.

Doctor Herre has written a number of popular articles upon Philippine fisheries, and especially in reference to the introduction of improved methods of catching and preserving fish and other marine products, for both the English and the Tagalog press. He has finished the manuscript of an extensive account of Philippine eels, which is now ready for publication except for its illustrations.

The cephalopod material in our collection, which is rather limited, together with that of the zoölogical department of the University of the Philippines, has been sent to Prof. S. S. Berry, of Redlands, California, who has just finished an extensive account of the Japanese representatives of this group and is now engaged in monographing those of Australia. Efforts are being made to enlarge our collections of cephalopods and to supply as much additional material to Professor Berry as possible, in order that he can prepare for publication here a general account of the Philippine species of this group, which is of very considerable economic importance.

## ORNITHOLOGY AND TAXIDERMY

The usual amount of custom work, consisting of mounting birds and mammals and tanning skins, was done. This work is continued as a convenience to the public.

The time of the artist assigned to this section is fully employed in making signs, maps, diagrams, charts, and black and colored drawings. Most of these are used to illustrate the Philippine Journal of Science. There is always much work ahead that cannot be completed by one artist. An additional artist is needed to meet the present current demands of other sections of the Bureau.

Mr. McGregor gave a series of lectures on Philippine birds before a class in systematic zoölogy at the College of Liberal Arts and carried a three-hour course in library science through the first semester.

One short field trip was made to Bataan Province, but no ornithological collecting of much value was possible, because of the lack of funds for travel expenses and because of urgent office work.

Almost no progress can be reported in the study of the food of birds. Some material on hand needs to be examined, and more must be collected before enough data will be available for publication. However, with the present work connected with publications that seems necessary, it is impossible to do much work on the important subject of economic ornithology. On the whole, we have been able to handle only the ordinary routine work appertaining to this division, and little progress can be expected with the limited personnel and the great demands on Mr. McGregor's time in connection with the editorial work and printing of the Philippine Journal of Science and our other technical and popular publications. Up to March 1, 1921, Mr. McGregor was Acting Director of the Bureau in the absence of the Director, in addition to his legitimate duties in the divisions of ornithology and of publications.

## GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

*Personnel.*—There has been no change in the personnel of this division since the last report except the detail of Miss Asuncion Sandoval, a temporary scientific assistant, Metropolitan Water District, to work in our water laboratory. Miss Sandoval is principally occupied in making analyses of water taken from the different stations along Angat River within the area covered by the proposed water-supply reservation for the City of Manila. Her salary is paid by the Metropolitan Water District.



*Routine.*—The routine work of the division has been varied and considerable, as shown in the following table:

Nature of material.	Samples.
Rocks and minerals.....	33
Metals and alloys.....	15
Soils, fertilizers, cements, and clays.....	8,511
Road materials.....	1
Stone, gravel, sand, and concrete.....	501
Physical tests of wire, twine, textiles, steel, fiber, tar, asphalt, paper, etc .....	23
Water .....	188
Standardization of weights and measures:	
Length .....	1,646
Capacities .....	
Weights .....	69
Coal analyses.....	18
Calorimeter determination of fuels.....	3
Paints, natural pigments, and varnishes.....	1
Crude chemicals (preparation and analysis).....	13
Fire assay of gold and silver.....	457
Refining of precious metals..... grams...	7,040
Miscellaneous .....	547

*Section of weights and measures and water analysis.*—The daily routine work of this section consists in the analysis of water for drinking, irrigation, and industrial purposes; the testing, standardization, and correction of weights and measures; the calibration and adjustment of various scientific apparatus, such as optical and electrical instruments, balances, thermometers, etc.; the preparation of standard solutions; and miscellaneous work, such as the analysis of clays, water, sediment, etc.

Considerable work has been added due to the active coöperation being rendered to the Metropolitan Water District on the water-supply project in the Angat region, Bulacan Province.

A preliminary report on the quality of the water of Angat River was submitted to the Metropolitan Water District in October, 1921. Coöperation is also being rendered the Philippine Health Service in its efforts to improve sanitation by helping the different municipalities in the solution of their water-supply problems.

It is regrettable that the important investigation on the provincial water-survey work had to be discontinued for lack of funds. This work was started last year in Bulacan Province, but was abruptly stopped due to shortage of funds. It is recommended that funds be provided for transportation expenses, so that the work on the provincial water survey started in 1920 can be resumed. This work is considered by the health author-

ities to be of considerable importance in connection with the improvement of sanitary conditions in the provinces.

The influence of bacteria on the acidity and alkalinity of surface waters under ordinary Philippine conditions is also being studied. Steaming tests of coals to determine their value under boiler conditions are also being undertaken.

During the year the control work on the fineness of silver bullion used by the Philippine Mint was continued, and a method for determining the quantity of silver in copper-silver alloys is now being developed. This method is considered more rapid and probably more accurate than the standard method now used in the different mints in the United States.

*Materials-testing laboratory.*—During the early part of this year the physical testing laboratory moved into new quarters amply commodious to accommodate all of the testing apparatus heretofore scattered in different places. Most of the testing machines have been mounted, but there still remain to be set up a sieving machine, a Dorry hardness-testing machine, and a twine and fabric tester. The ball mill and abrasion tester remain to be belted to the counter shaft. Three new pieces of testing apparatus acquired in 1921 are two Fairbanks tensile-strength-testing machines for cement briquettes and one Dorry machine.

In addition to the routine work, several research problems have received attention. A paper entitled Physical Properties of Philippine Concrete and Concrete Aggregates was published in the Philippine Journal of Science for February, 1921. Data on failing concrete in the Philippine Islands are being accumulated. The final data on Dr. J. C. Witt's cement studies have been obtained and have been forwarded to him in the United States. Considerable headway has already been made on the tensile-strength tests of standard grades of abacá, and it is probable that the results will be available early in 1922.

*Analytical section.*—Besides the regular chemical analyses made for the various bureaus of the Government as well as for local commercial concerns, the personnel has been often called upon to do work of an advisory nature, involving the interpretation of results for industrial purposes and such other information as may be pertinent to the cases presented.

Full advantage has been taken by private individuals of the facilities offered by the Bureau of Science for the assay of gold and silver in their business transactions. Special cyanidation and amalgamation tests were also made to accommodate the necessity of some mining concerns.

Recently the results of investigations made by this Bureau on galvanized iron attracted the attention of some manufacturers and exporters abroad, and as a result concerted efforts are being made so that roofing material of the quality suited to tropical conditions may become available to local dealers and consumers. This is an important step in securing a more durable kind of galvanized sheet. In view of the fact that we are annually importing approximately ₱2,000,000 worth of this material, various kinds of roofing materials that have recently been put on the market are being tested under weather exposure. It is planned in the very near future, in coöperation with other Government bureaus, to begin a comprehensive series of tests of all roofing materials available in the local market that can be submitted to weather-exposure tests. Important results will ultimately accrue from this work.

On account of the large number of samples submitted for analysis, very little time could be devoted to investigation work. However, some research problems are under way; such as the study of aluminum contents in galvanized sheets, the study of some of the local seaweeds with respect to their potash contents, and the exposure tests of tin plate. The work on testing coals for the various Government units, which has hitherto been done by a private laboratory, is about to be undertaken in coöperation with other sections of the division. In view of the fact that the Manila Railroad is a Government unit, the testing of the coal used by that company will add considerable work to the division. Additional personnel may be found necessary effectively to carry this added responsibility.

Regulatory measures on the sale of fertilizers and insecticides and fungicides have been prepared, based on the practice now in vogue in most of the states of the United States, in order to protect the farmers from reckless manufacturers and dealers. The ever-growing importance of the Philippines as an agricultural country requires these protective measures. Should these proposed laws, which have been prepared in this division, be passed by the present Legislature, some additional personnel will be required to handle the new activities.

#### ORGANIC CHEMISTRY

*Personnel.*—Two positions authorized by the Council of State were filled by the appointment of Dr. H. I. Cole and Mr. Bernard Nelson. Doctor Cole reported for duty on February 4, and Mr. Nelson on February 23. Doctor A. P. West resigned on June 30. Mr. Ramon Feliciano, one of our pensionado students, re-

turned to Manila in May, was given temporary appointment in June, and was promoted to chemist on September 1. During the absence of the chief of the division, Dr. G. A. Perkins assumed his duties as acting chief, and performed them in a creditable manner. Mr. A. H. Wells, chief of the division, returned from leave in the United States and resumed his duties on December 12.

*Routine.*—Due to lack of supplies, materials, and equipment, it has been found necessary to discontinue the manufacture of book varnish, and to limit other pursuits of the division, including the production of extract of tikitiki for the cure of beriberi.

*Manufacture of tikitiki extract.*—During the year, 18,187 bottles of this extract were prepared and delivered for the treatment of beriberi. Due to the fundamental economic policy of the Government, the division was unable to fulfill one-fourth of the requests for this product.

*Publications.*—A number of papers have been completed and submitted for publication in the Philippine Journal of Science by Messrs. West, Perkins, Cole, Agcaoili, and Salvador, which are enumerated under Publications.

*Research.*—Investigation is in progress and considerable data have been assembled along the following lines of research: Identification of alkaloids by microscopic methods; the use of alcohol mixtures as motor fuel with particular reference to the manufacture of an alcohol-ether mixture from Philippine products; the identification and differentiation of Philippine fibers; methods for the determination of ambergris; isolation of various constituents of Philippine plants for the treatment of tropical diseases; investigation of the possibility of making neosalvarsan for the treatment of yaws and syphilis; a survey of the distribution of *Hydnocarpus hutchinsonii* and other representatives of the genus used for the treatment of leprosy; the hydrogenation of Philippine oils; the oxidation of lumbang oil; the composition of baguilumbang oil; quantitative determination and composition of coconut oil by Haller's method; the development of a method to be used in the production of solid products from coconut oil by transformation into mono- and di-glycerides; investigation of the solid bitumens of Leyte with the view to determining the variety of materials most suitable to commercial utilization.

*Nipa sugar.*—Nipa-sugar work and field work in connection with the copra industry could not be continued on account of lack of travel money. Due to a change in the staff of the Santol Tuberculosis Colony and to the generally inconclusive and even

unfavorable results here and elsewhere of experiments with the cod-liver and chaulmoogra soaps, the work on the tuberculosis medicine was discontinued.

*Ethyl ester of chaulmoogra oil.*—A plant was designed and set up with a capacity for manufacturing 200 liters of ethyl ester of chaulmoogra oil per month as the original request of the Philippine Health Service for Culion was for 7,200 cubic centimeters per month. At present there are large stocks of ethyl ester at the Philippine Health Service headquarters, at San Lazaro, and at Culion. The plant is rapidly increasing this stock by working at half to three-fourths its capacity. Meanwhile cod-liver ethyl esters, sodium morrhuate, sodium gynocardate, Muir's E. C. C. O., and special Mercado mixture are being supplied to the Philippine Health Service.

*Iloilo sugar laboratory.*—The need for a complete sugar experiment station, situated either in Iloilo or in Negros, is again emphasized. The personnel of such a station should consist of a chief chemist (expert in all forms of sugar technology), one assistant sugar chemist, one soil analyst and two field men who could collect data and do general work. Space should be available for mycologists, plant pathologists, and other visiting experts sent from time to time from the Bureau of Science.

A table showing the amount of routine work and supplies manufactured and disposed of during the past ten years, a detailed summary of the routine work, and the number of chemists in the division is given herewith.

*Comparative table of routine work performed and supplies manufactured and disposed of during the past ten years by the division of organic chemistry.*

[Figures for the Iloilo Sugar Laboratory not included.]

Year.	Total samples (not units).	Pesos.	Comparison with previous year.			
			Increase.		Decrease.	
			Samples.	Pesos.	Samples.	Pesos.
1911.....	1, 670	14, 236	188			3, 579
1912.....	1, 921	15, 673	251	1, 437		
1913.....	1, 639	17, 272		1, 599	282	
1914.....	1, 294	8, 231			345	9, 041
1915.....	3, 650		2, 356			
1916.....	1, 761				1, 889	
1917.....	1, 719				42	
1918.....	2, 011		292			
1919.....	3, 185	27, 256	1, 174			
1920.....	4, 878		1, 693			
1921.....	8, 710	10, 302	3, 832			

*Comparative table of routine work performed and supplies manufactured and disposed of during the past ten years by the division of organic chemistry—Continued.*

Year.	Cash.				Government interbureau work.		Chemists.	
	Cash work.		Cash received.		Samples.	Pesos.	Amer-ican.	Fili-pino.
	Sam-ples.	Pesos.	In-crease.	De-crease.				
1911		3,069	1,678			11,167	7	2
1912		3,047		22		12,626	6	2
1913		1,980		1,067		15,292	6	1
1914		2,110	130			6,121	6	2
1915	478	2,785	675		3,172		5	2
1916	359	1,978		807	1,402		5	2
1917	623	3,279	1,301		1,096		4	3
1918	989	4,560	1,281		1,022		1	2
1919	1,263	5,493	933		1,925	21,763	2	2
1920	1,167	5,339		154	3,711		2	1
1921	2,708	10,302	4,963		5,674	137	4	1

#### MINES

*Personnel.*—The contract of Dr. W. D. Smith, as chief of the division of mines, expired on September 14 and was renewed for a period of one year. Mr. Hubert G. Schenck completed his contract on September 15 and returned to the United States. Mr. Leopoldo A. Faustino was in the United States during the entire year pursuing advanced studies in geology and mining. Mr. Victoriano Elicaño was reinstated as geologist on August 1, 1921. We have no mining engineer on the staff, although all of the technical men in the division have had some experience and training along the general lines of mining engineering. The staff, however, is very badly depleted as compared with its condition in 1914.

As this division, by the organic act which authorized its creation (first as a separate bureau), is principally a bureau of information, the principal function we have performed during the year is that of furnishing as far as possible reliable information on all matters pertaining to the mining industry in the Philippines. Hence a large part of the routine work is consultation. In this capacity we have been called many times during the year to conferences with the Secretary of the Department and with the Governor-General, chiefly in connection with

the revision of the coal and petroleum laws and regulations and concerning the affairs of the National Coal Company.

The activities of the division of mines can be classified as follows; under each head the accomplishments during the year are indicated:

*Geological, mining, and field work.*—In the early part of February Doctor Smith spent ten days making a survey of the National Coal Company operations in Cebu. In the latter part of February and March he was engaged in a reconnaissance of the Pidatan district of Cotabato Province, Mindanao, accompanying the party of Mr. M. L. Benedum, of Pittsburg, Pa. On the same trip he visited the Sibuguey district of Mindanao, completing a survey of the National Coal Company property in Mindanao. On April 21 Doctor Smith visited Taal Volcano in company with Doctor Cole, chemist of this Bureau. From May 1 to June 15 Doctor Smith and Mr. Schenck had their office in Baguio at the Forestry Station. Most of the work done in Baguio consisted of the preparation of special memoranda and work on the manuscript of a book on the geology and mineral resources of the Philippines, but several short trips of from one day to two weeks' duration were taken by both. These trips were to Mancayan, Acupan, Antamok, Mount Santo Tomas, etc. Owing to lack of funds the division of mines undertook no field work on its own account during the remainder of the year. However, Doctor Smith made a second trip to Mindanao and Cebu in the interests of the National Coal Company under instructions from the Governor-General. The trip was made in the early part of December and occupied about three weeks. At this time opportunity was taken to visit the property of the Curuon Gold Mining Company, about 75 kilometers north of Zamboanga on Zamboanga Peninsula, Mindanao, and on the return from Mindanao Doctor Smith visited the property of the Leyte Asphalt and Mineral Oil Company near Villaba, Leyte, as well as some coal properties other than those of the National Coal Company in Cebu Island. Five trips were made to Angat River, two by Mr. Elicaño, and three by Doctor Smith, in connection with an investigation of the proposed water-supply project of the Metropolitan Water District.

*Mineralogy and petrography.*—The principal work here has been the examination of all the stratification samples submitted by the Bureau of Public Works. Numerous rock and mineral

samples, sent to us through the mail or brought in by individuals, have been identified. The work of Mr. Schenck and Doctor Smith, on the former's collections from Samar, is the only piece of research along these lines done during the year.

*Palæontology.*—While some fossils have been collected by members of the division of mines, the determination of them has been largely turned over to Dr. Roy E. Dickerson, who has very kindly and sympathetically coöperated with us throughout the year.

*Engineering and metallurgy.*—Mr. Elicaño and Doctor Smith have given advice and have prepared reports on several projects coming under this head, the principal one being the new water-supply project of the Metropolitan Water District. Mr. Elicaño has given a course of lectures to students in the College of Engineering, University of the Philippines, on subjects pertaining to metallurgy. Although assaying is no longer a part of the work of this division, we have been in close coöperation in this matter with the division of inorganic chemistry. Our principal work under this head has been in connection with the National Coal Company operations. Doctor Smith has been appointed an advisor to the Board of Directors of that company.

*Drafting, mapping, and similar work.*—The following table shows the kind and amount of work done by the draftsmen of the division of mines:

Kind of work.	Private.	Official.	Total.
Maps .....		80	80
Sketches .....		136	136
Blue prints .....	155		155
Photographs, retouching .....		114	114
Miscellaneous .....		147	147
Total .....	155	477	632
Maps and plans arranged for file .....			600

*Publications.*—During the year the material for the biennial Mineral Resources of the Philippine Islands for the Years 1919 and 1920 has been prepared for the press. The manuscript, illustrations, and maps of a general publication on the Geology and Mineral Resources of the Philippines have been completed during the year. Several papers have been published in the Philippine Journal of Science and are enumerated under Publications. Some assistance in the laboratory and field has been



rendered to Doctor Dickerson in the preparation of several papers that will appear in the Philippine Journal of Science.

*Miscellaneous.*—The members of the division of mines staff endeavored to arouse the Filipinos to a realization of the importance of the development of the natural resources of the country and of their neglect of the same. In this connection it has been necessary or at least advisable to hold informal conferences on Saturday afternoons for the general public and to prepare several semipopular articles for the press. The work must be done by some local entity, and our efforts have in the main met with favor.

#### LIBRARY

*Personnel.*—There were few changes in the library staff during the year except among the library apprentices. Since these are all students, it is inevitable that frequent changes among them will occur when they graduate or leave Manila for the long vacations. Eleven appointments were made to this grade, and seven resignations were accepted. During the school and college vacation, three additional apprentices were authorized in order to complete the filing of the Library of Congress cards and proof, which had been accumulating for several years more rapidly than our regular staff could arrange and file them.

Mrs. Mary L. Crozier resigned on August 15 and returned to the United States. Mr. Melecio B. Lamayo resigned on May 31. Mr. Eudocio Cacho, junior stenographer, transferred to the College of Law on January 16. These were all temporary employees. Mr. Gorgonio V. Rivera was promoted from library apprentice to library assistant on November 16.

*Book orders.*—No book orders were forwarded during 1921, all requests being disapproved by the Emergency Board on account of the local financial conditions. Outstanding obligations were reduced during the year by the delivery of publications estimated at ₱4,155.18 in value. Deliveries from Europe have been more satisfactory than for any year since the beginning of the World War.

*Accessions.*—The total number of bound volumes accessioned during the year was 3,815 (Nos. 47,001 to 50,815, inclusive), 1,058 more than were accessioned during 1920. As usual, the bound volumes added included publications received by purchase,

by gift, and by the binding of serial publications. At the close of 1920 there were 2,952 unbound volumes and parts in the library; 6,110 of these were withdrawn from the shelves for binding during 1921, while 4,715 volumes and parts were added, making a total of 28,131 unbound volumes and parts in the library on December 31, 1921. The total number of bound and unbound volumes and parts available for use was 78,934, a net gain of 2,408, with a reduction of 1,407 in the number of pieces of unbound material. As usual, several unbound volumes and many parts are frequently combined into one volume in binding.

*Binding.*—Three hundred volumes to be bound were at the Bureau of Printing at the end of the last year, and 1,700 volumes were prepared and forwarded to the bindery during 1921. The congestion at the accession table has been reduced materially by bringing up the work in collation, accessioning, adding to shelf-list record, and labeling, so that there remain but 301 volumes of those returned from the bindery waiting to be prepared for the shelves.

*Classification and cataloguing.*—Satisfactory progress has continued in bringing up arrears in classification and cataloguing and in reclassifying and assigning subject headings to the publications temporarily catalogued many years ago.

The following table gives in comparative form the work of 1919, 1920, and 1921:

	Titles.			Volumes.			Parts.			Cards.		
	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921
Classification and cataloguing (new material) ..	622	746	877	864	731	891	601	825	679	2,510	2,872	3,304
Reclassification and cataloguing.	68	40	41	166	83	116	139	149	35	198	163	174
Total .....	690	786	918	1,030	814	1,007	740	974	714	2,708	3,035	3,478
Printed cards prepared and filed ..										6,761	6,132	3,685
Total cards filed in official catalogue .....										9,469	9,167	7,163

Almost every item except the preparation and filing of printed cards shows an increase. The one reduction is more than compensated for by the work done in filing cards and proof in the union catalogue.

The record of shelf listing shows 8,267 volumes and parts added during the year, distributed as follows:

Bound volumes .....	3,552
Unbound volumes .....	556
Pamphlets .....	1,831
Parts .....	2,328
<b>Total .....</b>	<b>8,267</b>

A lot of the older unclassified material in the library has been listed and stored in one of the concrete buildings near the north boundary of the Bureau of Science grounds. There is some good material in the collection, but little that has direct bearing upon the work of the Bureau of Science. Before the end of 1922, it is probable that the arrears in the work room will be finished, so that this old material can be sorted and what is of sufficient value to this library classified and made available for use. The handling of this old material, the reclassification of publications that were placed on the library shelves and temporarily classified and catalogued during the period before the first technical worker from the United States had sufficient assistance and the requisite reference tools to enable her to do permanent classification and cataloguing, the preparation of printed analytical cards for monograph series, and the handling of the current additions by purchase, gift, and binding are the most pressing demands of the catalogue division.

*Printed cards.*—The cards filed during the year consisted of continuations of series already partly analyzed and cards for new series not hitherto begun. The abstract cards for the publications of the Wistar Institute of Anatomy and Biology have been filed promptly as received.

*Union catalogue.*—All Library of Congress proof received before April 1, 1921, was filed in the union catalogue during April, May, and June, when three additional student apprentices were authorized for this work, and all others whose services, in whole or in part, could be spared from their regular work were assigned to it. Thirty boxes of proof, approximately 30,000 entries, were added to the reference catalogue in this way. It is desirable that this proof be kept filed up to date at all times, so that information concerning late publications may be available for the cataloguer, for reference work, and for book orders. Good progress on this work has been made during 1921, but each mail brings a new lot of proof, which must be cut, punched, alphabeted, and filed promptly in order to keep

this, the most valuable single working tool in the library, ready to render the greatest possible aid to its patrons.

*Missing numbers.*—Fair progress is being made in claiming and securing missing numbers. In a library like this, where we circulate all periodicals before binding them, this problem will always exist. It has been greatly increased during the last years by the losses of periodicals in transit, due to war conditions, by the temporary or permanent suspension of publication of many serials, by the cancellation of existing exchanges, and, locally, by the large number of periodicals at all times off the library shelves, in some cases charged to indifferent, if not negligent or careless, borrowers. To remedy this condition, to a degree at least, the custom in vogue for many years of sending all numbers of designated journals as received to persons submitting lists of titles of the journals which they wished to see regularly was discontinued on July 1. This in no way curtails the privileges of users of the library, but it puts upon each the responsibility of asking specifically for the publications desired. This change has contributed, without doubt, to the slight reduction in number of publications circulated, but on the other hand it has added greatly to the efficiency of the service in the reading room.

In the matter of securing missing numbers, both our European and our American agents have been extremely accommodating and successful. Mr. Perez, assistant librarian, has had general charge of this work, and has had good assistants in Messrs. Ayson, Rivera, and Abary. The shelves show improvement over last year in the disappearance of incomplete volumes, which have been completed and bound. Another year, with the improved conditions hoped for in the book trade, should see this part of the work of the library in a fairly satisfactory condition.

*Payment records, requisitions, etc.*—Mr. Rivera continues in charge of this work, with Mr. Abary an able assistant. Most of the outstanding bills have been paid, though a few bills recently received have been reported held for funds. Though no book orders were forwarded during 1921, the preparation of the original requisition and its subsequent reduction involved just as much work as if the order had been forwarded. There have been many perplexing questions in this department during the year, due to uncertainty about exchanges, missing numbers ordered, publications received without bills, journals that have suspended publication, etc.

*Duplicates.*—Work on duplicates was brought to a standstill for lack of shelf and table space to bring publications together into one room and to prepare them for mailing to the institutions that have offered to send their publications in exchange. The quarters allotted to the library when the serum laboratory was removed to Alabang have given relief, but have not helped in the storage and handling of duplicates.

*Cuts.*—During the year 373 cuts were cleaned, wrapped for protection, recorded, and filed for future use. Fifty-six new cuts were received too late to complete the work on them. The total number of cuts recorded in the library is now 5,982. The number of cuts circulated during the year was 212.

*Philippine Journal of Science and other Bureau of Science publications.*—All new Bureau of Science publications were sent for binding as soon as received. Volumes 1 to 17 of the Philippine Journal of Science and numbers 1 to 14 of the Publications of the Bureau of Science have been bound and shelved. The status of the reserve stock of publications formerly shelved in the library is still unsatisfactory.

*Trade catalogues.*—The most important of the incoming trade catalogues have been added as received. Due to changes in personnel, the employee who previously had charge of this branch of the work having resigned, no one has been regularly assigned to this work during the latter part of the year; hence no requests have been sent for catalogues except in cases where such action was specifically asked of the library. No action has been taken during the year toward the establishment of a business branch library, where this collection of trade catalogues would be of the most service, and where, with an energetic librarian in charge, they could be administered to the best advantage.

*Mending, fumigating, and cleaning books and making pamphlet binders.*—Mr. Abat, the expert binder detailed from the Bureau of Printing, has continued in general charge of the shelves, in addition to his work in receiving bound books from the Bureau of Printing, collating, accessioning, etc. During the year 515 volumes were repaired by Mr. Abat, assisted by one of the laborers, 423 volumes were sent for fumigation, and binders were made for 621 pamphlets. These figures, compared with 214 volumes repaired, 102 fumigated, and 266 pamphlet binders made during 1920, show a gratifying increase in results.

*Use of the library.*—During the year 14,653 publications were charged, an average of more than 40 per calendar day,

and 14,845 returned. During eight months, January to June, inclusive, October, and November, medicine led in the number of books circulated; during three months, July to September, inclusive, general science led; during one month, December, zoölogy showed the largest number of publications taken from the library.

In the library, 16,974 publications, distributed as indicated below, were used:

Bound volumes.....	7,823
Serials .....	7,881
Pamphlets .....	1,270
<b>Total .....</b>	<b>16,974</b>

The number of publications circulated shows a decrease of 2,027 below the record for 1920, while the number of publications used in the library shows an increase of 294.

Though no figures have been kept for publications sent away from Manila, the mail and express business of the library is an appreciable item. Most of these publications are sent to the scientific workers in the Colleges of Agriculture and Veterinary Medicine and to the School of Forestry, located at Los Baños.

For the first time in several years, it has been possible to make a definite effort to have all publications out of the library returned for discharging or recharging. A notice was sent to borrowers in groups asking that all publications which they have in their possession be sent to the library for discharging, if they have finished with them, or for recharging, if they wish to retain them longer. This work is still in progress. Several hundred volumes and parts have been returned to the library shelves, and many have been recharged and returned to the workers requesting them. A great many patrons of the library have been cleared of responsibility for all publications except those charged during recent months, and the total number of publications in circulation has been materially reduced. Bureau deposits and large deposits with individual workers have not yet been called in.

*Reference work.*—The designation of any one employee as reference librarian being impossible under present conditions, each employee has had to assist in this work. Most of the questions come to the desk usually occupied by Mr. Perez, through personal request, by messenger, by telephone, or by letter. Miss C. Sugang, Mr. Abat, and Mr. A. T. Salonga are valuable

assistants in this work. The librarian has had more time for reference work than for several years, due to being relieved of many of the routine matters at the desk she formerly occupied.

*Library quarters and equipment.*—The library has long passed its point of maximum efficiency in its present quarters. The one small room vacated by the serum laboratory which was assigned to the library, though filled with shelves reaching to the ceiling, has only to a very slight degree solved the problem. The need for more room has been emphasized in numerous official communications, and I can only reiterate what has been recommended in previous years; namely, a minimum of space not less than the entire second floor of the wing of the Bureau of Science building.

*Library training.*—The work with the library-training classes in the University of the Philippines has been continued during the year. During the first semester the enrollment was thirty-seven, no work with medical students being given. During the second semester, the enrollment was seventy-three, **thirty-five** in the regular College of Liberal Arts classes and thirty-eight in the two classes from the College of Medicine and Surgery.

*The American Library Association War Service.*—Early in the year, some 30,000 volumes belonging to the American Library Association War Service collection were transferred to the United States Army. The books administered by the United States Shipping Board were placed on ships coming into Manila and in hospitals where men from the shipping offices and ships usually go when ill. With the closing of the Merchant Marine work, by the American Library Association, the last department to be discontinued except the United States Public Health Service, all books in the Manila branch of the United States Shipping Board were permanently deposited in St. Luke's Hospital, St. Paul's Hospital, San Lazaro Hospital, and Bilibid Prison, and all unexpended funds returned to the central office of the American Library Association in Chicago, thus bringing to a close the work of the Library War Service in the Orient.

#### PUBLICATIONS

*The Philippine Journal of Science.*—As in 1920, the Philippine Journal of Science was published monthly, in two volumes for the year. Each volume consists of six numbers and is separately paged and indexed.

The following table shows the number of pages, plates, and text figures contained in volumes 18 and 19:

	Volume 18, January to June, 1921.	Volume 19, July to De- cember, 1921.
Pages .....	747	777
Plates .....	27	72
Text figures .....	41	27

At the close of the year the issue date of the Journal is one month nearer the actual date of publication than it was in 1920; the September number was mailed early in December, and at the close of December, 1921, the October number was in the bindery. Copy has been furnished the printer five months in advance, so that there is good reason to hope that the Journal will be issued on time during 1922.

The following list gives titles and names of authors of the papers published in the Philippine Journal of Science during 1921:

VOLUME 18, JANUARY TO JUNE

*No. 1, January, 1921*

- DICKERSON, ROY E. A fauna of the Vigo group: its bearing on the evolution of marine molluscan faunas.  
 LIGHT, S. F. Further notes on Philippine scyphomedusan jellyfishes.  
 MERRILL, ELMER D. New Philippine Moraceae.  
 FLEUTIAUX, ED. Deux genres nouveaux de Coléoptères (Melasidae).  
 FLEUTIAUX, ED. Deux espèces nouvelles de Coléoptères (Elateridae).  
 MCGREGOR, RICHARD C. New or noteworthy Philippine birds, III.  
 LEE, H. ATHERTON. The relation of stocks to mottled leaf of citrus trees.  
 NAKAYAMA, SHONOSUKE. An enumeration of the Japanese Aphelininae, with descriptions of two new species.  
 REVIEWS.

*No. 2, February, 1921*

- KING, ALBERT E. W. Physical properties of Philippine concrete and concrete aggregates.

*No. 3, March, 1921*

- SMITH, WARREN D. Tropical geology and engineering.  
 LIGHT, S. F. Notes on Philippine termites, I.  
 UICHANCO, LEOPOLDO B. New records and species of Psyllidae from the Philippine Islands, with descriptions of some preadult stages and habits.  
 MERRILL, ELMER D. New Philippine Myrtaceae.  
 ROHWER, S. A. Descriptions of new Philippine wasps of the subfamily Pseninae.



*No. 4, April, 1921*

- PERKINS, GRANVILLE A. The structure of the electron.  
 PERKINS, GRANVILLE A. Absolute units and the relativity principle.  
 FISHER, W. S. New Coleoptera from the Philippine Islands. Family  
 Buprestidae, tribe Agrilini.  
 HAUGHWOUT, FRANK G. A case of human coccidiosis detected in the Philip-  
 pine Islands, with remarks on the development and vitality of the  
 cysts of *Isospora hominis* (Rivolta).

*No. 5, May, 1921*

- VALENCIA, F. V. Mechanical tests of some commercial Philippine timbers.  
 MCGREGOR, RICHARD C. Birds of Antique Province, Panay, Philippine  
 Islands.  
 KIEFFER, J. J. Chironomides des Philippines et de Formose.  
 SACCARDO, P. A. Fungi Sinensis aliquot a cl. Prof. Otto A. Reinking col-  
 lecti et communicati.  
 KARNY, H. H. Katydids (Tettigonioidea) of the Philippine Islands, col-  
 lected by C. F. Baker.

*No. 6, June, 1921*

- WEST, AUGUSTUS P., and MONTES, ZOILA. The composition, solubility, and  
 oxidation of lumbang oil.  
 MORRISON, HAROLD. Some nondiaspine Coccidae from the Malay Peninsula,  
 with descriptions of apparently new species.  
 FUNKHOUSER, W. D. New genera and species of Philippine Membracidae.  
 ROHWER, S. A. Some Philippine wasps of the family Chrysididae.  
 PESCHET, R. Description d'un Canthyrus (Coleoptera Dytiscidae) nou-  
 veau, des Iles Philippines.  
 NAÑAGAS, JUAN C. Position and size of the kidneys among Filipinos.  
 GARCIA, ARTURO, and SOLLOZA, JUAN. Length and position of the vermi-  
 form appendix in Filipinos.  
 SPAETH, FRANK. Philippine and Bornean species of Hoplionota (Co-  
 leoptera).  
 REVIEWS.  
 INDEX.

## VOLUME 19, JULY TO DECEMBER

*No. 1, July, 1921*

- PERKINS, GRANVILLE A. The expression of the octet theory of valence in  
 structural formulas.  
 LIGHT, S. F. Notes on Philippine termites, II.  
 STAFF, O. A new species of *Vincentia* from the Philippines.  
 WELLS, A. H. The preparation of tikitiki extract for the treatment of  
 beriberi.  
 ROHWER, S. A. The Philippine wasps of the subfamilies Scoliinae and  
 Elidinae.  
 REINKING, OTTO A. Higher Basidiomycetes from the Philippines and their  
 hosts, V.  
 MCLEAN, F. T. The permeability of Citrus leaves to water.  
 REVIEWS.

*No. 2, August, 1921*

- LEE, H. ATHERTON. Citrus-canker control; a progress report of experiments.
- SCHREER, OTTO. Kalinga texts from the Balbalásang-Gináang group.
- WILEMAN, A. E. Notes on Japanese Lepidoptera and their larvæ: Part VI.
- SMITH, WARREN D. Ancient cave dwellers of Batwaan, Masbate, Philippine Islands.
- WHARTON, LAWRENCE D. *Opisthorchis wardi*, a new species of liver fluke from the cat in the Philippine Islands.
- LIGHT, S. F. Notes on the Philippine Alcyonaria, Part VI: New Philippine Pennatularia (sea pens) of the genus *Lituaria*.

*No. 3, September, 1921*

- MAXWELL, J. PRESTON. Filariasis in China.
- MERRILL, ELMER D. A review of the new species of plants proposed by N. L. Burman in his *Flora Indica*.

*No. 4, October, 1921*

- REINKING, O. A., and GROFF, G. W. The Kao Pan seedless Siamese pumelo and its culture.
- GEBIEN, HANS. Philippine Tenebrionidae, II.
- BANKS, CHARLES S. A Philippine nemestrinid (Diptera).

*No. 5, November, 1921*

- HELLER, K. M. New Philippine Coleoptera.

*No. 6, December, 1921*

- LANTIN, PEDRO T. Various methods of serum application in bacillary dysentery.
- PERKINS, GRANVILLE A. Unsymmetrical addition to the double bond, I: a theory of the reaction mechanism of the direct union.
- GROVES, JAMES. Charophyta from Annam and Guam.
- ROHWER, S. A. The Philippine wasps of the subfamily Sphecinae.
- MERRILL, ELMER D. Two new species of plants from Hainan.
- COLE, HOWARD IRVING. The dissociation of hexaphenylethane from the viewpoint of the octet theory of valence.
- MCGREGOR, RICHARD C. New or noteworthy Philippine birds, IV.
- BECKER, WILHELM. Die Vögel der Philippinen.
- OKAMOTO, KIKUO. Secondary sexual characters in the loach *Misgurnus anguillicaudatus* Cantor.
- PERKINS, GRANVILLE A. The structure of chlorine dioxide and related compounds.
- WELLES, COLIN G. *Cercospora* leaf spot of coffee.
- WELLES, COLIN G. *Cercospora* leaf spot of *Averrhoa carambola*.
- REVIEW.
- ERRATA.
- INDEX.

The material published during 1921 covers unequally a wide range of subjects. The greatest number of articles deal with systematic entomology, and botany holds second place. Ten

other subjects are each represented by very much fewer articles. A rough classification of the articles by subject matter follows:

	Articles.
Entomology .....	20
Botany .....	14
Chemistry .....	7
Invertebrate zoölogy other than entomology.....	3
Ornithology .....	3
Geology .....	2
Human anatomy .....	2
Medicine .....	2
Ethnology .....	2
Ichthyology .....	1
Cement .....	1
Timber tests.....	1

The following table shows the number of names on the mailing list of the Philippine Journal of Science during the last two years:

	1920	1921
Paid subscriptions .....	546	385
Exchanges .....	483	511
Review subscriptions .....	34	37
Free .....	65	68
Total .....	1,128	961

The decrease in paid subscriptions is due to the fact that, with the establishment of the official organ of the Philippine Islands Medical Association, the members of that organization as well as of the Manila Medical Society no longer subscribe for the Philippine Journal of Science.

An increase has been effected in the number of exchanges; increase will probably continue to be noted from year to year as conditions become more stabilized and mail routes more firmly reestablished throughout the world. In most cases these new exchanges can be considered as of more value to us than an equal number of paid subscriptions.

*Special publications.*—Two special publications were issued during 1921, namely:

Nineteenth Annual Report of the Bureau of Science.

Amphibians and Turtles of the Philippine Islands, by Edward H. Taylor.

Two other important herpetological works by Edward H. Taylor, Snakes of the Philippine Islands and Lizards of the Philippine Islands, are in page proof. These will be published in 1922.

The copy for a very important botanical work entitled *An Enumeration of Philippine Flowering Plants*, by myself, is now being furnished the printer and two or three parts of it will probably be issued during 1922. This work is a summary of our present knowledge of Philippine flowering plants, and represents a part of the knowledge accumulated by me during a course of about twenty years' study of the problem. It will be issued in fascicles, utilizing one volume for Gymnospermae and the monocotyledons and two volumes for the dicotyledons, and full introductory and explanatory matter in a general introduction to be prefixed to volume 1.

The copy for *Mineral Resources of the Philippine Islands for the Years 1919 and 1920* has been sent to printer and will be off the press early in 1922.

*Press bulletins.*—The following press bulletins were issued in 1921:

- No. 99. Petroleum in Mindanao. (March 9, 1921.)
- No. 100. The new serum laboratory at Alabang. (April 30, 1921.)
- No. 101. Report on present mosquito conditions in the City of Manila. (June 17, 1921.)
- No. 102. Mineral production in the Philippine Islands for 1920. (June 29, 1921.)
- No. 103. Petroleum development. (October 5, 1921.)
- No. 104. Why not here also? A discussion of the possibilities of growing silk in the Philippines. (October 12, 1921.)

#### POWER PLANT

During the year 140 shop orders were received for repairs, alterations, and construction of apparatus and equipment. On account of the transfer of the serum laboratory to Alabang, a large amount of additional work has been required in the re-arrangement of the laboratory and stable space made vacant by the removal of the activities of the serum laboratory and the transforming of the cement stables and bleeding house into testing laboratories. The cement-testing laboratory was installed in the concrete building originally constructed as a stable for the serum laboratory, and all testing machinery and the liquid-air machine have been installed in the bleeding house vacated by the serum laboratory. In the old cement-laboratory building, after the transfer of the apparatus to its new location, the tikitiki-extraction and chaulmoogra-oil apparatus were installed. To make space for the 180-horse-power Diesel engine, which is now being installed, a small concrete building was constructed by the Bureau of Public Works to accommodate the

Mansfield gas apparatus. The place in the rear of the power-plant wing made vacant by the removal of the Mansfield gas apparatus has been enlarged and the Diesel engine is now being installed in the room where the gas apparatus was formerly placed. The construction work is practically completed, the foundations for the engine are in place, and the new unit should be completely installed within the next two months.

*Boiler and producer gas.*—The arches of the two boilers were in bad condition due to constant use and were, accordingly, replaced. The refractory brick lining of the gas producer having deteriorated badly from long use and thus requiring frequent repairs, a new lining was ordered from Germany, which has arrived. As soon as the Diesel-engine installation is completed, the refractory lining of the gas producer will be replaced.

*Steam and gas engines.*—The steam engines and the Otto gas engine have remained in good working condition throughout the year, needing only minor repairs from time to time. The total amount of steam, electricity, and gas produced during 1921 and the production per unit are given below. For purposes of comparison, the data for 1920 are also shown.

Year.	Steam.		Kilowatt hours.	Average cost per kilo.		Gas.	Cost per 1,000 cubic feet.	
	Kilos.	Peso.		Peso.	Cubic feet.		Pesos.	
1920.....	8,185,476	0.00705	197,538	0.2208	1,108,114	2.825		
1921.....	5,504,338	0.00756	224,440	0.1480	1,146,225	2.872		
Difference.....	2,681,138	0.00051	26,902	0.0728	38,111	0.453		

Much less steam was produced in 1921 than in 1920 due to the fact that the Otto gas engine was in proper working order practically throughout the year, while in the previous year the gas producer was idle nearly seven months. The kilowatt production has considerably increased, the increase for 1921 being 26,902 kilowatts as compared with 3,717 kilowatts for 1920. This rather radical increase justifies the installation of the new Diesel unit. The cost per kilowatt has also decreased due to the fact that the producer-gas engine was working at full capacity for eleven months, this being a much more economical power unit than the steam engines, and further due to the great reduction in the price of coal; furthermore, there has been a considerable reduction in the price of lubricating oil. With the reduction in the price of crude oil, there has been a corresponding decrease in the cost of gas manufactured in the Mansfield gas

apparatus. The following table shows the quantity, cost, and distribution of the power and gas produced:

	Steam.		Electricity.		Gas.	
	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
	<i>Kilos.</i>	<i>Pesos.</i>	<i>Kilowatt hours.</i>	<i>Pesos.</i>	<i>Cubic feet.</i>	<i>Pesos.</i>
Production .....	5,604,838	41,301.49	224,440	32,304.43	1,146,225	2,714.81
Average per month .....	458,695	3,441.79	18,703	2,692.03	95,519	226.23
Consumption:						
Bureau of Science .....	919,118	6,869.84	113,642	16,452.77	929,244	2,204.34
Average per month .....	76,593	572.49	9,470	1,371.06	77,437	183.69
Engine room .....	1,331,180	9,845.08				
Average per month .....	110,932	820.42				
Manufacture of tiki-tiki extract, anti-typhoid vaccine, and antidyenteric serum .....	132,000	998.61	1,560	230.92	216,981	510.47
Average per month .....	11,000	83.22	130	19.24	18,082	42.54
Philippine General Hospital .....			88,567	12,623.87		
Average per month .....			7,380	1,051.99		
Total steam for pump .....	1,370,040	10,352.47				
Total steam for hot water .....	1,752,000	13,235.49				
Average steam per month for pump .....	114,170	862.70				
Average steam per month for hot water .....	146,000	1,102.96				
College of Liberal Arts .....			404	56.63		
Average per month .....			34	4.72		
College of Medicine and Surgery .....			20,267	2,940.24		
Average per month .....			1,689	245.02		

*Alabang power plant.*—The power plant installed at Alabang to supply light and power for the serum laboratory has been in proper working condition since the work was initiated there in March, 1921. The average number of kilowatt hours consumed per month was 6,115. The expenses in connection with the Alabang power plant for supplies and materials amounted to ₱10,096.22 and for salaries and wages, ₱9,120, making a total of ₱19,216.22, or an average monthly expense of ₱1,601.35.

#### CLERICAL DIVISION

*Personnel.*—Only one new appointment was made in the clerical division during the year, that of Mr. Casiano Anunciacion as junior stenographer for the botanical division. Miss Juana Adduru was given a classified Civil Service position, effective

August 15, 1921, due to her having passed the junior typist examination. Mr. Vicente Supleo, a clerk detailed to the botanical division, resigned; and Mr. Eudocio Cacho, junior stenographer, was transferred to the University of the Philippines. Several promotions were made based on the efficient and long service of those promoted.

*Filing.*—Due to the increased technical force of this Bureau, the work of the record section has been much increased during the year. This work, as in previous years, has been handled very satisfactorily by Mr. Vicente Velasco.

*Accounting and disbursing.*—On account of new rulings of the Insular Auditor, the work of this section has been increased without a corresponding increase in personnel. It is recommended that a new clerk and typist be appointed in this section.

*Property.*—As in the previous year, the work of the property section has been handled satisfactorily by Mr. Bembenuo Herrera with the help of Messrs. Mario Arrázola and Leoncio Mangubat. With the increased technical personnel the routine work of the storeroom in issuing and ordering supplies and materials has also increased, while the preparation of reports and vouchers for the Insular Auditor requires a great amount of routine work. It is recommended that a new clerk and typist be appointed in the property section whenever possible. A small amount of equipment was purchased for the administrative division, and certain office furniture, typewriters, etc., were secured by transfer from the Philippine National Guard, the House of Representatives, and the Philippine Census.

*Miscellaneous.*—During the year 309 rabbits were born as compared with 244 during the previous year, and only 22 were purchased against 165 purchased during the previous year; 166 were used, and 89 died during the year. Three hundred sixteen guinea pigs were born during 1921 as against 180 during the previous year; 138 died as against 124, and 315 were used. No guinea pigs were purchased during 1921. In the breeding of small animals we were much more successful than in the preceding year, being able to breed practically all the small animals needed for our work. Twenty-two horses and mules for serum purposes were obtained, free of charge, from the United States Army, 1 from the Philippine Constabulary, and 3 from the Bureau of Agriculture.

The new building to house the Mansfield gas apparatus was completed by the Bureau of Public Works during the year. The room to install the new power unit was also practically completed.

## PHOTOGRAPHY

There has been a distinct increase in the demands for the services of our photographer during the past year, especially for making negatives and prints. This is in part due to coöperative arrangements approved early in the year for photographic work on behalf of the Philippine General Hospital and for the leprosy work of the Bureau of Health. A large series of photographs was made at the Culion Leper Colony in September, 1921, by our photographer who was sent to Culion for this purpose. Photographs of lepers are distinctly important in connection with individual case records, especially for those under treatment with the chaulmoogra derivatives, so that an attempt is being made, as a part of the coöperative work of the Bureau of Science on the leper problem, to supply the required photographic work. There is a constant demand for prints from our enormous collection of negatives, a collection that has been consistently built up since 1902, as well as for lantern slides, enlargements, transparencies, etc. In our semi-commercial work we aim to fulfill only those demands that cannot be met by professional photographers, and the legitimate demands of our own staff and of other Government units. The following table indicates the extent of our photographic work during the year:

Negative plates:	
5 by 7 (serial Nos. 21922 to 23357, inclusive).....	1,436
8 by 10 (serial Nos. 1799 to 1885, inclusive).....	87
Prints:	
5 by 7 (including those for the album).....	7,333
8 by 10 (including those for the album).....	526
4 by 5 .....	172
11 by 14 .....	6
Miscellaneous sizes.....	1,398
*Direct enlargements:	
Colored .....	120
Uncolored .....	383
Developing:	
Plates, 5 by 7 .....	138
Films, rolls (exposures) .....	54
Lantern slides:	
Colored .....	293
Uncolored .....	221
Transparency plates:	
8 by 10, colored.....	31
11 by 14, colored.....	52
11 by 14, uncolored.....	15



**AQUARIUM**

One trip was made by the fish collector during January, 1921, to secure new specimens for the aquarium. The salt water of the tanks was replaced only once during the year, on account of lack of funds.

The income of the aquarium during 1921 from all sources amounted to ₱4,922.45, a decrease of ₱1,803.05 from that of the previous year. This decrease is unquestionably due to the adverse financial conditions existing in the Archipelago, and the fact that due to these conditions provincial visitors to Manila are fewer. Thus, during February, the month in which the Philippine Carnival is held, in 1920 the aquarium income was ₱2,202.20, while in 1921 it was but ₱1,239.50.

The cost of upkeep totaled ₱7,912.57, a decrease of ₱1,408.89 from the expenses of the previous year, the saving being largely in salaries and in power service. Repairs and changes in the electric wiring made late in 1920 have resulted in a reduction of over ₱1,000 in the charges for current used.

A total of 946 free admissions to the aquarium were granted in 1921 against 234 during the previous year. The free admissions were given to teachers and students in Government schools (588), teachers and students in private schools (75), provincial delegates to the Woman's Club Convention (62), members and residents of the Student Young Men's Christian Association (43), officers and sailors of a Japanese cruiser (150), and scientists and representatives of foreign governments (28).

**RECOMMENDATIONS**

The Bureau of Science is becoming badly cramped for space and no great enlargement of its operations is possible without providing this essential item. The library has reached its maximum expansion; in fact, were all books called in at one time, shelf space would not be available for them. The library needs to-day all the floor space on the second floor of the east wing. Provision should therefore be made at an early date either to extend the present east wing to the north or to construct a corresponding west wing to provide sufficient space for all work in botany, ornithology, and entomology on the second floor, as well as additional space for inorganic chemistry on the first floor. The need is most urgent.

The herbarium has also reached its maximum development in its present quarters. The same is true of entomology; in fact

all entomological work is now crowded into one room, whereas formerly three rooms were occupied. Space occupied by the herbarium and by the ornithological work should be turned over to the library and these activities moved elsewhere.

It is definitely recommended that coöperative arrangements be perfected with the Smithsonian Institution with the view to the preparation and publication of a general flora of the Philippines. This plan would meet with favor on behalf of the Smithsonian Institution authorities.

Provision should be made for adequate transportation facilities between the Alabang serum laboratory and the Bureau of Science in the form of a light Ford truck. The need is most urgent.

For the Alabang power plant a reserve pump is an absolute essential. It should be driven by an oil engine to safeguard our essential water supply in case of breakdown of our electrically driven pump. Additional dwellings for the Alabang staff should be provided.

For the main power plant in Manila an adequate oil-storage tank must be provided as soon as possible after the installation of the new power unit, which will be ready for operation in March, 1922. At the same time a water-cooling tower should be provided in order that we may reduce our already heavy expenses for water from the Metropolitan Water District and be more independent of this supply, which at times is inadequate for our needs.

The cold-storage rooms at the Bureau of Science must be remodeled in the immediate future, as the floor is now in a precarious condition. At the same time the brine tanks and the floor in the refrigerating-machine room must be repaired.

There should be an increased technical personnel, as revenues permit, in the biological laboratory, in the division of mines, fisheries, botany, and entomology, and in the library.

I would respectfully recommend and urgently request that our sales income from certain activities of a largely commercial nature, such as the output of the serum laboratory, manufacture of tikitiki extract, manufacture of chaulmoogra-oil derivatives, sale of prints and publications, etc., be made available to the Bureau in the form of revolving funds for furthering these specific lines of work. This is merely a simple business proposition. We are obliged to operate these manufacturing processes, but at present have no control over the income from these activities and thus are constantly handicapped in reference to the purchase of needed supplies.

The Iloilo sugar laboratory should be rehabilitated and developed in the form of a sugar experiment station, perhaps in coöperation with the Bureau of Agriculture and with the Philippine Sugar Centrals Agency.

The provincial branches of our biological laboratories should be increased in number and adequate support granted, or else the work should be turned over to the Bureau of Health.

If the Army Board for the Investigation of Tropical Diseases be rehabilitated it is definitely recommended that the laboratory and library facilities of the Bureau of Science be placed at the disposal of its personnel.

Respectfully submitted.

ELMER D. MERRILL,  
*Director, Bureau of Science.*

To the Honorable  
The SECRETARY OF AGRICULTURE  
AND NATURAL RESOURCES.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1921, as compared with the fiscal year 1920, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
General, inorganic, and physical chemistry:						
Metals and alloys.....	17	15	17	14	169.50	178.50
Rocks, minerals, natural pigments, and similar substances.....	27	33	26	26	195.50	211.00
Clays, shales, limestones, limes, wall plasters, cements, and slags.....	31	42	23	38	235.00	541.00
Fertilizers.....	107	72	95	48	801.00	436.00
Soils and similar substances.....	32	49	26	34	531.50	599.00
Coal analyses.....	63	18	55	11	1,632.00	283.00
Calorimetric tests of fuels.....		3		3		82.00
Paints and varnishes.....	10	1	9	1	128.38	12.00
Waters.....	174	188	26	37	650.00	1,223.50
Crude chemical and miscellaneous analyses.....	16	13	16	13	187.50	66.50
Standard solutions (liters).....	97	80	27	26	188.67	141.20
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	5	23	4	23	10.00	33.00
Cements.....	7,849	8,348	7,849	8,348	8,444.25	10,384.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....	127	501	127	501	217.50	850.00
Standardization of road materials.....		1		1		6.00
Standardization and correction of units of measure.....	2,885	1,715	2,885	1,714	937.90	311.50
Miscellaneous inorganic work and analyses.....	97	547	95	334	382.50	885.00
Total.....	11,537	11,649	11,280	11,172	14,711.20	16,243.70

TABLE 1.—Comparative table of routine work performed, etc.—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Organic chemistry:</b>						
Urines, clinical and toxicological analyses	582	625	366	504	1,191.35	1,621.03
Essential oils and essences	22	15	22	15	202.50	150.00
Petroleum and products, copra, and similar materials	403	871	302	563	1,602.00	3,161.50
Linseed and castor oils	3	4	1	4	15.00	18.00
Gums, resins, and similar materials	18		18		57.00	
Paper and similar materials	3	15	1	2	5.00	12.00
Gastric juice, clinical examinations	1	4		3		45.00
Foods, alcohols, and beverages	2,831	2,363	817	262	1,126.50	1,129.67
Food preservatives and coloring matter	7	4	3	4	14.50	17.00
Medicines and similar articles	834	4,549	57	1,124	641.00	3,584.50
Miscellaneous organic analyses and examinations	174	260	80	227	483.82	564.00
<b>Total</b>	<b>4,878</b>	<b>8,710</b>	<b>1,167</b>	<b>2,708</b>	<b>5,388.67</b>	<b>10,302.70</b>
<b>Mines:</b>						
Assays	393	457	392	449	1,218.50	1,124.00
Smelting and refining of gold	105,300	7,040	105,300	7,040	1,875.01	110.00
<b>Total</b>	<b>105,693</b>	<b>7,497</b>	<b>105,692</b>	<b>7,489</b>	<b>3,088.51</b>	<b>1,234.00</b>
<b>Biological laboratory:</b>						
Fæces	104,463	86,208	244	198	730.00	581.00
Sputum	296	211	127	100	368.00	298.00
Blood	55	82	35	38	146.67	275.84
Cultures	49	39	49	39	305.96	447.33
Widal tests	2,942	1,852	87	68	260.00	204.00
Wassermann tests	1,236	759	322	261	3,220.00	2,610.00
Leprosy	471	41		8		24.00
Urines	32	9	32	9	94.00	34.00
Gonococci	166	106	164	105	492.00	315.00
Waters	4,376	12,384	3	21	115.00	651.00
Histological examinations	10	12	9	12	86.67	120.00
Rabies	3		1		10.00	

TABLE 1.—Comparative table of routine work performed, etc.—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Biological laboratory—Continued.</b>						
Rats for plague .....	94, 151	91, 999				
Miscellaneous biological examinations .....	1, 893	2, 418	24	18	137.00	79.00
Total .....	210, 143	196, 120	1, 097	877	5, 965.30	5, 633.67
<b>Serum section of the biological laboratory:</b>						
Vaccine virus (doses) .....	4, 838, 120	3, 111, 687	4, 838, 120	3, 111, 687	51, 867.10	39, 883.68
Miscellaneous serums and vaccines (ampules and units) .....	4, 736, 823	5, 039, 685	4, 736, 823	5, 039, 685	78, 440.43	134, 525.88
Total .....	9, 574, 943	8, 151, 372	9, 574, 943	8, 151, 372	130, 307.53	174, 409.56
<b>Miscellaneous:</b>						
Photographic work .....	9, 627	10, 291	5, 854	6, 488	2, 439.65	2, 058.28
Natural-history specimens .....	20	57	20	57	205.00	403.80
Shop work .....	908	661	4	5	37.96	72.10
Drafting .....	95	188	52	156	45.55	78.00
Miscellaneous work .....	24	586	24	586	8, 559.24	9, 292.01
Supplies .....	3, 577	5, 474	3, 577	5, 474	4, 870.88	5, 175.58
Tikitiki extract .....	455	703	455	703	320.38	498.50
Sales of publications .....					5, 997.49	4, 675.87
Refunded, work not done, etc. (deducted) .....					(90.00)	(55.00)
Power, gas, etc. ....					42, 960.61	39, 208.70
Total .....	14, 706	17, 955	9, 986	13, 469	65, 346.76	61, 407.84
<b>Grand total .....</b>	<b>9, 921, 900</b>	<b>8, 393, 303</b>	<b>9, 704, 165</b>	<b>8, 187, 087</b>	<b>224, 757.97</b>	<b>269, 231.47</b>

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1921, as compared with the fiscal year 1920, by number or quantity and by value, arranged with reference to Government and other patronage.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Bureau of Agriculture:</b>						
Clays, shales, limestones, limes, wall plasters, and slags .....		2				
Fertilizers.....	12	19				
Soils and similar substances .....	6	15				
Foods, alcohols, and beverages .....	90	26				
Petroleum and products, copra, and similar materials .....	24					
Medicines and similar articles .....		1				
Photographic work.....	16	3	16	3	3.20	0.60
Total .....	148	66	16	3	3.20	0.60
<b>Bureau of Audits:</b>						
Photographic work.....		5		5		3.00
<b>Bureau of Coast and Geodetic Survey:</b>						
Supplies.....		2		2		10.00
<b>Bureau of Commerce and Industry:</b>						
Rocks, minerals, natural pigments, and similar substances .....		1				
Foods, alcohols, and beverages .....		10				
Blood .....		1				
Photographic work.....	96	23	96	23	22.80	42.00
Total .....	96	35	96	23	22.80	42.00
<b>Bureau of Customs:</b>						
Foods, alcohols, and beverages .....	3					
Waters, biological.....	2	1				
Waters, chemical.....	1	1				
Petroleum and products, copra, and similar materials .....	64	203				
Medicines and similar articles .....	164	404				
Total .....	234	609				

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Bureau of Education:</b>						
Clays, shales, limestones, limes, wall plasters, and slags	5					
Fertilizers		5				
Miscellaneous inorganic analyses	1	2				
Urines, clinical and toxicological analyses	1					
Miscellaneous organic analyses and examinations	3					
Photographic work	197		197		39.40	
Supplies	4	4	4	4	27.00	27.00
Total	211	11	201	4	66.40	27.00
<b>Executive Bureau:</b>						
Photographic work	6	2	6	2	11.60	5.00
<b>Department of Agriculture and Natural Resources:</b>						
Photographic work	6					
<b>Department of Mindanao and Sulu:</b>						
Miscellaneous organic analyses and examinations	1		1		10.00	
<b>Bureau of Dependent Children:</b>						
Vaccine virus	250		250		2.50	
Miscellaneous serums and vaccines (ampules and units)	312		312		124.80	
Total	562		562		127.30	
<b>Bureau of Forestry:</b>						
Miscellaneous inorganic analyses		52				
Foods, alcohols, and beverages		2				
Miscellaneous organic analyses and examinations		1				
Photographic work	423	90	423	90	72.58	20.21
Total	423	145	423	90	72.58	20.21



TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
Philippine Census:						
Photographic work	1		1		0.50	
Philippine Health Service:						
Rocks, minerals, natural pigments, and similar substances	1					
Waters, chemical	13	13				
Waters, biological	3,227	11,227				
Crude chemical and miscellaneous analyses		2				
Urines, clinical and toxicological analyses	208	101				
Petroleum and products, copra, and similar materials		1				
Linseed and castor oils		2				
Gastric juice, clinical examinations	1	2				
Foods, alcohols, and beverages	2,397	1,986				
Food preservatives and coloring matter	4	59				
Medicines and similar articles	2	9				
Miscellaneous organic analyses and examinations	1	51		48		19.20
Fæces	15,294	13,829				
Sputum	168	107				
Blood	17	40				
Widal tests	2,854	1,783				
Wassermann tests	890	485				
Leprosy	469	31				
Gonococci	2					
Histological examinations		2				
Rabies	2	2				
Rats for plague	94,151	91,954				
Miscellaneous biological work and examinations	1,866	2,397				
Vaccine virus	4,784,100	3,073,300	4,784,100	3,073,300	50,424.00	38,632.00
Miscellaneous serums and vaccines	2,406,311	2,837,819	2,406,311	2,837,819	64,618.75	114,582.00
Photographic work	101	2,127	101	2,127	27.40	395.37
Supplies	287	386	287	386	158.75	133.75
Total	7,312,366	6,037,585	7,190,799	5,913,632	115,223.90	153,743.12

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
Philippine General Hospital:						
Waters, chemical.....		3				
Petroleum and products, copra, and similar materials.....		1				
Gastric juice, clinical examinations.....		1				
Vaccine virus.....	20	10	20	10	1.70	1.00
Miscellaneous serums and vaccines.....	423,643	502,983	423,643	502,983	2,143.30	2,765.00
Photographic work.....	221	750	18		12.11	
Shop work.....		1		1		25.00
Tikitiki extract.....		7		7		4.90
Total.....	423,884	503,756	423,681	503,001	2,157.11	2,795.90
House of Representatives:						
Photographic work.....	114		114		284.00	
Bureau of Internal Revenue:						
Rocks, minerals, natural pigments, and similar substances.....		1				
Paints and varnishes.....	1					
Standardization and correction of units of measure.....	64	1	64		13.20	
Petroleum and products, copra, and similar materials.....	2	37				
Foods, alcohols, and beverages.....	2	1				
Medicines and similar articles.....	78	2,670				
Photographic work.....	107		107		48.00	
Total.....	254	2,710	171		61.20	
Bureau of Justice:						
Urines, clinical and toxicological analyses.....	1		1		20.00	
Medicines and similar articles.....	42	21	42	21	420.00	107.00
Blood.....		1		1		75.00
Total.....	43	22	43	22	440.00	182.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
Bureau of Labor:						
Photographic work.....	4		4		6.00	
Bureau of Mint:						
Assays.....	173	369	173	369	346.00	761.50
Smelting and refining of gold.....	820		820		28.09	
Total.....	998	369	998	369	374.09	761.50
Office of the Governor- General:						
Photographic work.....	249	4	249	4	268.00	12.00
Supplies.....		2		2		2.40
Total.....	249	6	249	6	268.00	14.40
Board of Pharmaceutical Examiners and Inspectors:						
Miscellaneous biological work and examinations.....		1				
Medicines and similar articles.....	239	347				
Total.....	239	348				
Public Welfare Commissioner:						
Vaccine virus.....	100	100	100	100	1.00	1.00
Miscellaneous biological work and examinations.....		1				
Total.....	100	101	100	100	1.00	1.00
Bureau of non-Christian Tribes:						
Photographic work.....	247		247		247.01	
Philippine Constabulary:						
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....		6		6		20.00
Miscellaneous organic analyses and examinations.....		8				
Blood.....		2				
Vaccine virus.....	3,600	2,150	3,600	2,150	36.00	21.50
Miscellaneous serums and vaccines.....	90	135	90	135	41.00	62.50
Supplies.....	107	60	107	60	4.90	3.00
Total.....	3,797	2,361	3,797	2,361	81.90	107.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Weather Bureau:</b>						
Photographic work .....		5		5		2.50
<b>Bureau of Posts:</b>						
Miscellaneous inorganic analyses .....		1		1		20.00
Photographic work .....		19		19		40.00
Total .....		20		20		60.00
<b>Bureau of Printing:</b>						
Paper and similar materials .....	2	13				
<b>Bureau of Prisons:</b>						
Fæces .....	87,866	71,317				
Widal tests .....	1					
Wassermann tests .....	22	11				
Leprosy .....	2	2				
Gonococci .....		1				
Rats for plague .....		1				
Histological examinations .....	1					
Waters, biological .....		1				
Vaccine virus .....	3,300	7,200	3,300	7,200	33.00	72.00
Miscellaneous serums and vaccines .....	18	7	18	7	12.60	6.00
Supplies .....		1		1		.50
Total .....	91,210	78,541	3,318	7,208	45.60	78.50
<b>Bureau of Public Works:</b>						
Metals and alloys .....		1				
Cements .....		1,140		1,140		1,167.30
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc. ....	57	220	57	220	85.00	283.00
Waters, chemical .....	132	125				
Miscellaneous inorganic analyses .....		3				
Waters, biological .....	11	2				
Photographic work .....	30		30		17.60	
Total .....	230	1,491	87	1,360	102.60	1,450.30
<b>Bureau of Quarantine Service:</b>						
Urines, clinical and toxicological analyses .....		6				
Fæces .....	594	374				
Rats for plague .....		44				

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Bureau of Quarantine Service—Continued.</b>						
Vaccine virus .....	10,000	6,603	10,000	6,603	100.00	66.30
Miscellaneous serums and vaccines (ampules, cc., and units) .....		5		5		3.50
Total .....	10,594	7,026	10,000	6,608	100.00	69.80
<b>Bureau of Science:</b>						
Rocks, minerals, natural pigments, and similar substances .....		5				
Clays, shales, limestones, limes, wall plasters, cements, and slags .....	3	2				
Coal analyses .....	8	7				
Standard solutions (liters) .....	70	54				
Physical tests of wire, twine, fibers, textiles, papers, and similar articles .....	1					
Foods, alcohols, and beverages .....		8				
Miscellaneous inorganic analyses .....	1					
Fæces .....	4	2				
Petroleum and products, copra, and similar materials .....	4					
Sputum .....	1	4				
Urines, clinical and toxicological analyses .....		15				
Petroleum and products, copra, and similar materials .....		14				
Wassermann tests .....	2	2				
Widal tests .....		1				
Medicines and similar articles .....	291	2				
Miscellaneous organic analyses and examinations .....	90	23				
Assays .....	1	8				
Waters, chemical .....	2	6				
Waters, biological .....	1	3				

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>Bureau of Science—Continued.</b>						
Photographic work.....	3,564	3,063				
Shop work.....	904	656				
Drafting.....	43	27				
<b>Total.....</b>	<b>4,996</b>	<b>3,892</b>				
<b>Bureau of Supply:</b>						
Waters, chemical.....		3				
Physical tests of wire, twine, fibers, textiles, papers, and similar materials.....		13		13		6.00
Cements.....	7,703	6,554	7,703	6,554	7,700.50	6,538.50
Paints and varnishes.....	6	6	6	6	54.00	75.00
Standardization and correction of units of measure.....	2,378	1,645	2,378	1,645	531.60	164.50
Miscellaneous inorganic analyses.....		151				
Petroleum and products, copra, and similar materials.....	7	51				
Miscellaneous organic work and examinations.....		8		8		30.00
Foods, alcohols, and beverages.....	22	68				
Medicines and similar articles.....		1				
Miscellaneous biological work and examinations.....	3	1				
Miscellaneous serums and vaccines.....		12,112		12,112		86.00
Supplies.....	227	796	227	796	355.19	780.00
Tikitiki extract.....	55	314	55	314	36.00	
<b>Total.....</b>	<b>10,403</b>	<b>21,403</b>	<b>10,369</b>	<b>21,128</b>	<b>8,677.29</b>	<b>7,605.00</b>
<b>University of the Philippines:</b>						
Vaccine virus.....	600		600		6.00	
Fæces.....	461	488				
Miscellaneous serums and vaccines.....	32,000	75,283	32,000	75,283	38.00	219.00
Photographic work.....	945	236	945	236	204.81	89.44
Shop work.....	1		1		14.00	
Supplies.....	22	7	22	7	110.00	42.00
<b>Total.....</b>	<b>34,029</b>	<b>76,014</b>	<b>33,568</b>	<b>75,526</b>	<b>372.81</b>	<b>350.44</b>

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
<b>City of Manila:</b>						
Standard solutions (liters).....	8		8		98.67	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc. ....	19	35	19	35	60.00	140.00
Urine, clinical and toxicological analyses.....	4	5	3		75.00	
Petroleum and products, copra, and similar materials.....		2				
Medicines and similar articles.....	2	1,087		1,087		3,270.00
Miscellaneous organic analyses and examinations.....		1				
Blood.....	3	1				
Waters, biological.....	1,132	1,129				
Miscellaneous biological work and examinations.....		3		3		5.00
Miscellaneous serums and vaccines.....	500,000	450,000	500,000	450,000	500.00	700.00
Supplies.....	2		2		3.70	
<b>Total.....</b>	<b>501,170</b>	<b>452,263</b>	<b>500,032</b>	<b>451,125</b>	<b>787.37</b>	<b>4,115.00</b>
<b>Metropolitan Water District:</b>						
Crude chemical and miscellaneous analyses.....		4		4		16.00
Standard solutions (liters).....		18		18		108.50
<b>Total.....</b>		<b>22</b>		<b>22</b>		<b>119.50</b>
<b>Provinces and municipalities:</b>						
Metals and alloys.....	1		1		4.00	
Cements.....		9		9		43.75
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....		9		9		45.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
Provinces and municipalities—Continued.						
Petroleum and products, copra, and similar materials.....	1		1		15.00	
Medicines and similar articles.....	4		4		40.00	
Waters, chemical.....	5	15	5	15	195.00	785.00
Urines, clinical and toxicological analyses.....		1		1		20.00
Medicines and similar articles.....		8		8		80.00
Waters, biological.....		5		5		200.00
Photographic work.....	6	18	6	18	36.00	3.60
Supplies.....	6		6		6.00	
Total.....	23	65	23	65	296.00	1,177.35
United States Army and Navy:						
Metals and alloys.....	3		3		44.60	
Rocks, minerals, natural pigments, etc.....	3		3		36.00	
Coal analyses.....	4		4		140.00	
Waters, chemical.....	3		3		95.00	
Crude chemical and miscellaneous analyses.....	1		1		3.00	
Cements.....		6		6		22.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....	10	9	10	9	11.00	20.00
Miscellaneous inorganic analyses.....		7		7		42.00
Foods, alcohols, and beverages.....	10		10		72.00	
Histological examinations.....		1		1		10.00
Miscellaneous organic analyses and examinations.....	2		2		12.00	
Waters, biological.....	1		1		40.00	
Vaccine virus.....	30,800	18,315	30,800	18,315	969.50	816.50
Miscellaneous serums and vaccines.....	106,138	81,004	106,138	81,004	1,078.20	1,894.60



TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
United States Army and Navy—Continued.						
Supplies.....	20	16	20	16	100.00	80.00
Tikitiki extract.....		6		6		4.20
Total.....	136,995	99,364	136,995	99,364	2,600.70	2,889.80
Philippine Senate:						
Photographic work.....		235		235		55.20
Commission of Independence:						
Photographic work.....		35		35		7.00
Philippine National Guard:						
Supplies.....		1		1		5.00
Public Utility Commissioner:						
Miscellaneous inorganic analyses.....		5				
Miscellaneous:						
Metals and alloys.....	13	14	13	14	121.50	178.50
Clays, shales, limestones, limes, wall plasters, cements, and slags.....	23	38	23	38	235.00	541.00
Rocks, minerals, natural pigments, and similar substances.....	23	26	23	26	159.50	211.00
Fertilizers.....	95	48	95	48	801.00	436.00
Soils and similar substances.....	26	34	26	34	531.50	599.00
Coal analyses.....	51	11	51	11	1,492.00	283.00
Crude chemical and miscellaneous analyses.....	15	9	15	9	184.50	50.50
Paints and varnishes.....	3	1	3	1	74.38	12.00
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	4	4	4	4	10.00	7.00
Standard solutions (liters).....	19	8	19	8	90.00	37.70
Cements.....	146	639	146	639	743.75	2,612.45
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....	41	228	41	228	61.50	362.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
Miscellaneous—Continued.						
Standardization and correction of units of measure.....	443	69	443	69	393.10	147.00
Miscellaneous inorganic analyses.....	95	326	95	326	382.50	823.00
Urine, clinical, and toxicological analyses.....	362	503	362	503	1,096.35	1,601.03
Essential oils and essences.....	22	15	22	15	202.50	150.00
Petroleum and products, copra, and similar materials.....	301	563	301	563	1,587.00	3,161.50
Linseed and castor oils.....	1	4	1	4	15.00	18.00
Calorimetric tests of fuels.....		3		3		82.00
Standardization of road materials.....		1		1		6.00
Gastric juice, clinical examinations.....		3		3		45.00
Gums, resins, and similar materials.....	18		18		57.00	
Paper and similar materials.....	1	2	1	2	5.00	12.00
Foods, alcohols, and beverages.....	307	262	307	262	1,054.50	1,129.67
Foods, preservatives, and coloring matter.....	3	4	3	4	14.50	17.00
Medicines and similar articles.....	11	8	11	8	181.00	127.50
Miscellaneous organic analyses and examinations.....	77	219	77	219	461.82	534.00
Assays.....	219	80	219	80	867.50	362.50
Smelting and refining of gold.....	104,480	7,040	104,480	7,040	1,846.92	110.00
Waters, chemical.....	18	22	18	22	360.00	438.50
Waters, biological.....	2	16	2	16	75.00	451.00
Fæces.....	244	198	244	198	730.00	581.00
Sputum.....	127	100	127	100	368.00	293.00
Blood.....	35	37	35	37	146.67	200.34
Cultures.....	49	39	49	39	305.96	447.33
Widal tests.....	87	68	87	68	260.00	204.00
Wassermann tests.....	322	261	322	261	3,220.00	2,610.00
Leprosy.....		8		8		24.00
Urine, biological.....	32	9	32	9	94.00	34.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1920	1921	1920	1921	1920	1921
Miscellaneous—Continued.						
Gonococci .....	164	105	164	105	492.00	315.00
Histological examinations .....	9	11	9	11	86.67	110.00
Rabies .....	1		1		10.00	
Miscellaneous biological work and examinations .....	24	15	24	15	187.00	74.00
Vaccine virus .....	5,350	4,009	5,350	4,009	298.40	273.38
Miscellaneous serums and vaccines .....	1,268,311	1,080,337	1,268,311	1,080,337	9,888.78	14,207.28
Photographic work .....	3,294	3,686	3,294	3,686	1,138.64	1,382.36
Natural-history specimens .....	20	57	20	57	205.00	408.80
Shop work .....	3	4	3	4	23.96	47.10
Drafting .....	52	156	52	156	45.55	78.00
Miscellaneous work .....	24	586	24	586	8,559.24	9,292.01
Supplies .....	2,902	4,199	2,902	4,199	4,110.34	4,091.98
Tikitiki extract .....	400	690	400	690	284.88	489.40
Sales of publications .....					5,997.49	4,675.87
Refunded, work not done, etc. (deducted) .....					(90.00)	(55.00)
Power, gas, etc. ....					42,960.61	39,208.70
Total .....	1,388,269	1,104,775	1,388,269	1,104,775	92,367.01	93,533.35
Grand total .....	9,921,900	8,393,303	9,704,165	8,187,087	224,757.97	269,231.47

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1921 (January 1 to December 31, 1921) as compared with the fiscal years 1919 and 1920.

## EXPENDITURES.

Item.	Fiscal year—		
	1919	1920	1921
<b>Salaries and wages, etc.:</b>	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Salaries and wages, including accrued leave.....	229,600.39	280,196.09	345,364.47
Bonuses.....	30,186.48	32,345.96	24,075.65
Travel expenses of personnel.....	8,998.20	12,000.00	14,654.30
Total.....	268,785.07	324,542.05	384,094.42
<b>Apparatus, supplies, etc.:</b>			
Consumption of supplies and materials, including subscriptions <sup>a</sup> .....	111,172.13	180,000.00	178,603.53
Apparatus and equipment, including books.....	20,134.81	23,049.57	131,945.85
Total.....	131,306.94	203,049.57	310,549.38
<b>Miscellaneous:</b>			
Rental of buildings.....	16.10		
Postal, telegraph, telephone, and cable service.....	4,500.00	6,500.00	3,566.70
Freight, express, and delivery service.....	1,191.01	2,500.00	2,560.41
Printing and binding reports, documents, and publications.....	27,000.00	35,000.00	35,000.00
Illumination and power service.....	1,749.35	3,000.00	1,851.87
Miscellaneous service.....	4,717.87	9,000.00	10,605.64
Maintenance and repair of furniture and equipment....	2,092.24	4,200.00	1,475.13
Total.....	441,358.58	60,200.00	55,069.75
<b>Distribution of tikitiki extract, antityphoid vaccine, and antidyenteric serum:<sup>b</sup></b>			
Salaries and wages.....		2,632.16	4,462.22
Bonuses.....		442.99	331.25
Equipment.....		3,787.13	3,579.35
Consumption of supplies and materials.....		17,024.17	31,516.97
Other services.....		113.55	165.45
Total.....		24,000.00	40,065.24
<b>Grand total.....</b>	<b>441,358.58</b>	<b>611,791.62</b>	<b>789,758.79</b>

<sup>a</sup> Subscriptions in 1920 and 1921 are included under miscellaneous service.

<sup>b</sup> Formerly under miscellaneous accounts.

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1921 (January 1 to December 31, 1921) as compared with the fiscal years 1919 and 1920—Continued.

INCOME.

Item.	Fiscal year—		
	1919	1920	1921
	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Receipts from operation.....	198,258.97	219,857.10	264,487.61
Sales of supplies.....	600.00	83.44	12.26
Sales of fixed assets.....	5,028.96	3,794.00	3,392.00
Other.....	1,681.11	1,023.43	810.90
Total.....	205,569.04	224,757.97	268,702.77
Appropriation account:			
Appropriated.....	525,930.00	772,160.00	785,925.00
Allotted by the Emergency Board.....	2,500.00	.....	41,800.00
Reduction by the Emergency Board.....	.....	.....	(47,500.00)
Brought forward for equipment.....	10,399.46	10,264.65	107,215.08
Total.....	538,829.46	782,424.65	837,440.08

MISCELLANEOUS ACCOUNTS (1921).

Item.	Available.	Expended.	Balance.
	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Replacement fund (Iloilo and Carnival fires).....	1,127.89	1,127.89	.....
Construction of Serum Laboratory, Act No. 2786.....	43,999.50	35,915.34	8,084.16
Publicity service for the Philippine Food Commission (allotted by the Emergency Board).....	1,738.80	.....	1,738.80
Total.....	46,866.19	37,043.23	9,822.96



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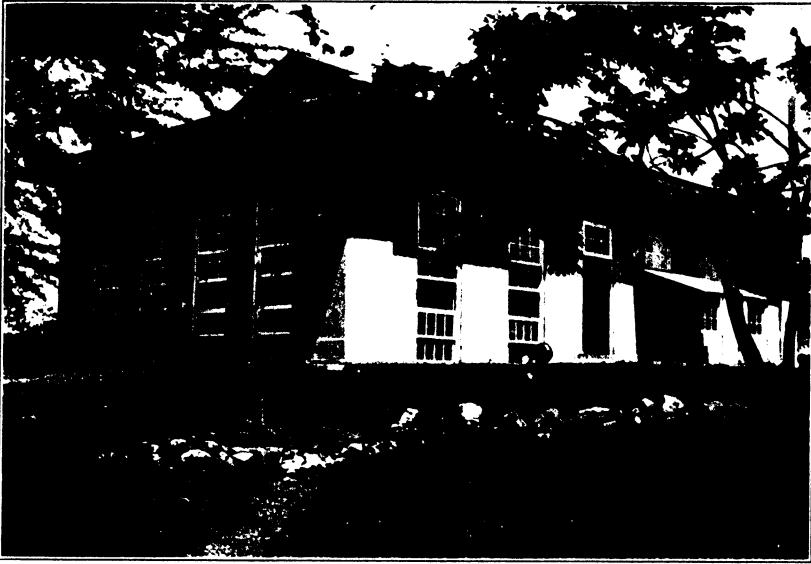


Fig. 1. The main laboratory building at Alabang.



Fig. 2. The horse stables at Alabang.

PLATE 1.





Fig. 1. A room in the main laboratory at Alabang.



Fig. 2. Smallpox vaccine operating room at Alabang.

PLATE 2.





PLATE 3. TIKITIKI-EXTRACTION PLANT, MANILA.



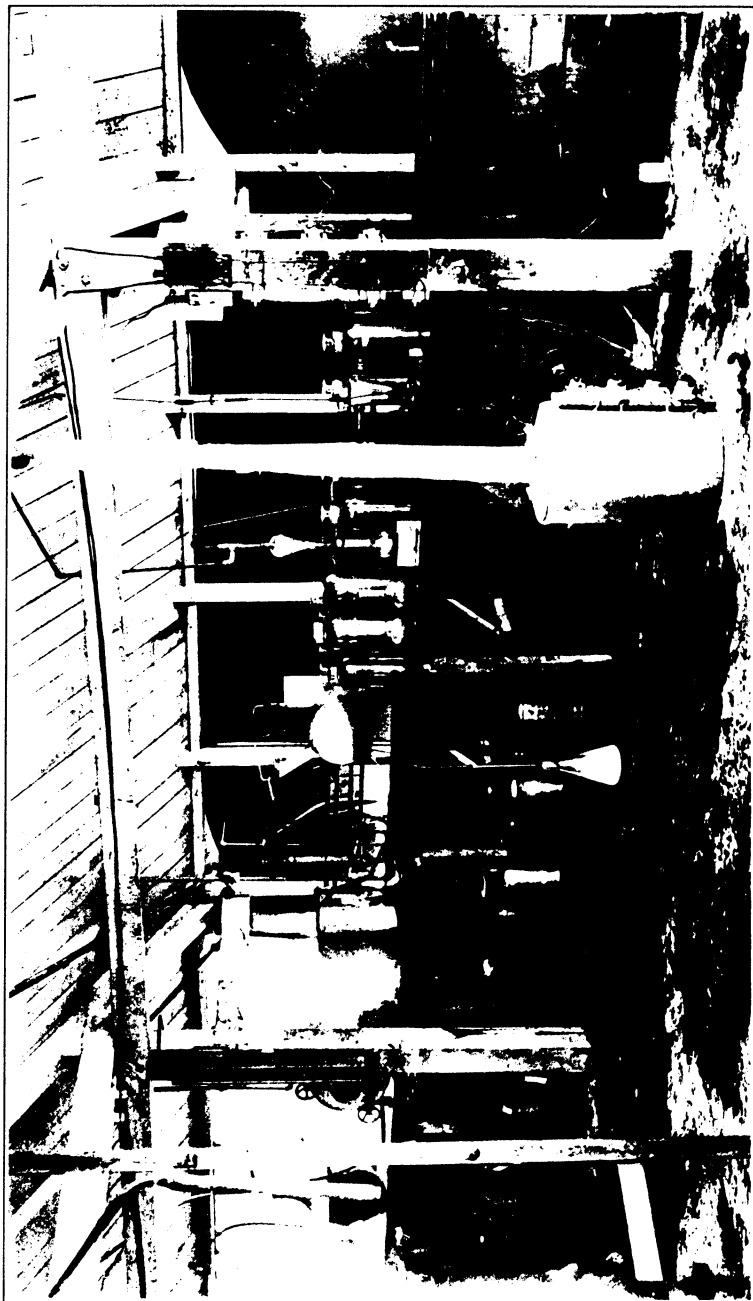


PLATE 4. PLANT FOR MAKING ETHYL ESTER OF CHAULMOOGRA OIL. MANILA.







TWENTY-FIRST ANNUAL REPORT OF THE BUREAU OF SCIENCE. ]



MAIN BUILDING AND EAST WING, BUREAU OF SCIENCE, MANILA.

# TWENTY-FIRST ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

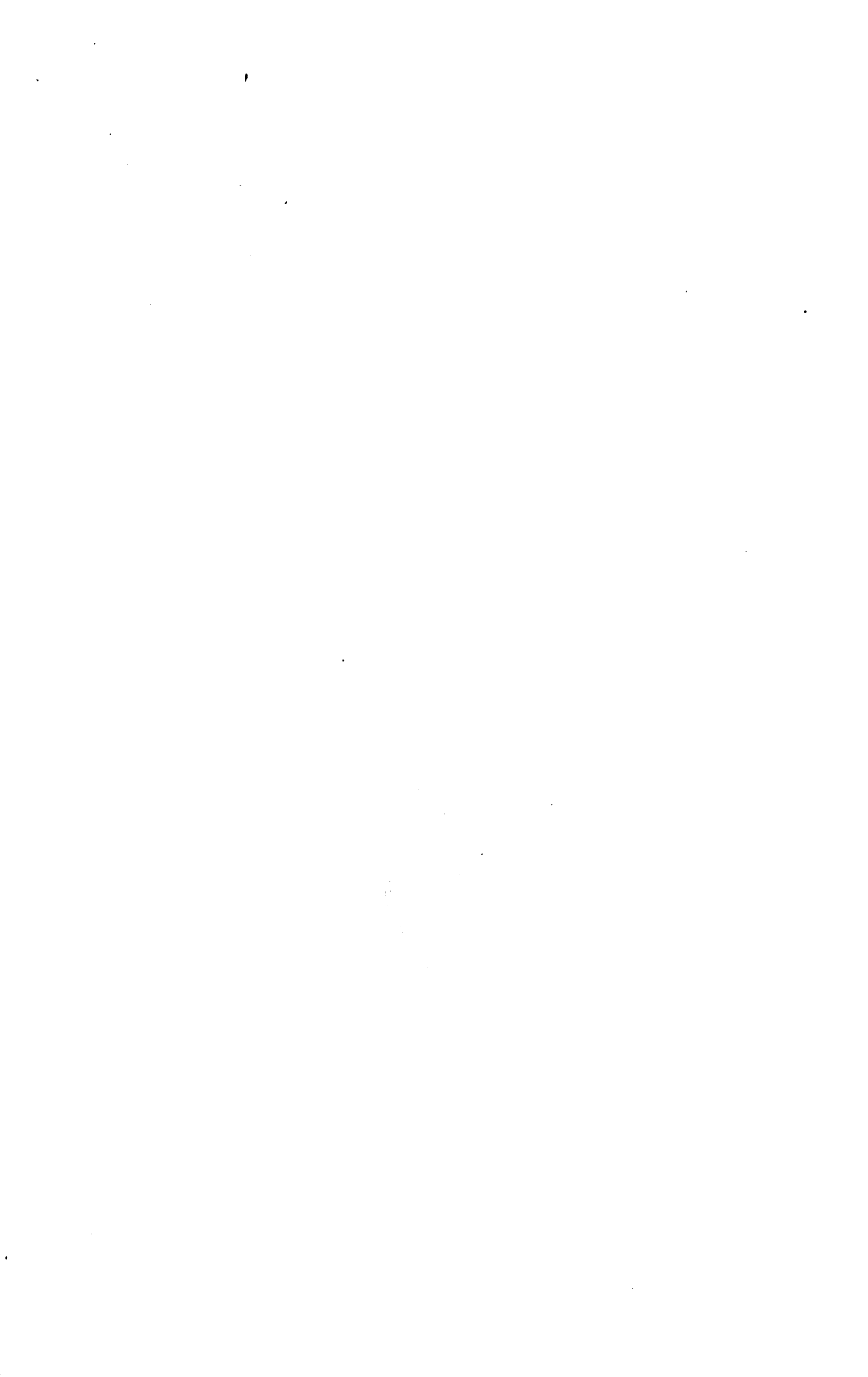
BY

ELMER D. MERRILL  
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1922



MANILA  
BUREAU OF PRINTING  
1923



W. E. P. Campbell,  
2-27-1922

## TWENTY-FIRST ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE,

MANILA, *December 31, 1922.*

SIR: I have the honor to submit the following report covering the operations of the Bureau of Science for the fiscal and calendar year 1922.

The year has not been an easy one on account of continued adverse financial conditions which made the utmost economy absolutely essential. Needed improvements, equipment, and additional personnel have of necessity been impossible to secure. All the members of the staff of the Bureau have worked conscientiously for the best interest of the institution and of the service as a whole. The routine work in practically all departments has increased, which is reflected in the greatly increased service income of the Bureau, which in 1922 amounted to ₱343,651.33. This is nearly ₱75,000 in excess of that of 1921 and by far the largest annual income ever earned by the institution. At the same time the total expenditures of the Bureau have decreased from ₱789,758.79 in 1921 to ₱626,334.57 in 1922, a difference of ₱163,424.22.

Could the Bureau of Science be given adequate financial support it is felt that within the course of a few years it could be placed on a practically self-supporting basis, as its service income is steadily increasing from year to year. The maximum income must of necessity soon be reached unless more liberal support be provided for the purchase of equipment and materials and additional technical personnel be provided for. The general policy that has been followed for several years past of abolishing those positions which happen to be vacant at the close of the year, of reducing all salaries to the actual salary of the incumbent, and of providing no new positions, and no promotions must soon be changed, or the results to this institution will be disastrous.

To a considerable degree the institution is reduced to the services of but a single technical man in each of several departments. Thus, in geology and mining, in fisheries, in entomology, in systematic botany, in plant pathology, in ornithology, and in parasitology only one employee in each subject is provided for. This merely means that when the one employee in any one department goes away on leave, or is absent on field work, all productive work stops. The system is unscientific and unbusinesslike, and the minimum number of scientific men that should be provided for in each of these departments is two, while in several the number of employees should be radically increased.

The Bureau of Science, maintained wholly at the expense of the Philippine Government, was organized in 1901 as the Bureau of Government Laboratories and became the Bureau of Science in 1906. The prime object in establishing the institution was to assemble, so far as possible in one unit, the scientific activities of the Philippine Government in order to avoid duplication of technical personnel, equipment, and literature by other units of the Government service; in other words, to gain economy and efficiency in administration. The idea, essentially new in 1901, has attracted the attention of administrative authorities in other countries.

From the beginning the policy has been to stress two distinct but more or less interdependent fields, research and routine. Research needs no explanation and no defense. The term routine, however, is unfortunate in the sense that it conveys to many individuals the idea of perfunctory daily tasks, perfunctorily accomplished; whereas, as a matter of fact, the enormous mass of routine work carried on by the institution demands on the part of its technical staff charged with the performance or supervision of these duties high technical training, wide experience, and distinct ability; not only the ability to perform the technical daily tasks efficiently and well, but also to initiate new work, to modify standard methods to meet local needs, and to apply locally the results obtained by modern research, whether carried on here or elsewhere.

Among scientific institutions generally the field covered by the activities of the Bureau of Science is an unusually wide and diversified one. With the funds made available from year to year it is charged with the maintenance of an extensive plant in Manila, and a secondary one (the serum laboratory) at Alabang, operating twenty-four-hour unit power plants in both

places; with the care and upbuilding of the central scientific library of the Philippine Government, without which productive work would be impracticable and impossible and which now contains about 52,000 bound volumes; with the publication of technical and popular papers in which the results of our investigations are made available; with the prosecution of research; and with the maintenance of a large public aquarium. In addition to the above the institution is charged with all of the routine Government work in organic and inorganic chemistry, whether required by this Bureau or by any other Government unit, including the analysis of drugs, foods, water, coal, fertilizers, oils, etc.; the testing of structural materials, such as cement, steel, and timber; the standardization of all weights and measures for the Archipelago; the manufacture of the standard serums and vaccines in sufficient quantities to supply the needs of a population of 11,000,000 people; the preparation and administration of the Pasteur antirabic treatment; the manufacture of tikitiki extract on an enormous scale for the treatment of beriberi; to carry on the laboratory work needed by the Health Service in connection with the control of communicable diseases; and to maintain and augment the extensive collections of natural-history material in botany, mycology, zoölogy, entomology, ichthyology, ornithology, conchology, geology, paleontology, etc., essential for study purposes. Some of the collections, notably in botany, mycology, entomology, and ornithology, are relatively large, in botany alone now approximating 250,000 specimens. These natural-history specimens are not museum exhibits as such, but are working study collections. To meet its own needs the Bureau is obliged to maintain a large number of horses, cattle, and goats at Alabang for serum and vaccine purposes, and at both Alabang and Manila very large numbers of small animals, such as rabbits, guinea pigs, white rats, and monkeys, for the routine and research work of the biological and serum laboratories.

The laboratory work done in connection with its own problems and that done for other Government units is only a part of its daily routine. Work on a commercial basis in chemistry, testing materials, and standardization is provided for, the Bureau thus occupying an important position in the industrial field. Similar private work for physicians, hospitals, etc., is provided for in the medical and biological sciences.

The institution is thus intimately connected with the whole problem of the industrial and agricultural development of the Philippines, as also with medical and public-health problems,

and with practically all phases of natural-history investigations. Its work is and always has been prosecuted with a relatively small technical staff. The combination of scientific and routine work for both Government and private units strongly characterizes the institution among others of its general type in that, in spite of an enormous amount of work done for other Government units, for which no charge can be made under the provision of the Administrative Code, a large service income is received from its commercial and semicommercial work.

This service income, all of which reverts to the Insular Treasury as government revenue, amounted in 1922 to ₱343,651.33, an increase of ₱74,948.56 over that of 1921. The total expenditures for the Bureau in 1922 were ₱626,334.57; in other words, the total cost of the institution to the Government during the year was less than ₱283,000. The indications are that the income of the Bureau will increase rather than decrease in the coming year on account of the constantly increasing demands for service. If but nominal charges per unit were made for the work now done without charge for other Government units, the service income of the Bureau would be very greatly in excess of the total cost of maintenance and operation.

#### NEW POWER UNIT

In connection with the construction of new buildings at the Philippine General Hospital, plans were initiated in 1919 to secure and install a new and larger power unit in the Bureau of Science. It was decided to purchase an internal combustion engine and, after considering all phases of the subject, a Busch-Sulzer Diesel 180-horsepower engine was selected. This unit is directly connected to a 120-kilowatt dynamo. The actual installation was completed early in June, the unit was thoroughly tested during that month, and was accepted from the contractors the latter part of the month. Since it was installed it has given very satisfactory service and has enabled us materially to reduce the unit cost of production of electric power.

#### INDUSTRIAL FELLOWSHIPS

The general policy of establishing industrial fellowships between the Bureau of Science and local commercial units was adopted in 1921, although no actual agreements were consummated up to the end of that year. The subject was briefly mentioned in my last annual report.

During the year 1922 there has been considerable development in this field. Nine fellowships have been approved, and preliminary propositions have been received in reference to the



possible establishment of additional ones. The general idea in respect to industrial fellowships is that developed by the Mellon Institute for Industrial Research at Pittsburgh, whereby coöperative work on specific problems can be carried on by technical employees of the institution with funds supplied wholly or in part by the other contracting parties. The initiation of this type of coöperative work locally has enabled the Bureau of Science to prosecute work on important local problems that would have been impossible with the resources of the institution alone.

Industrial fellowship No. 1 was approved January 12, with the Philippine Sugar Centrals Agency. The object of this fellowship is to increase the output of sugar in the Philippines by demonstrating to planters associated with the Sugar Centrals Agency that the adoption of modern agricultural methods is a paying proposition. The Philippine Sugar Centrals Agency consists of a group of six modern sugar centrals that are controlled by the Philippine National Bank. This fellowship is the largest one established during the year, and for the Bureau of Science has been placed in charge of Mr. H. A. Lee. The Philippine Sugar Centrals Agency itself employs at its own expense five individuals who are working under Mr. Lee's direction. The results so far obtained have been excellent.

Industrial fellowship No. 2 was approved January 31, with the Antamok Valley Group, an association of individuals who have spent a considerable amount of money in developing certain mining claims in the vicinity of Baguio. It called for a thorough geological examination of all mineral claims held by the association and for the submittal of a geological report with recommendations. The field work in reference to this project was carried on by Dr. Warren D. Smith and Mr. Victoriano Elicaño, of the division of mines. The work has been completed, and the final report was rendered on June 16, 1922.

Industrial fellowship No. 3 was approved April 6, with the San Carlos Milling Company, of Negros, and is practically an extension of industrial fellowship No. 1, the work being under the direction of Mr. H. A. Lee.

Industrial fellowship No. 4 was approved August 17, with the Union Oil Company. This involved geological exploration work in the regions in which this company holds geological exploration leases in reference to petroleum deposits. The field work on this project was accomplished by Mr. V. Elicaño, and the final report was rendered on October 26.

Industrial fellowship No. 5 was approved August 25, with Daywalt and Company, San Jose, Mindoro, in reference to geological exploration of southern Mindoro regarding certain supposed petroleum deposits. In approving this fellowship it was specified that no field work should be done during the year 1922, but that the work would be undertaken in the early part of 1923. The work on this project will be done by Mr. Elicaño.

Industrial fellowship No. 6 was approved August 29, with Mr. Joshua T. Colvin, of Manila. This fellowship calls for geological exploration and report on certain phosphate and guano deposits in Panay. The field work was done by Mr. Elicaño, and the final report was rendered by him under date of November 10.

Industrial fellowship No. 7 was approved October 17, with the Banisilan Oil Company and calls for geological exploration in reference to supposed petroleum deposits, the work to be done in the early part of 1923. This fellowship is practically a duplicate of No. 4.

Industrial fellowship No. 8 was approved October 19, with the North Negros Sugar Company and Victorias Milling Company, and is practically an extension of industrial fellowships Nos. 1 and 3. The actual work is placed under the direction of Mr. Lee.

Industrial fellowship No. 9 was approved October 31, with the Richmond Petroleum Company, involving certain geological field work in reference to the possible location of petroleum-bearing strata. The field work in connection with this fellowship has been completed; it was accomplished by Mr. Elicaño, of the division of mines.

Summarizing the industrial fellowship work of the Bureau during 1922, fellowships Nos. 1, 3, and 8 have been in operation since they were respectively approved, and it is expected that they will continue to be in operation for at least the next year or so. All work in reference to fellowships Nos. 2, 4, 6, and 9 has been completed, and the required reports have been rendered. With reference to the work required under fellowships Nos. 5 and 7, it was specifically arranged that this would be undertaken during the early part of 1923.

The industrial fellowship work so successfully initiated during the year 1922 has been of very distinct value to the Bureau of Science and to the other contracting parties. As problems needing solution arise and as the technical personnel in the Bureau is available for solving such problems, the number of

fellowships should be extended, as work of the type that is done under this arrangement is of benefit not only to the Bureau of Science and the other contracting parties but also to the Philippines as a whole. Moreover, under the terms of the agreements entered into between the Bureau of Science and the various other contracting parties, all field and incidental expenses in connection with the operations of the fellowships are paid by the other contracting parties; thus, during the year 1922 practically all of the field work of this Bureau in reference to geological work and plant pathology has been accomplished without expense to the Government. During its past history the Bureau of Science has carried on a large amount of investigation for the benefit of the local industries that under the present arrangement would be classed as industrial fellowships, but with the specific difference that in general all of the work accomplished was wholly at the expense of the Government.

During the year a number of small projects have been investigated by the technical employees of the Bureau which have not in general involved any considerable amount of field work or expense to the Bureau. While much of this consultory work has been more or less in the nature of industrial fellowship work, yet the time and financial elements involved have been so small that it was not considered advisable to place these minor investigations on an industrial fellowship basis; however, in several instances the minor investigations carried on by members of our technical staff have resulted to the distinct advantage of the individuals to whom technical data have been supplied.

#### COÖPERATION

The coöperative work of the Bureau of Science with other Government units and private entities was discussed at considerable length in the last annual report. With the exception of a few projects which have been completed, the coöperative work of 1921 has been continued through 1922. In connection with the Bureau of Agriculture, Messrs. F. Serrano, M. Medalla, F. Clara, and G. Reyes have continued plant pathology work in the laboratories of the Bureau of Science, investigating diseases of such major crops as abacá, bananas, sugar cane, tobacco, pineapples, rice, and citrus fruits, as well as prosecuting other minor investigations. The coöperation with the Bureau of Agriculture has been extended to soil analysis, Mr. R. Isidro of the Bureau of Agriculture being detailed to our laboratories under the immediate direction of Mr. Argüelles. Mr.

Adduru has continued the compilation of data on Philippine economic plants for the Bureau of Commerce and Industry. The geological and chemical work undertaken in coöperation with the Metropolitan Water District in reference to the Angat River project has been completed and final reports have been submitted. The coöperation of the United States Army medical authorities in reference to the survey of intestinal diseases at Fort Mills, Corregidor, has been completed and a final report rendered. A great deal of additional coöperative work with industrial units has been initiated during the year, much of this being done through the industrial fellowships discussed above, of which nine were approved during the year. Coöperative work in botany has been initiated with the Amoy University, and continued with the Canton Christian College, the Nanking University, the Forestry Department of British North Borneo, and with the College du Protectorat, Hanoi, Indo-China.

With the International Health Board a considerable amount of coöperative work has been accomplished in reference to their malarial survey in Luzon and the prevalence of certain intestinal parasites, notably the hookworm. In order to further the development of medical investigations in the Philippines, laboratory space has been supplied to the United States Army Medical Department Research Board, the entire personnel of this board being accommodated in the Bureau of Science. The Carnegie Museum of Pittsburgh has supplied the sum of ₱500 to be utilized in coöperative work between that institution and the Bureau of Science for zoölogical exploration. The courtesies of the institution have been extended to Mr. E. H. Taylor in connection with his work on Philippine herpetology, and to Dr. R. E. Dickerson, geologist of the Richmond Petroleum Company, and the Bureau of Science is under obligation to both of these gentlemen for assistance rendered on technical problems coming within their respective fields.

#### ROCKEFELLER FOUNDATION

In connection with the coöperative work arranged for between the Rockefeller Foundation and the Philippine Government it has been proposed that the services of a thoroughly trained and experienced laboratory man be supplied by the Rockefeller Foundation to the biological laboratory of this Bureau, on approximately the same basis that technical assistance is being rendered by the Foundation to the Philippine Health Service and the College of Medicine and Surgery, University of the Philippines. While as yet no one has been sent by the Rockefeller

Foundation, we are definitely informed that the services of an experienced man will be available in March, 1923. It is proposed that he act as an assistant to the Director, his special field to be in the biological laboratory of the Bureau. During the past year I have acted as chairman of a committee appointed by the Governor-General to select Filipino doctors and nurses for advanced work in the United States, the scholarships being supplied by the Rockefeller Foundation.

#### UNITED STATES ARMY MEDICAL DEPARTMENT RESEARCH BOARD

During the early part of the year the matter of the rehabilitation of the United States Army medical research work was brought to my attention by Maj. J. E. Ash. In discussing this possibility with him it was agreed that, if this work should be rehabilitated by the Army Authorities, laboratory space, such equipment as is available at the Bureau of Science, and library facilities would be granted to the board by the Bureau of Science. It was thought that, if the research work to be carried on by the proposed board were done at the Bureau of Science, it would be to the mutual advantage of the Army and of the Insular Government in that the personnel detailed for the work would have access to the library, equipment, and accumulated data of the Bureau of Science and would be able to consult directly with the technical employees of the Bureau.

Acting on the recommendation of the local authorities, the Army Medical Department Research Board was established and the several members of the staff reported for duty in Manila early in September. The board brought with it practically all of the laboratory equipment needed for its special purposes.

Two laboratories, on the second floor of the main building of the Bureau of Science, and appropriate storage facilities have been assigned to the board. The personnel of the board is as follows: Lieut. Col. Fielding Garrison, M.C.; Maj. George R. Callender, M.C.; Capt. William D. Fleming, M.C.; Capt. Theodore Bitterman, M.A.C.; Second Lieut. Mary E. Cardwell, A.N.C.; Geraldine R. Frost, Secretary; and four technical assistants.

The work on a number of medical problems is being actively prosecuted, beriberi, tuberculosis, and leprosy being at present the subjects of research.

#### PASTEUR ANTIRABIC TREATMENT

The prophylactic treatment against rabies has been given free, as in past years, the product being prepared in our serum labo-

ratory, the actual administration being under the charge of Dr. Santos T. Rivera. The total number of individuals treated in Manila was 404, while 464 treatments were sent to provincial points in response to requests received from physicians and by the Philippine health authorities. The total number of treatments given by the Bureau of Science since 1911 when this work was initiated is 4,276. The number of treatments during 1922 was 868, practically the same as in the preceding year but with a relatively very much higher proportion for the provinces than for Manila, in this respect reversing the conditions of 1921.

#### SYMPOSIUM

The symposium organized in 1921 for the general discussion of the entire subject of the origins and relationships of the Philippine fauna and flora has been continued throughout the year. All members of the technical staff directly interested in paleontology, geology, zoölogy, and botany have attended and contributed to the discussions, as have also members of the staff of the University of the Philippines and professional men in private life. The large amount of data compiled on geographic distribution within Malaysia is proving to be of very special value in enabling us to draw definite conclusions as to the origins and migration lines of the Philippine flora and fauna. One paper has been prepared by me to be published in 1923, in which it has been possible to give a geological explanation of the real cause of the differences between the fauna and flora of eastern and of western Malaysia; and in this paper the peculiar alliances of the Philippine fauna and flora to both eastern and western Malaysia are brought out.

#### PENSIONADO STUDENTS

There are nine pensionado students prosecuting advanced work in the United States at the present time, on behalf of the Bureau of Science, one more than in the preceding year. Dr. Antonio Garcia returned and reported for duty on December 23. In 1922 but one new pensionado was assigned to the Department and the selection was in turn assigned to the Bureau of Science. The position was filled by the appointment of Mr. H. R. Montalban for advanced work in fisheries. Mr. Montalban left for the United States to take up advanced work at Leland Stanford Junior University on August 18. Dr. Onofre Garcia was granted an extension of six months, and the same privilege was also granted to Mr. Faustino. The pensionado

students remaining in the United States at the end of the year are Dr. Onofre Garcia for work in bacteriology; Mr. Ramon Abarquez, inorganic chemistry and metallurgy; Mr. Leopoldo A. Faustino, mining and geology; Mr. Faustino L. Abad, mining and geology; Mr. Antonio Alvir, mining and geology; Mr. Pedro Sengson, organic chemistry; Mr. Salvador Fernandez, inorganic chemistry; Mr. Vicente G. Lava, inorganic chemistry; and Mr. H. R. Montalban, ichthyology. Messrs. Alvir, Lava, and Abad were granted scholarships and assigned to the Bureau of Science after their arrival in the United States; all others are regular members of the staff of the Bureau.

#### BIOLOGICAL LABORATORY

*Personnel.*—Miss Rita Villaamil and Miss Teresa V. del Rosario were appointed junior bacteriologists on April 22 and 17, respectively. Mr. Ramon Garlitos was appointed temporary microscopist on February 1, and received permanent appointment July 16. Dr. Antonio Garcia completed his post-graduate work in the University of Chicago and in the New York Post Graduate Medical School. He returned to Manila and reported for duty on December 23. Dr. Andrew W. Sellards resigned at the expiration of his special contract on July 23, returning to his permanent position in the Harvard University, Medical School. Resignations were accepted from Dr. E. Limson, on March 16; Dr. Jose Andaya, on March 31; Dr. P. Trinidad, on August 17; and Dr. J. Alberto, on December 31. Dr. Ana Vasquez-Colet resigned on April 19 and was reinstated on July 1.

*Provincial laboratories.*—The provincial laboratory at Cebu was inspected by me in September, 1922. Both the laboratory at Cebu and the one at Iloilo were inspected by Major Callender, of the United States Army Medical Department Research Board, at my request in November, as he had occasion to visit both Cebu and Iloilo in connection with certain preliminary medical-survey work. My findings and those of Major Callender being unsatisfactory, Dr. Liborio Gomez, chief of the Biological Laboratory, was sent to Iloilo and Cebu in December for the purpose of thoroughly investigating the condition and activities of both laboratories.

The Iloilo laboratory is very badly located, in the tower of the Custom House building. It is the belief that this laboratory cannot be properly developed in its present location and that therefore better and more conveniently located quarters should be provided for it. The matter of possible transfer of the

laboratory to the provincial building, or to some point near the Iloilo office of the Bureau of Health, was discussed by Doctor Gomez with the provincial authorities.

The Cebu laboratory is well located, but the quarters assigned to it are exceedingly unsatisfactory, consisting of a dilapidated room in one corner of an old building in Fort San Pedro. The matter of improving the laboratory space assigned to the Bureau of Science in Cebu was discussed by Doctor Gomez with the provincial authorities, and until a change is made there is little hope for improvement in the Cebu situation. On the whole the Iloilo and Cebu branches of the biological laboratory have not been eminently successful. It is believed that, unless steps be taken in the near future to secure better quarters for both laboratories, these two branches should be discontinued and the actual laboratory work necessary in Cebu and Iloilo turned over to the Bureau of Health. More frequent inspections should be made from the central office in Manila; but, with the greatly restricted funds available for traveling expenses, this has hitherto been impracticable.

*Routine work.*—The general routine work carried on in the biological laboratory has been at least as extensive as during past years and in some respects has been increased. Most of this routine work is done for the Philippine Health Service as our laboratories also serve as laboratories for that service. Numerous examinations are, however, made for private physicians and for private hospitals.

*Special work.*—The results of studies carried on in reference to the Schick reaction among Filipinos by Dr. Liborio Gomez, Dr. Regino Navarro, and Mr. Amando M. Kapauan has been completed and published. A study on the early lesions and the development and incidence of leprosy in children of lepers prepared by Doctors Gomez, Avellana, and Nicolas, has also been completed and published; this work was done in coöperation with employees of the Philippine Health Service. A series of papers by Doctors Sellards, Leiva, Goodpasture, and De Leon regarding the treatment of amœbic dysentery, the effect of stasis on the development of amœbic dysentery in the cat, general investigations concerning yaws, and the immunity and the public-health aspects of the disease, together with a summary concerning its control have been completed and will be published in the early part of 1923. Doctors Gomez and Navarro have completed for publication a study of diphtheria carriers and their significance in the Philippines. Partly finished projects



consist of studies of the initial lesions of leprosy among adults, to determine if possible the existence of a primary lesion in leprosy comparable with the primary lesion in syphilis. Doctor Navarro has been investigating the bacteriostatic effect of aniline dyes on acid-fast bacilli which may possibly have some bearing on the treatment of leprosy. The work was suggested by the investigations of Doctor Denney, who obtained some success in the treatment of leprosy ulcers at Culion with solutions of fuchsin. In connection with the possible transmission of leprosy in lower animals, Doctor Gomez has initiated a systematic study of this problem, utilizing monkeys for experimental work. He has also initiated work on systematic blood cultures from patients suffering with typhoidlike fever with the view to demonstrating conclusively the presence of paratyphoid fever in the Philippines. With the cooperation and assistance of other employees of the laboratory, Doctor Gomez is also studying the paracolon bacilli found in the stools of normal individuals with the view to determining their significance. In connection with their routine work on the biological examination of water, Misses del Rosario and Villaamil are investigating the significance of the types of the colon group of bacilli most frequently found in water. This has been undertaken with the view to determining, if possible, if there is a method of distinguishing between colon bacilli of vegetable and of animal origin. Doctor Basaca has commenced work on serum reaction among lepers in conjunction with routine Wassermann reaction work, to secure further data on qualitative and quantitative differences of Wassermann and other serum reactions as between syphilis and leprosy. In cooperation with Doctor Avellana, superintendent of the Culion Leper Colony, statistical work on the distribution of leprosy, with reference to its possible bearing on the efficacy of segregation, has been initiated. The work of the Committee on Leprosy Investigation, in which the Bureau of Science has cooperated with the Philippine Health Service during the past two and a half years, is practically completed, and the final report will be rendered shortly.

Professor Haughwout, in cooperation with Maj. J. E. Ash, has completed a voluminous report to the Surgeon-General of the United States Army on health conditions with special reference to intestinal diseases at Corregidor. The cooperation of the Bureau of Science in this work has been greatly appreciated by the military authorities. In continuation of this survey and in cooperation with Major Ash a malarial survey has been made

in parts of Bataan Province, and recommendations have been prepared for the guidance of commanding officers in charge of troops in that region. A study of 1,000 Americans and Europeans with reference to the incidence and manifestation of parasitism and the paper embodying the results of these studies is in course of preparation. A similar study of about 2,000 Filipinos and Chinese, along the same lines, is also finished and a paper is in course of preparation. A study of several hundred Caucasian children, along the same lines but of a somewhat more intensive nature, has been carried on and the results will soon be made available by publication. In coöperation with Dr. C. N. Leach, of the International Health Board, a study of the action of carbon tetrachloride as an antihelminthic has been carried on, together with a survey of the incidence and geographic distribution of the hookworm in the Philippine Islands. In coöperation with Doctor Leach and Dr. Benjamin Schwartz, of the College of Veterinary Science, University of the Philippines, a study of hookworm disease in Cebu, with special reference to the type of organism and incidence of the infection, has been completed.

In addition to the large amount of research work carried on by Professor Haughwout a considerable amount of special routine work has been performed by him. This work has consisted mainly in consultations with physicians and the intensive study of chronic and obscure cases.

#### SERUM LABORATORY

*Personnel.*—Dr. Jose Andaya resigned on March 31, Mr. E. Perez was transferred on April 1 to the Philippine Health Service for work in Culion, and Dr. O. Schöbl, in charge of the serum laboratory, was absent on accrued leave from April 1 until October 21. Five months of his leave was spent at the Kitasato Institute, Tokyo, Japan, in studying flood fever, rat-bite fever, and Weil's disease.

The serum laboratory was transferred to Alabang during 1921, the new installation being described in considerable detail in my last annual report. At the beginning of 1922 the installation was complete. Certain modifications in the main laboratory have been made during the year, including the construction of a glass partition in the bacteriological laboratory, and the screening of all windows. A number of cages for breeding rabbits have been constructed; the roofs of two dwelling houses have been replaced; a new gasoline-driven

pump for emergency purposes has been purchased and is being installed, and toward the end of the year authorization was secured for purchasing a new boiler. The old donkey boiler used for generating steam for sterilization purposes has deteriorated so greatly that it was practically impossible to repair it, rendering the purchase of a new one absolutely essential. The new pump is being installed to meet a possible emergency in the case of breakdown of the electrically driven pump. A continuous water supply is an absolute essential to both the power plant and the cold-storage plant at Alabang, and a breakdown in the pumping system would automatically involve the closing of the entire installation at Alabang and the stoppage of all work in the manufacture of serums and vaccines until the necessary repairs could be completed. The area devoted to the cultivation of forage grass has been extended.

At the beginning of the year only fifteen horses and mules were maintained at Alabang for serum purposes. The number was gradually increased until at the end of the year eighty-nine were being maintained. The necessary carabaos and calves have been purchased during the year for utilization in connection with the manufacture of smallpox vaccine. Since the outbreak of surra among the horses in 1921 we have adopted the policy of maintaining at Alabang at any one time only the number of carabaos necessary for current vaccine production, and these animals are maintained in a screened stable. In general practice it has been found that in surra-infected regions carabaos and horses cannot safely be maintained near each other, as the carabao acts as host to the trypanosome that causes surra, and the disease is very readily transmitted from carabaos to horses when the animals are maintained in too close proximity. Six sheep, thirty goats, seventy-five rabbits, and four hundred guinea pigs (averages) have been maintained for routine work.

The general routine work at Alabang has been successfully maintained throughout the year. The only untoward incident was the discovery in May that certain issues of typhoid vaccine were contaminated by an aerobic, nonpathogenic organism. These issues were immediately withdrawn from sale, the whole method of procedure in the manufacture of this product was carefully investigated, the source of the infection discovered, and remedial measures were adopted.

Investigations initiated in preceding years on the preservation of the viability of vaccine virus exposed to adverse

conditions, and the investigations of vegetable oils, with special reference to their antiseptic properties as affecting tuberculosis bacilli, have been continued.

The amounts of products manufactured and dispatched, both to the Government and to private entities, are indicated in the following table:

*Comparison of serum and vaccines bottled and disposed of at the Bureau of Science in 1920, 1921, and 1922.*

Product.	1920	1921	1922	Increase.	Decrease.
Antitetanic serum..... units	4,616,000	4,412,000	6,203,000	1,791,000	-----
Antidysenteric serum..... cc.	73,740	63,040	43,700	-----	19,340
Normal horse serum..... cc.	13,150	15,750	18,590	2,840	-----
Vaccine virus..... units	4,494,204	3,278,599	2,846,242	-----	432,357
Cholera vaccine..... cc.	-----	557,974	373,732	-----	184,242
Gonococcus vaccine..... ampules	3,460	5,913	4,464	-----	1,449
Typhoid vaccine..... cc.	-----	-----	130,524	130,524	-----
Other vaccines..... ampules	271,466	62,978	3,681	-----	59,297
Cholera and typhoid vaccine cc.	-----	-----	628,965	628,965	-----
Pasteur treatments..... sets	771	1,072	2,317	1,245	-----
Autogenous vaccine treatments	79	64	67	3	-----
Wassermann reactions.....	1,236	736	641	-----	95

#### BOTANY

*Exploration.*—A considerable amount of field work has been done in Mindoro, Leyte, Pangasinan, and Benguet Provinces, Luzon, and in certain parts of Mindanao, Sulu Archipelago, and Palawan. Comparatively little material has been received from the Bureau of Forestry. A considerable amount of material has been submitted for identification by various residents of the Archipelago.

*Identifications.*—All of the Philippine material received has been identified and incorporated in the herbarium. A large amount of extra-Philippine material has been received for study and report, and approximately 7,300 identifications have been made, chiefly of Chinese material submitted by Nanking University, Canton Christian College, Amoy University, and Prof. K. K. Tsoong. About 490 identifications of Indo-Chinese material have been made for Prof. A. Petelot, and 300 identifications of Tahiti plants have been made for Dr. W. A. Setchell, of the University of California. Smaller collections from Siam and Borneo have been studied and reported upon. The Philippine and Malaysian material collected by Dr. O. Warburg, received from the Botanic Garden at Berlin during the preceding year, has been identified and distributed, totaling 2,354 numbers.

*Herbarium.*—Accessions to the herbarium from all sources during the year total 17,803, nearly 4,000 more than in the preceding year. This brings the total number of mounted sheets in the herbarium up to 244,400. While a large part of this material has consisted of specimens of Chinese origin submitted for identification, extensive exchanges have been received from the Botanic Gardens at Singapore, the Botanic Garden at Buitenzorg, Java, the United States Department of Agriculture, the Brisbane Botanic Garden, the herbarium of Prince Roland Bonaparte, the National Southeastern University, Nanking, China, and the Department of Agriculture, Union of South Africa.

*Exchanges.*—No general distribution of accumulated duplicate material has been made during the past year, but this will be accomplished during the early part of 1923. Including the fungi, lichens, and mosses, about 7,000 duplicates have been distributed to other botanical institutions for exchange purposes during the year. In the same period approximately 7,900 specimens have been received from other institutions in exchange, without considering a complete set of the Kryptogamae Exsiccatae prepared by the Vienna Museum, which has not been accessioned as yet. New exchanges have been arranged with the National Southeastern University of Nanking, China, and with the Natural History Museum, Vienna, Austria.

*Loans.*—Several hundred mounted specimens in various groups have been loaned to specialists in various countries, including Orchidaceae to Mr. Oakes Ames, and Dipterocarpaceae, Flacourtiaceae, Theaceae, and Sapotaceae to various botanists at the Botanic Garden, Buitenzorg, Java.

In addition to mounted sheets loaned, a considerable amount of duplicate material has been supplied to various specialists for identification, including orchids to Mr. Oakes Ames, lichens to Doctor Wainio, mosses to Doctor Brotherus, and grasses to Prof. A. S. Hitchcock.

*Medicinal plants.*—Work on this project has been prosecuted as in previous years under the direction of Dr. Leon M. Guerrero. Empirical data have been compiled during the past few years regarding a large number of local medicinal plants. During the year data regarding sixty-six additional species were received. Our chief handicap in prosecuting productive investigations in this field at the present time is the lack of the services of thoroughly trained pharmaceutical chemists and physiologists to isolate, determine, and study the effect of the drugs on animals, with the view to adapting new principles to

the practice of medicine or to substituting local for imported products.

#### PLANT PATHOLOGY AND MYCOLOGY

The work of this division during the past year has, as in previous years, been mainly devoted to the solution of problems in reference to agricultural mycology. Actual work has been arranged under the heads of diseases of abacá, diseases of sugar cane, diseases of tobacco, and diseases of rice. In addition to the investigations on diseases of the major economic crops, a considerable amount of time has been devoted to routine examination of materials submitted by various agriculturists and Government offices for identification.

More time has been devoted to the study of sugar-cane diseases than to any other one group, and several new diseases have been identified. At the present time we find in the Philippines every major disease of sugar cane described in technical literature, with two exceptions. Actual field experiments have been carried on in Negros to demonstrate the losses caused by the presence of mosaic and Fiji diseases. The transmission of these diseases by cuttings has also been demonstrated in field experiments. Investigations on a field basis have also been made regarding the losses caused by cane smut and on the methods of transmission of this disease. Various papers have been published in the *Sugar News* on cane diseases during the year.

In connection with the pathological investigations being carried on through the several industrial fellowships between the Bureau of Science and various sugar centrals in the Philippines, a collection of disease-free varieties of sugar cane is being maintained in Negros and, through this collection as a parent field, other fields of these disease-free varieties are being established at the several sugar centrals. During the year more than 20,000 cuttings of carefully selected seed cane have been distributed.

The work on abacá heart rot has been continued by Mr. Serrano, of the Bureau of Agriculture, working in coöperation with Mr. Lee. A considerable amount of work has also been carried on in reference to the deterioration of Manila hemp in storage, this being done in coöperation with the fiber division of the Bureau of Agriculture. No extensive work has been done on the study of the tobacco diseases, due to the shortage of funds for field work. Mr. Clara, of the Bureau of

Agriculture, working in our laboratories, has been in charge of the diseases of tobacco. In addition to this work he has made very numerous current identifications of fungi causing diseases on various cultivated plants other than tobacco. The work on the diseases of rice is progressing, and a number of new types of disease have been identified and correlated with their causative organisms.

Other than making current identifications of recent collections, comparatively little work has been done in systematic mycology other than distributing named material into the herbarium as received and maintaining our exchanges with other institutions. Very extensive collections of fungi have been received during the past year from the Cryptogamic Laboratories of Harvard University, the United States Department of Agriculture, and the Department of Agriculture of South Africa.

Probably the most-striking work that has been done in this office during the year has been the cane-deterioration studies. It has been demonstrated quantitatively by field work just what the losses are, and that certain methods followed in the Philippines actually cause losses as high as ₱10 per ton of cane at the current prices of sugar. Methods have been devised for avoiding these unnecessary losses. When cane is cut that cannot be milled promptly, it has been demonstrated that losses in sucrose may be very much lessened by shading the cane in cheaply constructed loading sheds. This work has been done in connection with the industrial fellowships between the Bureau of Science and various branches of the Philippine sugar industry, as have also certain studies on deterioration of sugar in storage.

Much of the mycological work performed in the Bureau of Science has been done in close coöperation with the Bureau of Agriculture. The policy of detailing technical assistants from the Bureau of Agriculture to work in the laboratories of the Bureau of Science has produced excellent results, not only to the mutual advantage of the two bureaus but also to Philippine agriculture as a whole. It is believed that the field work of the demonstration division of the Bureau of Agriculture may be made distinctly more efficient if the farm advisers, at least those assigned to work in the sugar-producing provinces, could be given a very brief period of training in our pathological laboratories to enable them to familiarize themselves more fully with the sugar diseases already identified, the losses occasioned

by these diseases, cane varieties, and especially those varieties that are susceptible and that are resistant to various diseases, and also the chief methods of controlling diseases in the field.

In coöperation with the division of inorganic chemistry a considerable amount of work has been done on the use of artificial fertilizers in connection with the production of sugar cane.

#### ENTOMOLOGY

*Personnel.*—On June 30 Prof. C. S. Banks, chief of this division, retired from the Government service under the terms of the Osmeña retirement act, and Mr. W. Schultze was given a temporary appointment as entomologist, effective July 17.

*Routine and research.*—In connection with the work of the Bureau of Agriculture in reference to the control of locusts, investigations have been carried on in breeding parasites of locusts, and in testing chemicals suitable for dusting these insects with a view of controlling them. In connection with the malarial survey work that is being carried on under the auspices of the Rockefeller Foundation, a considerable amount of time has been devoted to the identification and classification of mosquitoes with special reference to those that carry malarial parasites.

A general rearrangement of the insect collection of the Bureau is in progress. In connection with this work, about 1,000 specimens have been selected and forwarded to specialists for identification, including material to Dr. W. Horn, Berlin; Doctor Schenkling, Berlin; Dr. G. Ochs, Frankfurt; Dr. A. Roepke, Holland; Mr. R. Hancock, Birmingham; Dr. Preston Clark, Boston; and Dr. W. M. Wheeler, Boston.

In connection with the work on silk culture that has been carried on for a number of years, an importation of new stock of silkworms was made from China. Through the courtesy of the entomological department of the Canton Christian College, several selected strains were received. The work in silk culture has, however, been curtailed as a necessary economy.

The general routine work of the division has consisted of the classification and mounting of insects, current identifications, and the supplying of specific information regarding injurious insects in reference to agriculture and commercial problems. In reference to major crops, considerable work has been done on insects affecting sugar cane, copra, rice, and coffee. At



the request of the Director of Forestry investigations have been commenced regarding certain small beetles that are seriously affecting our export market for certain types of timber; these insects are commonly known as shot-hole borers.

With the very limited personnel in this division and the cramped quarters assigned to it, no great amount of productive work can possibly be expected. Additional space and additional personnel are urgent requirements in connection with the efficient development of our entomological work.

#### FISHERIES

*Personnel.*—Mr. H. R. Montalban was appointed an assistant in this division on April 17. He is a graduate of Stanford University, and a position was specifically provided for him in the appropriation bill for 1922. Before accepting appointment, however, it was considered best that he complete his year's work with the Bureau of Education, remaining in the service of that bureau until the end of the school year. During his period of teaching at Iba, Zambales, he prepared a valuable collection of fishes for the Bureau of Science. On August 19, he left for the United States as a Government pensionado for advanced training in ichthyology at Stanford University and at the School of Fisheries at the University of Washington.

*Field work.*—Field work has been carried on by Doctor Herre in the Angat River region, Bulacan, with special reference to determining the possible effect upon the fisheries of the Angat River system of the proposed dam in connection with the Metropolitan Water District project. In March he spent some time in southern Negros, investigating the possibilities of bañgos pond culture and in collecting material. In May some field work was accomplished in Mindoro. In September and October an extensive trip was made throughout Lanao, Cotabato, Davao, and Agusan Provinces in Mindanao with the specific object of determining what types of fishes should be planted in the inland waters of Mindanao, and where. In consultation with the Governor-General a plan was drawn up for distributing black bass in certain high-altitude lakes in Mindanao and for introducing and disseminating various other fresh-water fishes in the Islands. Mr. Montalban utilized parts of the months of May and June for field work in Panay and Guimaras, making general collections and obtaining specific information concerning the

extensive fisheries industries of Panay. Mr. Lopez has prosecuted field work in the neighborhood of Monja Island, Mariveles, Nasugbu, and Jamillo in coöperation with Japanese fishermen. In May he collected in the vicinity of Cabalian, Leyte, Dinagat Island, and in Surigao Province, Mindanao. In September and October he prosecuted field work in the Calamian Islands, and in November and December made another trip to Leyte and also explored the Camotes Islands. His collections have been very extensive and especially valuable, as he secured not only ichthyological material, but also reptiles, amphibians, mollusks, and crustaceans. In addition to the collections made by employees of the Bureau, small collections of fishes have been contributed by Mr. Alejo J. Arce, of Ambos Camarines, and by Mr. De Leon, of Santo Domingo de Basco, Batan Island.

*Research and investigation.*—An extensive paper on the eels of the Philippine Islands has been completed and revised for publication. Papers have also been prepared treating of certain sharks and of the families of poisonous or dangerous fishes known generally as hornfishes, trigger fishes, and filefishes. Considerable advances have been made in preparing scientific data concerning other groups of Philippine fishes in general. A great deal of time has of necessity been devoted to identifying, not only currently collected fishes, but also mollusks, reptiles, batrachians, etc., collected by our employees, or submitted by others for identification. Much assistance has been rendered in this work by Mr. E. H. Taylor who has identified the current receipts of reptiles and batrachians. Technical and economic data have been supplied to various individuals in connection with the development of Philippine sponge fisheries, while much time has of necessity been spent in conferences and in giving advice orally or through correspondence to individuals interested in the commercial exploitation of fishes and various other Philippine marine products.

Bills for the purpose of correcting certain abuses in fishing have been drawn and submitted to the proper authorities. The essential points covered in these bills are now embodied in a general fish and game bill which it is hoped will be approved by the Legislature in the near future.

#### ORNITHOLOGY AND TAXIDERMY

Custom work, consisting of mounting of birds and animals and tanning skins, has been continued for the convenience of the public, as in previous years.

A small amount of field work has been accomplished in Pangasinan Province, Luzon, and in Mindanao and Sulu. Through the coöperation of certain individuals in the United States, a small allotment of funds has been made available to assist the Bureau in our field work in ornithology. There are several valuable collections of birds on hand awaiting identification, including collections from the southern Philippines, and material from southern China and Hainan submitted by Prof. S. F. Light, of Amoy University.

The series of colored plates and line drawings to illustrate the birds of the Philippines has been increased during the year; the work on this is, however, frequently interrupted, as the one artist available must of necessity make the required drawings for other publications of the Bureau.

Mr. McGregor, as in previous years, has continued his lectures on Philippine birds to the classes in systematic zoölogy at the University of the Philippines, and has also given lectures in reference to printing, proof reading, etc., to the students in library science at the University.

Some progress has been made in the study of the food of Philippine birds. This work, if it can be completed, will definitely demonstrate which species of birds are most beneficial to man and which species, if any, are detrimental. Until such information is available, most species of birds as a general proposition should be protected from indiscriminate destruction.

So long as this division commands the services of but one technical man who, on account of his editorial work in connection with the Philippine Journal of Science and other technical publications of this Bureau, can devote only a comparatively small amount of time to this special field, rapid progress is, of course, impossible.

#### GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

*Personnel.*—Mr. Francisco D. Reyes was given permanent status as chemist on March 16. Miss Asuncion Sandoval, working in the water laboratory for the Metropolitan Water District, completed the work on this project in August. Dr. Amando Clemente, of the University of the Philippines, who was employed on a part-time basis, severed his connection with the Bureau on December 31.

*Routine.*—As in previous years, the routine work of this division has been exceedingly varied, as shown in the following table:

Nature of material.	Samples.
Rocks and minerals .....	8
Metals and alloys .....	82
Soils, fertilizers, cements, and clays.....	10,501
Stone, gravel, sand, and concrete .....	787
Physical tests of wire, twine, textiles, steel, fiber, tar, asphalt, paper, etc.....	39
Water .....	191
Standardization of weights and measures:	
Length .....	24
Capacity .....	8
Weight .....	166
Coal analyses .....	77
Paints, natural pigments, and varnishes .....	14
Crude chemicals (preparation and analysis) .....	16
Fire assay of gold and silver .....	100
Refining of precious metals .....	grams... 13,945
Miscellaneous .....	89

*Section of weights, measures, and water analysis.*—The routine work in this section has continued on about the same scale as in the preceding year. The specific problem of a chemical study of the water of Angat River in connection with the Metropolitan Water District has been completed, about 300 analyses of water having been made on this project. The final report has been submitted to the Manager of the Metropolitan Water District, and a technical paper has been prepared for publication by Mr. Aguilar.

*Materials-testing laboratory.*—In addition to the regular routine work of this office, a study is being made of the mechanical properties of the standard grades of abacá fiber, and the results will be ready for publication at an early date. Numerous concrete cubes prepared and immersed in salt water several years ago have been tested, and the compressive strength results made available in publication will be of distinct interest to engineers engaged in concrete construction in salt water.

*Analytical section.*—In addition to the regular chemical analyses done for various units of the Government service and for local commercial organizations, our personnel has constantly been called upon for technical data in reference to the interpretation of results in various branches of industrial work. The order of the Governor-General directing that all coal analyses in connection with the purchase of coal by Government units and Government-controlled corporations be done by the Bureau

of Science has added a large amount of work, and has increased the responsibility of this division. A large amount of coal sampling, chemical analyses, and calorific determinations have been made during the year in reference to the general problems of imposing penalties or awarding premiums in connection with coal deliveries. In addition to the Government work a considerable amount of work of a similar nature has been done for commercial units. This work will be distinctly increased during the next year, and the service income of the division will be correspondingly increased by the charges made for this type of work.

Coöperative work on soils and fertilizers is being undertaken with the Bureau of Agriculture, but no large extension of this can be hoped for until additional personnel and facilities are supplied. Mr. Rufino Isidro, of the Bureau of Agriculture, has been detailed for soil and fertilizer work in our laboratory. In connection with the general advances in Philippine agriculture and the desirability of developing the manufacture of commercial fertilizers from local products, the fertilizer analysis work of the division has been largely increased. Field fertilizer experiments in connection with the development of the sugar industry have been initiated in connection with the industrial fellowships now in force between the Bureau of Science and various commercial sugar interests in the Archipelago.

The manufacture of high-grade lime in the Archipelago, largely the result of actual investigation and demonstration work carried on in this division, is constantly increasing the demands for chemical analysis of this material, and requests for technical advice in its manufacture are frequently received. In one of the northern provinces where the manufacture of lime had not been successful a brief investigation by Mr. Reyes indicated the necessary changes in the process of manufacture, and the acceptance of his suggestions has resulted in the production of high-grade lime here where previous efforts had failed.

The gypsum deposits in Batangas Province investigated by Mr. Elicaño, of the division of mines, have been studied from a chemical standpoint. The product has been found to be of superior grade and will be utilized by the National Cement Company in the manufacture of cement. Mr. Jose Argüelles,

proprietor of the deposits, has been instructed in the methods of manufacturing plaster of Paris and, through our work on this project, will be able to place this local product on the Manila market, thus eliminating in large degree the necessity of further importations.

A considerable amount of attention has also been given to a chemical study of the Philippine deposits of phosphatic guano with the view to assisting local industrial units that are engaged in the manufacture of commercial fertilizers.

A considerable amount of work carried on in this division in preceding years in reference to the improvement of methods of manufacturing leather is resulting in the development of a considerable local industry. A large amount of correspondence is received each year in reference to this product.

Some years ago an investigation was made of the various types of galvanized-iron roofing material utilized in the Archipelago. While violent exceptions were taken to our published results by certain manufacturers, it is now generally admitted that the results obtained by Mr. Argüelles are correct, and his contention that a heavier coating of zinc should be applied to the iron surface is now meeting with the approval of manufacturers in the United States. This year has seen the beginning of a definite campaign in the United States to improve the grade of galvanized-iron roofing material, an improvement which this Bureau has advocated for several years.

In connection with the analysis of paints and paint materials submitted to this Bureau by private concerns, comparative exposure tests have been initiated in addition to the chemical work.

On account of the increased routine with no corresponding increase in the technical personnel of the division, comparatively little research work has been accomplished, although several problems are now under investigation. These include a series of tests of Philippine commercial timbers, exposure tests of various types of roofing material, and an investigation of local products which may be utilized in the manufacture of commercial fertilizers.

Regulatory measures in reference to the control of commercial fertilizers, insecticides, and fungicides have been resubmitted to the Philippine Legislature and, in case they are not made laws this year, will be resubmitted until such time as satisfac-

tory protective measures shall be enacted. The local farmers should be protected from irresponsible dealers and manufacturers, and the local manufacturers of fertilizers likewise demand similar protection. The only possible method by which this can be done is by chemical control of commercial fertilizers.

In connection with the general work of the division various employees have been appointed on special committees working on general Government problems. Doctor Dar Juan has served as a member of the concrete-building committee; Mr. Reyes as a member of the committee to study the actual valuation of the Manila Gas Corporation with reference to certain proposed regulations regarding the price of gas; Mr. Argüelles has served as a member of a committee appointed for the coördination of the agricultural activities of the Philippine Government; and Mr. Peña has served as a member of the board of directors of the National Cement Company.

#### ORGANIC CHEMISTRY

*Personnel.*—The transfer of Dr. G. A. Perkins to the Philippine Health Service became effective on February 14. This transfer was a direct result of the decision that the manufacture of the derivatives of chaulmoogra oil for the treatment of leprosy should be done at the Culion Leper Colony in connection with the general investigation planned in reference to the entire leprosy problem. The temporary appointment of Miss Maria Orosa as chemist was approved on May 16.

*Routine.*—This type of work has been prosecuted in a very satisfactory manner during the year. For ordinary routine, supplies and materials have been sufficient; but the semi-commercial and industrial work now demanded of this division, such as the manufacture of medicinal preparations, tikitiki extract, book varnish, and other products, has been handicapped by lack of sufficient supplies. The manufacture of the ethyl ester of chaulmoogra oil for the treatment of leprosy was transferred to the Philippine Health Service in April, this being accomplished as soon as the new laboratory at Culion Leper Colony was properly equipped. A graphic idea of the large amount of routine analyses demanded of this division and of the products manufactured by it may be gained by an examination of the following table:

*Routine analyses.*

Nature of material.	Samples.
Meats and manufactured meats .....	1,484
Lards and lard substitutes .....	30
Milk and its products .....	249
Grain products .....	158
Vegetables, etc .....	80
Fruits and fruit products .....	112
Sugars and related substances .....	366
Condiments and flavoring extracts .....	67
Edible vegetable oils other than coconut oil .....	51
Coconut and its products .....	568
Tea, coffee, and cocoa products .....	156
Alcoholic beverages .....	93
Nonalcoholic beverages .....	351
Petroleum and products .....	169
Gum, resins, and similar materials .....	35
Papers and similar materials.....	10
Urines, fæces, etc .....	484
Paint oils and castor oil .....	72
Essential oils .....	16
Toxicological analyses.....	18
Preservatives and coloring matters .....	13
Chemical and pharmaceutical preparations .....	232
Sherbets .....	14
Opium .....	920
Miscellaneous .....	150
	5,898

*Products manufactured.*

Nature of material.	Samples.
Extract of <i>Amaranthus spinosus</i> ... 60-cc. bottles...	12,180
Leprosy treatment..... do.....	24,000
Extract of tikitiki .....	48,772
Carbon tetrachloride purified and refined for medicinal purposes .....	200
Book varnish..... do.....	300
Label varnish .....	70
Other products .....	400

*Manufacture of tikitiki extract.*—During the year 48,772 fifty-cubic-centimeter bottles of this extract were prepared and delivered to the Public Welfare Commissioner and the Director of Health for free distribution for the treatment of beriberi, an increase of 30,585 over the number of bottles manufactured in 1921. The production is far below the demands of the Public Welfare Commissioner and can only be increased by the installation of a new plant with larger appropriations for its operation. The present plant is operated twenty-four hours per day, with three shifts of employees.



*Research.*—The research work carried on in this division is largely devoted to the solving of problems in reference to the development of the natural resources of the Archipelago. The information thus made available to the technical staff is disseminated to the public through publications and through consultation with professional men and manufacturers. The field covered by employees of this division during the year has been a very broad one, if actual research work and consultation work be taken into consideration. Subjects covered include the preparation and test of toxic gases for the possible control of locusts and other pests; the elimination of odors in connection with the manufacture of sugar at certain large modern centrals; the chemical control in the manufacture of ether and alcohol for motor fuel and the prevention of precipitates in motor fuels; the preparation of canisters for use in protection against poisons and injurious gases in manufacturing plants; investigations of colloidal fuels; the extraction of various medicinal principles from local and imported plants for the treatment of amoebic dysentery; investigations of wines and liquors of local manufacture; further analysis of local vegetables and fruits; and dehydration and canning experiments in reference to food preservation. Local manufacturers of soap and of pickles, and those interested in the preservation of meat have been given considerable aid and assistance. Analyses of local and imported cereals, beans, and forage crops, such as Napier grass and Japanese sugar cane, have been made for the Bureau of Agriculture.

*Legal work.*—Members of the staff have supplied expert technical advice in over two hundred court cases during the year. Many documents submitted by private individuals and by other Government units have been tested in reference to the probable age of ink, etc., in connection with legal cases.

*Iloilo sugar laboratory.*—As emphasized in the last annual report, this laboratory should be rehabilitated. Reopening it, however, is impossible unless more technical employees be provided and the general funds appropriated to the purposes of the Bureau somewhat increased. It is believed that the time is propitious for the rehabilitation of sugar and soils work of the Bureau, with Iloilo as a center, in view of the great development that has taken place in sugar in Negros during the past few years and, further, in view of the fact that so many modern centrals are now practically in one association under the Philippine Sugar Centrals Agency of the Philippine National

Bank. The work of the Iloilo sugar laboratory could be made most effective through and in coöperation with the industrial fellowships now in actual operation between the Bureau of Science and most of the sugar centrals in Negros. It is probable that the Iloilo branch of our biological laboratory could be combined with the rehabilitated sugar laboratory to the advantage of both branches of the service.

The following comparative table gives a very definite idea of the amount of work carried on by this division and the actual cash income, as compared with previous years:

*Comparative table of routine work performed and supplies manufactured and disposed of during the past ten years by the division of organic chemistry.*

Year.	Total samples (not units).	Pesos.	Comparison with previous year.				
			Increase.		Decrease.		
			Samples.	Pesos.	Samples.	Pesos.	
1913.....	1,639	17,272		1,599	282		
1914.....	1,294	8,231				345	9,041
1915.....	3,650		2,356				
1916.....	1,761					1,889	
1917.....	1,719					42	
1918.....	2,011			292			
1919.....	3,185	27,256	1,174				
1920.....	4,878		1,693				
1921.....	8,710	10,302	3,832				
1922.....	5,906	9,794				2,804	508

#### MINES

*Personnel.*—Dr. Warren D. Smith, chief of the division, resigned on September 3, at the expiration of his contract, to return to the United States. Since Doctor Smith's resignation Mr. Victoriano Elicaño has been the only technical employee available in this division. Under the existing circumstances it is not expected to increase the technical personnel here until the pensionado students now in the United States return and report for duty.

*Geological, mining, and field work.*—Doctor Smith made four trips and Mr. Elicaño three to the Angat River region to make a geological examination of the proposed new dam and tunnel sites of the Metropolitan Water District. All expenses in connection with this work were paid by the latter organization. In March Doctor Smith carried on a general reconnaissance of the sugar-producing section of Negros in the interest of the Philip-

pine Sugar Centrals Agency, all expenses being paid by that organization. Doctor Smith and Mr. Elicaño devoted a part of March and April to a geological examination of the Antamok Valley Group claims in Benguet, under industrial fellowship No. 2; all expenses were paid by the Antamok Valley Group. After the completion of this work Doctor Smith made an inspection of the Mancayan-Suyoc mining district and Mount Data. In March Mr. Elicaño made a brief trip to Batangas to investigate and report on a certain gypsum deposit for the National Cement Company. The latter half of March he spent in Bondoc Peninsula, Tayabas Province, Luzon, at the request of the mineral lands division of the Bureau of Lands, in connection with certain investigations in reference to petroleum claims and leases. In April Mr. Elicaño made a short trip to Umingan, Pangasinan, to examine an iron prospect in that region. The time from June 28 to August 7 was utilized by Mr. Elicaño in geological exploration of the extreme northwestern corner of Leyte, under industrial fellowship No. 4, between the Bureau of Science and the Union Oil Company, and under this same fellowship made a short trip to southern Camarines Sur Province the latter part of August to conduct similar field work; all expenses were defrayed by the Union Oil Company. The time from September 7 to 24 was utilized by Mr. Elicaño in the prosecution of field work in Capiz Province, Panay, under industrial fellowship No. 6, entered into with Mr. J. T. Colvin; the object of this work was to arrive at an estimate of the quantities of phosphates and guano available for possible use in local fertilizer manufacture. Three days were spent by Mr. Elicaño in Nueva Ecija to investigate the source of water at Gapan, at the request and at the expense of Mr. E. Payawal. In December Mr. Elicaño carried on certain geological exploration work in Rizal Province, under industrial fellowship No. 9, with the Richmond Petroleum Company, the work being prosecuted at the expense of that organization.

*Special reports.*—A special report covering all phases of the geological investigations made in connection with the proposed dam and tunnel sites on Angat River has been submitted to the Metropolitan Water District. A special report on the Antamok Valley Group claims has been prepared and submitted to the Antamok Valley Group, in connection with industrial fellowship No. 2. A preliminary report on the results of the geological reconnaissance in the sugar-producing portion of Negros has been published in the Sugar News. A short special

report on the Acupan Mining Company's property has been prepared for that company. In connection with industrial fellowship No. 4 a report on the geology of northwestern Leyte has been prepared and submitted to the Union Oil Company, and a similar report on the geology of the vicinity of Lake Bato, Camarines Sur Province, Luzon, was also prepared and submitted.

The division of mines has been constantly consulted by the higher officials on subjects pertaining to mining and, particularly, in regard to the nature of petroleum legislation. Doctor Smith has also acted as an adviser for the board of directors of the National Coal Company. In addition to these official and semi-official matters very numerous requests for information have been received from residents of the Archipelago covering almost every phase of geology and mining in the Philippines. Coöperative exploration work has been carried on with the Richmond Petroleum Company to the mutual advantage of the division of mines and that organization.

*Drafting, mapping, and similar work.*—There has been a radical increase in the amount of work accomplished under this head during the past year as shown by the following table:

Kind of work.	Private.		Official.		Total.	
	1921	1922	1921	1922	1921	1922
Maps.....			80	151	80	151
Sketches.....			136	374	136	374
Blue prints.....	155	100		175	155	275
Photographs, retouching.....			114	92	114	92
Miscellaneous.....			147	503	147	503
Total.....	155	100	477	1,295	632	1,395

*Publications.*—The large general publication covering the geology and mining of the Philippines prepared by Doctor Smith has been completed and submitted for publication, to appear as technical publication No. 19 of the Bureau of Science. This general summary of the two subjects should be issued some time during 1923. Two press bulletins have also been issued, as well as a number of press notices, and a preliminary report on the geology of Negros was prepared and published in Sugar News.

#### LIBRARY

*Personnel.*—There have been fewer changes in the staff of the library than usual, which has resulted in a consequent gain

in the amount of work accomplished. Practically all of the changes involved merely the temporary employees among the junior personnel.

*Book orders, accessions, and binding.*—One requisition for books amounting to ₣3,560.56 was approved on June 19; on this order books to the value of approximately ₣2,500 have been received. The total number of bound volumes accessioned during the year was 1,864 (Nos. 50816–52679, inclusive), slightly over 100 volumes remaining to be accessioned on December 31. During the year 1,000 volumes were bound and returned to the library with about 100 volumes at the bindery at the end of the year.

*Classification and cataloguing.*—Excellent progress has been made in this work, the increased result being due largely to the increased experience and training of the staff. The record of shelf listing shows 8,802 volumes and parts added during the year. The following table gives in comparative form the relative amount of work accomplished in 1920, 1921, and 1922:

	Titles.			Volumes.			Parts.			Cards.		
	1920	1921	1922	1920	1921	1922	1920	1921	1922	1920	1921	1922
Classification and cataloguing (new material)	746	877	887	731	891	540	825	679	895	2,872	3,304	3,405
Reclassification and cataloguing.	40	41	162	83	116	359	149	35	290	163	174	617
Total	786	918	1,149	814	1,007	899	974	714	1,185	3,035	3,478	4,022
Printed cards prepared and filed										6,132	3,685	10,169
Total number of cards filed in official catalogue										9,167	7,163	14,191

*Printed cards and union catalogue.*—As usual, the Library of Congress printed cards and those issued by the Wistar Institute have been filed promptly as received. The union catalogue was brought up to date during 1921, and comparatively little work has been necessary in this connection during 1922.

*Missing numbers, payment records, etc.*—This work has been continued, the results showing a marked improvement over those of the previous years in the number of volumes completed and bound. Within the next year most of the problems that have arisen since the beginning of the World War in reference to

missing numbers, payments, etc., should be adjusted, if no further unfavorable conditions arise.

*Cuts.*—During the year 436 cuts were cleaned, wrapped, recorded, and filed for future use. The total number of cuts recorded in the library during the year was 6,290; 172 were circulated during the year.

*Catalogues.*—The entire collection of university, college, and school catalogues has been transferred to the University of the Philippines as being of much greater value to that institution than to the Bureau of Science. New trade catalogues have been received in answer to specific requests or as routine additions to the library.

*Use of the library.*—Eleven thousand four hundred seventy-three publications were charged and 19,151 were consulted in the library, the former showing a decrease of 3,180 and the latter an increase of 2,177 compared with 1921.

*Quarters and equipment.*—The fact is again emphasized that the library has reached its approximate maximum development in the quarters provided for it. Even with the removal of duplicate publications and little-consulted sets to other parts of the building, the shelves still remain in a badly crowded condition. The issue must be faced in the immediate future of providing additional space, stacks, and filing cabinets for the library.

#### PUBLICATIONS

*The Philippine Journal of Science.*—As in 1921, the Philippine Journal of Science was published monthly, in two volumes for the year. Each volume consists of six numbers and is separately paged and indexed.

The following table shows the number of pages, plates, and text figures contained in Volumes 20 and 21:

	Volume 20, January to June, 1922.	Volume 21, July to De- cember, 1922.	Total.
Pages.....	683	611	1,294
Plates.....	59	44	103
Text figures.....	46	11	57

Beginning with October, 1922, the Philippine Journal of Science, for the first time in years (possibly since its beginning), was published and distributed during its issue month. To bring the Journal up to date has entailed much hard work on the part of all concerned with its publication, and credit is

also due the Bureau of Printing for expediting the work of printing. It is the aim of the publications division to issue the Journal sufficiently early each month to have every subscriber's copy in his hands during the month of the issue date. Copy for the numbers for January to June, 1923, has already been sent to the printer; page proof for March number and galley proof for May number were received from the printer by the close of the year. Therefore, there is very good reason for hope that our aim will be achieved during the coming year.

The following list gives titles and names of authors of the papers published in the Philippine Journal of Science during 1922:

VOLUME 20, JANUARY TO JUNE

*No. 1, January, 1922*

- YAP, S. E., and PINEDA, E. V. Two interesting cases of ectrosyndactyly. DEL ROSARIO, MARIANO V., and VALENZUELA, PATROCINIO. Commercial acetylsalicylic acid.
- SMITH, WARREN D. Geologic reconnaissance of the Pidatan oil field, Cotabato Province, Mindanao.
- WELLS, A. H., and PERKINS, G. A. Recent improvements in nipa-sugar manufacture.
- SCHENCK, HUBERT G. Drainage control by jointing in Angat district, Bulacan Province, Philippine Islands.
- KIEFFER, J. J. Philippine Serphidae (Proctotrupidae).
- COLE, HOWARD IRVING. Identification of ambergris.
- MUIR, F. New Malayan Cixiidae (Homoptera).

*No. 2, February, 1922*

- LEE, H. ATHERTON, and SHINO, ARIKUNI. Citrus-canker control experiments in Japan.
- KLEINE, R. Neue Brenthiden von den Philippinen und Borneo.
- TRELEASE, SAM F. Foliar transpiring power of the coconut.
- LEIVA, LAMBERTO. The cultivation of *Leishmania infantum* and *Leptomonas ctenocephali* on the triple-N medium.
- BRILL, HARVEY C., and BROWN, ROBERT E. The digestive properties of Philippine papain.
- DICKERSON, ROY E. Review of Philippine paleontology.

*No. 3, March, 1922*

- SCHENCK, HUBERT G. Physiography and geology of Samar Island, Philippine Islands.
- LALLEMAND, V. Cercopides nouveaux des Philippines.
- WELLES, COLIN G. Identification of bacteria pathogenic to plants previously reported from the Philippine Islands.
- HARTENDORF, A. v. H. Some results with intelligence tests in the Philippine Islands.
- MCLEAN, FORMAN T., and LEE, H. ATHERTON. Pressures required to cause stomatal infections with the citrus-canker organism.

- GOMEZ, LIBORIO; NAVARRO, REGINO; and KAPAUAN, AMANDO M. The Schick reaction in Filipinos.
- LEE, H. ATHERTON. Relation of the age of citrus tissues to the susceptibility to citrus canker.
- SHUFELDT, R. W. A mounted specimen of the monkey-eating eagle (*Pitheophaga jefferyi*) of the Philippines.
- MUIR, F. Three new species of Derbidae (Homoptera).
- WELLS, A. H.; AGCAOILI, F.; and FELICIANO, R. T. Philippine rice.
- SALVADOR, WENCESLAO. The food value of Philippine bananas.

*No. 4, April, 1922*

- MERRILL, ELMER D. New or noteworthy Philippine plants, XVII.

*No. 5, May, 1922*

- SHAW, WALTER R. Janetosphaera, a new genus, and two new species of *Volvox*.
- WEST, A. P., and FELICIANO, J. M. Extraction of copra cake with solvents.
- LÜTTSCHWAGER, H. Alcyonarien von den Philippinen I. Die Gattung *Alcyonium* Linnaeus.
- CUSHMAN, R. A. New Oriental and Australian Ichneumonidae.

*No. 6, June, 1922*

- GARCIA, FAUSTINO, and GUEVARA, ROMULO. Pharmacodynamics of *Datura alba*.
- SCHWARTZ, BENJAMIN, and TUBANGUI, MARCOS A. Uncommon intestinal parasites of man in the Philippine Islands. Reports of new cases.
- FOOTS, R. M. New parasitic Hymenoptera from the Oriental islands.
- MENDIOLA, NEMESIO B. Effect of different rates of transpiration on the dry weight and ash content of the tobacco plant.
- RADLKOFER, L. Sapindaceae novae Philippinenses.
- SCHWARTZ, BENJAMIN. Observations on the life history of *Ascaris vitorum*, a parasite of bovines in the Philippine Islands. Preliminary paper.
- ERRATA.
- INDEX.

VOLUME 21, JULY TO DECEMBER

*No. 1, July, 1922*

- PERKINS, GRANVILLE A. Manufacture of certain drugs for the treatment of leprosy.
- COLE, HOWARD IRVING. Manufacture of industrial alcohol and alcohol motor fuel in the Philippine Islands.
- WELLS, A. H., and PERKINS, G. A. The use of sulphur fumes in copra drying.
- WEISE, J. Hispinen der alten Welt.
- SHAW, WALTER R. *Merrillosphaera*, a new genus of the *Volvocaceae*.

*No. 2, August, 1922*

- SYDOW, H. The Amboina fungi collected by C. B. Robinson.
- WERNER, F. Philippine mantids, or praying insects.



- TAYLOR, EDWARD H. Additions to the herpetological fauna of the Philippine Islands, I.  
 SHAW, WALTER R. Copelandosphaera, a new genus of the Volvocaceae.

*No. 3, September, 1922*

- GOMEZ, LIBORIO; BASA, JOSÉ AVELLANA; and NICOLAS, CATALINO. Early lesions and the development and incidence of leprosy in the children of lepers.  
 TAYLOR, EDWARD H. Additions to the herpetological fauna of the Philippine Islands, II.  
 ABRÍOL, RUFINO. Correlation of death rates from certain diseases with certain economic and housing factors in the Philippine Islands.  
 WELD, LEWIS H. Notes on the Liopterinae with descriptions of new species from the Oriental Region (Hymenoptera, Cynipidae).

*No. 4, October, 1922*

- MERRILL, ELMER D. Diagnoses of Hainan plants.  
 WITT, J. C. The effect of sulphur compounds on cement.  
 COLE, HOWARD IRVING. The use of textile fibers in microscopic qualitative chemical analysis. V. The detection of gold by means of stannous chloride-pyrogallol viscose-silk fibers.  
 WITT, J. C. Some generalizations on the influence of substances on cement and concrete. Second paper.  
 ALEXANDER, CHARLES P. New or little-known Tipulidae from the Philippines (Diptera).  
 VOSS, EDUARD. Indo-Malayische Rhynchitinen (Curculionidae). I, Siebenter Beitrag zur Kenntniss der Curculioniden.

*No. 5, November, 1922*

- ROHWER, S. A. Philippine parasites of the family Trigonalidae.  
 TAKAHASHI, RYOICHI. Some Malayan Aphididae.  
 WEISE, J. Chrysomeliden der Philippinen, III.  
 MERRILL, ELMER D. Notes on the flora of southeastern China.

*No. 6, December, 1922*

- MERRILL, ELMER D. Additions to our knowledge of the Bornean flora.  
 MENDOZA-GUAZON, MARIA PAZ. Schistosomiasis in the Philippine Islands.  
 SCHULTZE, W. X. Beitrag zur Coleoptera Fauna der Philippinen.

The following table shows the number of names on the mailing list of the Philippine Journal of Science during the last two years:

	1921	1922
Paid subscriptions.....	335	310
Exchanges.....	511	553
Review subscriptions.....	37	34
Free.....	68	66
Totals.....	951	963

The slight decrease in paid subscriptions, largely caused by adverse financial conditions in Europe, is more than offset by the increase in exchanges. From a merely financial viewpoint the exchange of publications is distinctly advantageous. From an educational viewpoint it is exceedingly gratifying to note the annual increase in our exchange list as indicating the high regard entertained for the Philippine Journal of Science in the scientific world.

*Special publications.*—Other than the Philippine Journal of Science, the following special publications were issued during 1922:

The Snakes of the Philippine Islands, by Edward H. Taylor. Publication No. 16 of the Bureau, pp. 1-312, pls. 1-37, text figs. 1-32. Issued February 11, 1922.

The Lizards of the Philippine Islands, by Edward H. Taylor. Publication No. 17 of the Bureau, pp. 1-269, pls. 1-23, text figs. 1-53. Issued December 7, 1922.

Enumeration of Philippine Flowering Plants, Vol. 1, fasc. 1 and 2, by Elmer D. Merrill. Publication No. 18 of the Bureau, pp. 1-240. Issued December 27, 1922.

Twentieth Annual Report of the Director of the Bureau of Science, pp. 1-83, pls. 1-4.

Mineral Resources of the Philippine Islands for 1919-1920, pp. 1-70, pls. 1-4. Issued March 9, 1922.

*Press Bulletins.*—The following press bulletins were issued in 1922.

No. 105. Philippine Hydnocarpus oils. (January 27, 1922.)

No. 106. The Possibilities of the Mungo. (February 9, 1922.)

No. 107. Coconut Press Cake. (February 9, 1922.)

No. 108. The Culture of Bañgos in the Philippines. (February 4, 1922.)

No. 109. Yaws. (June 3, 1922.)

No. 110. Scientific Ore-hunting. (June 17, 1922.)

Copy for a comprehensive work entitled Geology and Mineral Resources of the Philippine Islands, by Warren D. Smith, former chief of the division of mines, has been sent to the printer, to be issued as publication No. 19 of the Bureau. This work embodies the results of Doctor Smith's studies and investigations of the geology of the Islands and of the mining possibilities of the country, and will no doubt prove of great value and interest to the mining industry.

Two fascicles of An Enumeration of Philippine Flowering Plants, by the Director, Publication No. 18 of the Bureau, have been issued, several more fascicles are in page proof and in

galley proof, and copy for others is in the hands of the printer. It is planned to issue this basic work in four volumes, and it is expected that much of it will be issued during 1923.

#### POWER PLANT

During the year 344 shop orders were received for repair, the construction, and alteration of apparatus and equipment, a radical increase over the number for the preceding year, when but 140 orders were received and executed. A considerable amount of extra work has been occasioned by the necessary installation of pipe connections with the materials-testing laboratory, the media kitchen, and the tikitiki and distillation room, which was undertaken and completed during the first part of the year. In June the installation of the new 180-horsepower Busch-Sulzer Diesel engine was completed. This is connected directly with a new 120-kilowatt dynamo; preliminary operations gave very satisfactory results, and throughout the month of June the new engine was tested under varying loads until the maximum capacity was gradually reached. Since it was accepted, the latter part of June, this new engine has been operated regularly eight hours per day except on holidays. It is rendering very satisfactory service, although the average load and present demands are only about one-third of its total capacity. Including the cost of crude oil, lubricating oil, salaries, and wages, but excluding maintenance, depreciation, and repairs, electricity can now be produced at a cost of ₱0.06 per kilowatt hour utilizing the new power unit; this cost of production will be lowered when heavier demands are made upon the engine for power, or when it reaches approximately two-thirds of its capacity. The combined use of two engines, the new Diesel engine and the smaller Otto gas-producer engine, has considerably reduced the cost of production of electricity during the last six months of the year. The average cost per kilowatt hour in 1920, using the gas-producer engine and the steam engine, was ₱0.22; in 1921 this was reduced to ₱0.148; in 1922 to ₱0.1156. During the last six months of 1922, utilizing in alternation the gas-producer engine and the new Diesel engine, the average cost has been but ₱0.08 per kilowatt hour. During the last-named period almost no use has been made of the steam engine.

The total amount of steam, electricity, and gas produced during 1922, as compared with 1920 and 1921, is shown in the following table:

Year.	Steam.	Average cost per kilo.	Kilowatt hours.	Average cost per kilo.	Gas.	Cost per 1,000 cubic feet.
	<i>Kilos.</i>	<i>Peso.</i>		<i>Peso.</i>	<i>Cubic feet.</i>	<i>Pesos.</i>
1920.....	8,185,476	0.00705	197,538	0.2208	1,108,114	2.825
1921.....	5,504,338	0.00756	224,440	0.1480	1,146,225	2.372
1922.....	4,568,741	0.00762	238,858	0.1156	1,128,060	1.771
Difference, 1921 and 1922....	935,597	0.00006	14,418	0.0324	18,165	0.601

The reduction in the production of steam is largely due to the comparatively slight use made of the steam engines. The production of electricity shows an increase of 14,418 kilowatt hours over that of the preceding year, but the cost per kilowatt hour is ₱0.03 less. There has been a considerable reduction in the cost of gas as compared with the preceding year, this being due to the fact that we have utilized in the manufacture of gas the waste lubricating oil from the power plant at Alabang and the newly installed Diesel engine in Manila. The following table shows the quantity, cost, and distribution of the power produced:

	Steam.		Electricity.		Gas.	
	Quantity.	Cost.	Quantity.	Cost.	Quantity.	Cost.
	<i>Kilos.</i>	<i>Pesos.</i>	<i>Kilowatt.</i>	<i>Pesos.</i>	<i>Cu. ft.</i>	<i>Pesos.</i>
Production.....	4,568,741	34,887.85	238,858	27,040.59	1,128,060	1,927.30
Average per month.....	380,720	2,907.32	19,906	2,253.38	94,005	160.61
Consumption:						
Bureau of Science.....	619,192	4,487.53	118,296	13,517.22	694,098	1,197.37
Average per month.....	51,600	373.97	9,858	1,126.44	57,842	99.78
Engine room.....	888,320	7,025.57				
Average per month.....	72,360	585.47				
Manufacture of tiki-tiki extract.....	629,184	4,487.44	3,120	360.78	433,962	729.93
Average per month.....	52,432	373.96	260	30.07	36,164	60.83
Philippine General Hospital.....			99,428	11,203.05		
Average per month.....			8,286	933.59		
Total steam for pump.....	987,045	7,660.47				
Total steam for hot water.....	1,611,000	12,509.75				
Average steam per month for pump.....	82,254	638.37				
Average steam per month for hot water.....	134,250	1,042.48				
College of Liberal Arts.....			4,162	407.49		
Average per month.....			347	33.96		
College of Medicine and Surgery.....			13,852	1,552.06		
Average per month.....			1,155	129.34		

The reduction in cost of steam production, as compared with 1922, amounts to ₱6,413.64; of electric power, ₱5,263.84 although there was an increased production amounting to 14,418 kilowatt hours; and of gas, ₱787.51.

*Alabang power plant.*—The Alabang power plant is in good condition, and no important repairs have been necessary during the year. The total expenses in connection with its operation were ₱16,676.13, as compared with ₱19,216.22 for the preceding year, an economy of somewhat over ₱2,500, as compared with 1921. The total amount of power produced was 52,349 kilowatt hours, the average cost of production being ₱0.3204.

*General.*—For the power plant at Alabang a new air compressor is necessary, as the two small ones at present in use are inadequate for the requirements of the work. For the power plant at the main office of the Bureau of Science in Manila two adjustable 12,000-pound trolleys must be purchased and installed in connection with the necessary cleaning and repairs of the new Diesel engine, and a larger storage tank for crude oil is an essential. In order better to control the consumption of fuel in the furnace, the purchase of carbon dioxide recording apparatus is highly desirable. Since the installation of the new Diesel engine the consumption of water has radically increased, our charges for water consumption at present being very heavy. These charges should be very greatly reduced in 1923 with the completion of the cooling tank now under construction, as for the internal-combustion engines we shall be able to use the same water over and over again instead of being compelled to draw constantly on the Metropolitan Water District. It is probable that the water charges will be reduced at least 50 per cent in 1923.

#### CLERICAL DIVISION

*Personnel.*—Few changes have been made in the personnel of this division during the year. Mr. Pedro Dalupang, a clerk, resigned effective January 31; Mr. Melecio Cantara, junior bookkeeper, resigned effective April 2; and Mr. Guillermo Dacumus, junior stenographer, transferred to the office of the city fiscal on June 30. Mr. Mariano Garcera was appointed junior bookkeeper April 3; and Mr. Benjamin J. Remollino was appointed junior stenographer on June 16. There were also a few reassignments within the division. With the exception of the above changes, the personnel of the division has remained as in previous years. The work of filing, disbursing, accounting, and care

of property has been handled very satisfactorily by Messrs. Velasco, Espiritu, Reyles, and Herrera, respectively.

*Miscellaneous.*—The cold-storage compartments have been entirely reconstructed during the year. The changes also involved extensive repairs to the room containing the cold-storage machinery and brine tanks. The roof of the porte cochere at the main entrance of the Bureau has been replaced. The installation of the new Diesel engine involved some reconstruction in the power plant, it being necessary to raise the roof of that section of the plant in which the new engine is installed.

The raising of rabbits and guinea pigs for the use of the biological laboratory has been eminently successful, as in the preceding year. Two hundred twenty-one rabbits were used and 110 died, while 165 guinea pigs were used and 138 died. The stock has been maintained at all times in excess of the actual needs of the Bureau. The work of breeding white rats was also continued. About 118 monkeys were secured for the use of the biological laboratory. One hundred five horses and mules for serum purposes were obtained free of charge from the United States Army, and one horse from the Bureau of Agriculture.

#### PHOTOGRAPHY

The photographic work in 1922 showed a distinct increase over the preceding years, as mentioned in the twentieth annual report of this Bureau. The increased demands on our photographer have continued during the present year, a total of 14,799 units being accomplished in 1922 in comparison with 12,265 in 1921. There is a constant demand for prints from the large collection of negatives belonging to the Bureau. There have also been increased demands for photographic work in other units of the Government service for legal and for commercial and semi-commercial work. The following table presents graphically the increase of work in this department from 1920 to 1922:

	1920	1921	1922
Negative plates:			
5 by 7.....	691	1,436	1,168
8 by 10.....	32	87	357
Prints:			
5 by 7 (including those for the album).....	6,352	7,333	8,069
8 by 10 (including those for the album).....	421	526	1,337
4 by 5.....		172	
11 by 14.....		6	
Miscellaneous sizes.....	1,475	1,398	2,548

	1920	1921	1922
Direct enlargements.....	195	503	32
Developing:			
Plates, 4 by 5.....	47		
Plates, 5 by 7.....	232	138	
Films, rolls (exposures).....	19	54	
Plates and films, 5 by 7.....			38
Film packs of 12 exposures.....			14
Film rolls of 6 exposures.....			68
Transparency plates:			
8 by 10, colored.....	253	31	4
11 by 14, colored.....	6	52	
11 by 14, uncolored.....		15	2
Lantern slides:			
Colored.....	311	293	315
Uncolored.....	524	221	847
Total.....	10,558	12,265	14,799

**AQUARIUM**

The income of the aquarium for the year from all sources amounted to ₱4,701.75, a decrease of ₱220.70 as compared with the previous year. The cost of upkeep was ₱7,410.80, a decrease of ₱501.77 compared with the expenses of the previous year. Nominal repairs have been made from time to time.

A total of 1,787 free admissions were granted in 1922, as compared with 946 for the previous year, to students and teachers in Government and private schools, various delegates to conventions, visiting sailors of American and foreign naval boats, and scientists and representatives of foreign governments.

One field trip was made by Mr. D. Deroy in January for the purpose of securing new specimens for the aquarium. The salt water of the tanks was replaced but once during the year.

**PRESENT NEEDS**

The vital needs of the Bureau of Science have already been indicated in the four-year program submitted during the year. They resolve themselves under three heads; more space, additional technical personnel, and additional funds for salaries, equipment, and supplies. The laboratories are overcrowded, the library has reached its maximum development in its present quarters, the entomological division is compressed into one small room, and no further expansion of the herbarium is possible without adopting the doubtful expedient of arranging additional herbarium cases in the corridors. The institution is steadily approaching the stage of being self-supporting, its

service income in 1922 having increased to such a degree that it approximated 54 per cent of its total expenditures. Without better financial support it can hardly be expected that this percentage can be raised much higher. From a purely business standpoint the system of revolving funds should be reinstated, at least to cover the manufacturing phases of our work. The present policy of increasing the required work of the institution without correspondingly increasing its resources and technical personnel is gradually reducing it to a routine rather than a research institution, and to gain the best results neither routine nor research should be sacrificed.

Respectfully submitted.

ELMER D. MERRILL,  
*Director, Bureau of Science.*

To the Honorable  
The SECRETARY OF AGRICULTURE  
AND NATURAL RESOURCES.



TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1922, as compared with the fiscal year 1921, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivisions of the Bureau of Science.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
General, inorganic, and physical chemistry:						
Metals and alloys.....	15	82	14	63	178.50	488.00
Rocks, minerals, natural pigments, and similar substances.....	33	8	26	8	211.00	130.00
Clays, shales, limestones, limes, wall plasters, cements, and slags.....	42	26	38	24	541.00	250.00
Fertilizers.....	72	348	48	329	436.00	2,433.50
Soil and similar substances.....	49	36	34	9	599.00	143.00
Coal analyses.....	18	77	11	77	283.00	2,650.59
Calorimetric tests of fuels.....	3		3		82.00	
Paints and varnishes.....	1	14	1	14	12.00	283.50
Waters.....	188	191	37	37	1,223.50	1,040.00
Crude chemical and miscellaneous analyses.....	13	16	13	15	66.50	86.00
Standard solutions (liters).....	80	90	26	30	141.20	165.00
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	23	39	23	39	33.00	38.00
Cements.....	8,348	10,091	8,348	10,089	10,384.50	11,809.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	501	787	501	727	850.00	1,300.00
Standardization of road materials.....	1		1		6.00	
Standardization and correction of units of measure.....	1,715		1,714		311.50	
Length.....		24		24		10.65
Capacity.....		8		8		9.60
Weight.....		166		166		236.46
Miscellaneous inorganic work and analyses.....	547	89	334	73	885.00	415.00
Total.....	11,649	12,092	11,172	11,732	16,243.70	21,499.10

TABLE 1.—Comparative table of routine work performed, etc.—Continued.

Subdivisions of the Bureau of Science.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Organic chemistry:</b>						
Urines, clinical and toxicological analyses.....	625	537	504	415	1,621.03	1,345.34
Essential oils and essences.....	15	13	15	13	150.00	130.00
Petroleum and products, copra, and similar materials.....	871	733	563	665	3,161.50	4,113.50
Linseed and castor oils.....	4	13	4	6	18.00	111.00
Paper and similar materials.....	15	1	2	1	12.00	10.00
Gastric juice, clinical examinations.....	4	1	3	1	45.00	5.00
Foods, alcohols, and beverages.....	2,363	3,304	262	398	1,129.67	1,750.00
Food preservatives and coloring matter.....	4	3	4	2	17.00	10.00
Medicines and similar articles.....	4,549	1,201	1,124	741	3,584.50	2,174.80
Miscellaneous organic analyses and examinations.....	260	100	227	31	564.00	145.00
<b>Total.....</b>	<b>8,710</b>	<b>5,906</b>	<b>2,708</b>	<b>2,273</b>	<b>10,302.70</b>	<b>9,794.64</b>
<b>Mines:</b>						
Assays.....	457	100	449	97	1,124.00	329.00
Smelting and refining of gold.....	7,040	13,945	7,040	13,945	110.00	445.65
<b>Total.....</b>	<b>7,497</b>	<b>14,045</b>	<b>7,489</b>	<b>14,042</b>	<b>1,234.00</b>	<b>774.65</b>
<b>Biological laboratory:</b>						
Fæces.....	86,208	91,038	198	149	581.00	131.04
Sputum.....	211	143	100	93	293.00	281.00
Blood.....	82	2,467	38	26	275.34	219.34
Cultures.....	39	30	39	30	447.33	161.32
Widal tests.....	1,852	1,634	68	40	204.00	135.00
Wassermann tests.....	759	641	261	158	2,610.00	1,580.00
Leprosy.....	41	76	8	1	24.00	3.00
Urines.....	9	2	9	1	34.00	3.00
Gonococci.....	106	73	105	69	315.00	209.00
Waters.....	12,384	11,836	21	28	651.00	543.00
Histological examinations.....	12	7	12	6	120.00	53.34
Rats for plague.....	91,999	81,750				
Miscellaneous biological examinations.....	2,418	4,055	18	12	79.00	152.00
<b>Total.....</b>	<b>196,120</b>	<b>193,752</b>	<b>877</b>	<b>613</b>	<b>5,633.67</b>	<b>3,471.04</b>

TABLE 1.—Comparative table of routine work performed, etc.—Continued.

Subdivisions of the Bureau of Science.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Serum section of the biological laboratory:</b>						
Vaccine virus (doses) . . . . .	3, 111, 687	2, 727, 196	3, 111, 687	2, 727, 196	39, 883. 68	35, 316. 70
Miscellaneous serums and vaccines (ampules and units) . . . . .	5, 039, 685	7, 467, 312	5, 039, 685	7, 467, 312	134, 525. 88	222, 704. 79
<b>Total</b> . . . . .	<b>8, 151, 372</b>	<b>10, 194, 508</b>	<b>8, 151, 372</b>	<b>10, 194, 508</b>	<b>74, 409. 56</b>	<b>258, 020. 49</b>
<b>Miscellaneous:</b>						
Photographic work . . . . .	10, 291	13, 366	6, 488	6, 358	2, 058. 28	1, 986. 30
Natural-history specimens . . . . .	57	86	57	85	408. 80	390. 60
Shop work . . . . .	661	363	5	2	72. 10	7. 50
Drafting . . . . .	183	227	156	19	78. 00	11. 00
Miscellaneous work . . . . .	586	122	586	122	9, 292. 01	5, 880. 65
Supplies . . . . .	5, 474	15, 102	5, 474	15, 102	5, 175. 58	3, 877. 39
Tikitiki extract . . . . .	703	723	703	723	498. 50	511. 83
Sales of publications . . . . .					4, 675. 87	3, 892. 72
Refunded, work not done, etc. (deducted) . . . . .					(55. 00)	(205. 70)
Power, gas, etc. . . . .					39, 208. 70	33, 739. 15
<b>Total</b> . . . . .	<b>17, 955</b>	<b>29, 989</b>	<b>13, 469</b>	<b>22, 411</b>	<b>61, 407. 84</b>	<b>50, 091. 41</b>
<b>Grand total</b> . . . . .	<b>8, 393, 303</b>	<b>10, 450, 292</b>	<b>8, 187, 087</b>	<b>10, 245, 579</b>	<b>269, 231. 47</b>	<b>348, 651. 83</b>

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1922, as compared with the fiscal year 1921, by number or quantity and by value, arranged with reference to Government and other patronage.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Bureau of Agriculture:</b>						
Clays, shales, lime-stones, limes, wall plasters, and slags.....	2					
Fertilizers.....	19	7				
Soils and similar substances.....	15	12				
Foods, alcohols, and beverages.....	26	44				
Miscellaneous serums and vaccines.....		10,000		10,000		20.00
Medicines and similar articles.....	1					
Photographic work.....	3		3		0.60	
Total.....	66	10,063	3	10,000	0.60	20.00
<b>Bureau of Audits:</b>						
Miscellaneous inorganic work and analyses.....		1				
Photographic work.....	5		5		3.00	
<b>Bureau of Coast and Geodetic Survey:</b>						
Supplies.....	2		2		10.00	
<b>Bureau of Commerce and Industry:</b>						
Rocks, minerals, natural pigments, and similar substances.....	1					
Petroleum and products, copra, and similar materials.....		1				
Foods, alcohols, and beverages.....	10	5				
Blood.....	1					
Photographic work.....	23		23		42.00	
Total.....	35	6	23		42.00	
<b>Bureau of Customs:</b>						
Metals and alloys.....		5				
Foods, alcohols, and beverages.....						
Waters, biological.....	1	2				
Waters, chemical.....	1					

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Bureau of Customs—Ctd.</b>						
Petroleum and products, copra, and similar materials .....	208	10				
Medicines and similar articles .....	404	139				
Total .....	609	156				
<b>Bureau of Education:</b>						
Clays, shales, limestones, limes, wall plasters, and slags .....		2				
Fertilizers .....	5					
Miscellaneous inorganic analyses .....	2					
Waters, biological .....		3				
Miscellaneous work .....				1		1.00
Supplies .....	4	8	4	8	27.00	41.00
Total .....	11	14	4	9	27.00	42.00
<b>Executive Bureau:</b>						
Waters, biological .....		1				
Photographic work .....	2		2		5.00	
Supplies .....		1		1		1.20
Total .....	2	2	2	1	5.00	1.20
<b>Bureau of Forestry:</b>						
Miscellaneous inorganic analyses .....	52					
Foods, alcohols, and beverages .....	2	3				
Miscellaneous organic analyses and examinations .....	1					
Photographic work .....	90	329	90	329	20.21	80.45
Total .....	145	332	90	329	20.21	80.45
<b>Philippine Health Service:</b>						
Waters, chemical .....	13	26				
Waters, biological .....	11,227	10,665				
Crude chemical and miscellaneous analyses .....	2					
Urines, clinical and toxicological analyses .....	101	102				
Petroleum and products, copra, and similar materials .....	1					

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
Philippine Health Service— Continued.						
Linseed and castor oils.....	2					
Gastric juice, clinical examinations.....	2					
Foods, alcohols, and beverages.....	1,986	2,758				
Food preservatives and coloring matter.....	59	1				
Medicines and similar articles.....	9	7				
Miscellaneous organic analyses and exam- inations.....	51		48		19.20	
Fæces.....	13,829	29,385				
Sputum.....	107	49				
Blood.....	40	2,436				
Widal tests.....	1,783	1,593				
Wassermann tests.....	485	461				
Leprosy.....	31	74				
Gonococci.....		4				
Histological examina- tions.....	2					
Rabies.....	2					
Rats for plague.....	91,954	81,011				
Miscellaneous biological work and examina- tions.....	2,397	4,036				
Vaccine virus.....	3,073,300	2,690,450	3,073,300	2,690,450	38,632.00	34,275.50
Miscellaneous serums and vaccines.....	2,837,819	5,184,563	2,837,819	5,184,563	114,582.00	201,286.20
Photographic work.....	2,127	2,032	2,127	312	395.37	97.36
Supplies.....	386	418	386	418	133.75	128.25
Total.....	6,037,585	8,040,071	5,913,632	7,875,743	153,743.12	235,787.31
Philippine General Hospital:						
Waters, chemical.....	3					
Standardization and cor- rection of units of weight.....		1		1		16.66
Urines, clinical and tox- icological analyses.....		1				
Petroleum and products, copra, and similar materials.....	1					
Foods, alcohols, and be- verages.....		2		2		10.00
Gastric juice, clinical examinations.....	1					
Vaccine virus.....	10	10	10	10	1.00	1.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
Philippine General Hospital—Continued.						
Miscellaneous serums and vaccines	502,983	768,315	502,983	768,315	2,765.00	3,141.80
Photographic work	750	561				
Shop work	1		1		25.00	
Tikitiki extract	7		7		4.90	
Supplies		4		4		10.04
<b>Total</b>	<b>503,756</b>	<b>768,894</b>	<b>503,001</b>	<b>768,332</b>	<b>2,795.90</b>	<b>3,179.50</b>
House of Representatives:						
Photographic work		9		9		22.50
Bureau of Internal Revenue:						
Rocks, minerals, natural pigments, and similar substances	1					
Standardization and correction of units of measure	1					
Length		9		9		0.90
Weight		8		8		0.80
Petroleum and products, copra, and similar materials	37					
Foods, alcohols, and beverages	1					
Medicines and similar articles	2,670	59				
Miscellaneous inorganic work and analyses		3		3		50.00
<b>Total</b>	<b>2,710</b>	<b>79</b>		<b>20</b>		<b>51.70</b>
Bureau of Justice:						
Urines, clinical and toxicological analyses		1		1		20.00
Medicines and similar articles	21	38	21	38	107.00	45.00
Blood	1	1	1		75.00	
<b>Total</b>	<b>22</b>	<b>40</b>	<b>22</b>	<b>39</b>	<b>182.00</b>	<b>65.00</b>
Bureau of Lands:						
Waters, chemical		1				
Miscellaneous organic work and examinations		1				
Photographic work		1,205		1,205		716.70
<b>Total</b>		<b>1,207</b>		<b>1,205</b>		<b>716.70</b>
Bureau of Mint:						
Assays	369		369		761.50	

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Office of the Governor-General:</b>						
Petroleum and products, copra, and similar materials.....		3				
Photographic work.....	4	1	4	1	12.00	7.00
Supplies.....	2		2		2.40	
Total.....	6	4	6	1	14.40	7.00
<b>Board of Pharmaceutical Examiners and Inspectors:</b>						
Miscellaneous biological work and examinations.....		1				
Medicines and similar articles.....	347	254				
Total.....	348	254				
<b>Public Welfare Commissioner:</b>						
Waters, biological.....		1				
Vaccine virus.....	100		100		1.00	
Miscellaneous serums and vaccines.....		3		3		3.00
Miscellaneous biological work and examinations.....	1	4				
Total.....	101	8	100	3	1.00	3.00
<b>Bureau of Non-Christian Tribes:</b>						
Foods, alcohols, and beverages.....		1				
<b>Philippine Constabulary:</b>						
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	6	4	6	4	20.00	4.00
Urines, clinical and toxicological analyses.....		7				
Histological examinations.....		1				
Miscellaneous organic analyses and examinations.....	8					
Blood.....	2	2				



TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
Philippine Constabulary— Continued.						
Vaccine virus .....	2,150	3,150	2,150	3,150	21.50	31.50
Miscellaneous serums and vaccines .....	135	13,468	135	13,460	62.50	219.60
Supplies .....	60	5,090	60	5,090	3.00	134.50
Total .....	2,361	21,722	2,351	21,712	107.00	889.60
Weather Bureau:						
Photographic work .....	5		5		2.50	
Bureau of Posts:						
Miscellaneous inorganic analyses .....	1		1		20.00	
Photographic work .....	19		19		40.00	
Total .....	20		20		60.00	
Bureau of Printing:						
Paper and similar mate- rials .....	13					
Bureau of Prisons:						
Fæces .....	71,317	30,716				
Widal tests .....		1				
Wassermann tests .....	11	21				
Leprosy .....	2	1				
Gonococci .....	1					
Rats for plague .....	1					
Miscellaneous biological work and examina- tions .....		1				
Waters, biological .....	1	1				
Vaccine virus .....	7,200	4,500	7,200	4,500	72.00	45.00
Miscellaneous serums and vaccines .....	7	243	7	243	6.00	105.00
Supplies .....	1		1		.50	
Total .....	78,541	35,484	7,208	4,743	78.50	150.00
Bureau of Public Works:						
Metals and alloys .....	1	30		30		4.00
Cements .....	1,140	2,793	1,140	2,793	1,167.30	3,941.10
Clays, shales, lime- stones, limes, wall plasters and slags .....		5		5		47.00
Soils and similar sub- stances .....		1				

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Bureau of Public Works—</b>						
<b>Continued.</b>						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc .....	220	558	220	558	283.00	926.00
Waters, chemical .....	125	120				
Crude chemical and miscellaneous analyses .....		1				
Miscellaneous inorganic analyses .....	3	13				
Waters, biological .....	2	5				
Petroleum and products, copra, and similar materials .....		1				
Miscellaneous work .....		1		1		1.00
Supplies .....		5		5		19.50
Total .....	1,491	3,533	1,360	3,392	1,450.30	4,938.60
<b>Bureau of Quarantine Service:</b>						
Urines, clinical and toxicological analyses .....	6					
Fæces .....	374	214				
Rats for plague .....	44	739				
Sputum .....		1				
Vaccine virus .....	6,603	10,000	6,603	10,000	66.30	100.00
Miscellaneous serums and vaccines (ampules, cc., and units) .....	5		5		3.50	
Total .....	7,026	10,954	6,608	10,000	69.30	100.00
<b>Bureau of Science:</b>						
Rocks, minerals, natural pigments, and similar substances .....	5					
Fertilizers .....		12				
Soils and similar substances .....		14				
Clays, shales, limestones, limes, wall plasters, cements, and slags .....	2					
Coal analyses .....	7					
Standard solutions (liters) .....	54	60				
Cements .....		2				

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Bureau of Science—Ctd.</b>						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc .....		60				
Foods, alcohols, and beverages .....	8	1				
Miscellaneous inorganic analyses.....		1				
Fæces.....	2	1				
Petroleum and products, copra, and similar materials.....		14				
Sputum .....	4					
Blood .....		2				
Urines, clinical and toxicological analyses .....	15	13				
Petroleum and products, copra, and similar materials .....	14					
Wassermann tests.....	2	1				
Widal tests.....	1					
Medicines and similar articles .....	2	1				
Miscellaneous organic analyses and examinations.....	23	68				
Assays .....	8	3				
Waters, chemical .....	6	3				
Waters, biological.....	3	6				
Photographic work.....	3,053	4,713				
Natural-history specimens .....		1				
Shop work .....	656	361				
Drafting .....	27	208				
<b>Total .....</b>	<b>3,892</b>	<b>5,545</b>				
<b>Bureau of Supply:</b>						
Metals and alloys .....		11				
Waters, chemical.....	3	4				
Coal analyses.....		11		11		1,520.59
Physical tests of wire, twine, fibers, textiles, papers, and similar materials.....	13	27	13	27	6.00	6.00
Cements.....	6,554	7,076	6,554	7,076	6,588.50	6,956.20

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
Bureau of Supply—Ctd.						
Paints and varnishes.....	6	4	6	4	75.00	13.50
Standardization and correction of units of measure—						
Capacity.....	1,645		1,645		164.50	
Weight.....		16		16		8.00
Miscellaneous inorganic analyses.....	151	1				
Petroleum and products, copra, and similar materials.....	51	39				
Linseed and castor oils.....		7				
Miscellaneous organic work and examinations.....	8		8		30.00	
Foods, alcohols, and beverages.....	68	94				
Medicines and similar articles.....	1					
Miscellaneous biological work and examinations.....	1	1				
Miscellaneous serums and vaccines.....	12,112	6,049	12,112	6,049	86.00	46.60
Supplies.....	796	603	796	603	780.00	730.34
Tikitiki extract.....	314		314			
Total.....	21,403	13,943	21,128	13,786	7,605.00	9,281.23
University of the Philippines:						
Vaccine virus.....		900		900		9.00
Fæces.....	488	573				
Miscellaneous serums and vaccines.....	75,283	10,000	75,283	10,000	219.00	20.00
Photographic work.....	236	562	236	548	89.44	161.26
Shop work.....		1		1		5.00
Supplies.....	7	8	7	8	42.00	53.23
Total.....	76,014	12,044	75,526	11,457	350.44	248.49
Bureau of Treasury:						
Metals and alloys.....		3				
City of Manila:						
Metals and alloys.....		3		3		24.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....	35	43	35	43	140.00	135.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
City of Manila—Continued.						
Standardization and correction of units of measure:						
Capacity .....		6		6		3.60
Weight .....		38		38		28.00
Urines, clinical and toxicological analyses .....	5					
Petroleum and products, copra, and similar materials .....	2	4		4		59.00
Medicines and similar articles .....	1,087	676	1,087	676	3,270.00	2,061.00
Miscellaneous organic analyses and examinations .....	1	9		9		2.00
Blood .....	1	1		1		75.00
Waters, biological .....	1,129	1,124				
Miscellaneous biological work and examinations .....	3	1	3		5.00	
Miscellaneous serums and vaccines .....	450,000	300,000	450,000	300,000	700.00	600.00
Total .....	452,263	301,905	451,125	300,780	4,115.00	2,987.60
Metropolitan Water District:						
Crude chemical and miscellaneous analyses .....	4	11	4	11	16.00	44.00
Standard solutions (liters) .....	18	20	18	20	103.50	115.00
Total .....	22	31	22	31	119.50	159.00
Provinces and municipalities:						
Cements .....	9		9		48.75	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc .....	9	24	9	24	45.00	40.00
Standardization and correction of units of weight .....		33		33		21.00
Medicines and similar articles .....		2		2		10.00
Waters, chemical .....	15	18	15	18	785.00	600.00
Urines, clinical and toxicological analyses .....	1		1		20.00	

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
Provinces and municipalities—Continued.						
Medicines and similar articles.....	8		8		80.00	
Waters, biological.....	5	6	5	6	200.00	90.00
Photographic work.....	18		18		3.60	
Total.....	65	83	65	83	1,177.35	761.00
United States Army and Navy:						
Metals and alloys.....		18		18		332.00
Coal analyses.....		1		1		35.00
Waters, chemical.....		1		1		25.00
Cements.....	6	8	6	8	22.50	30.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....	9		9		20.00	
Standardization and correction of units of weight.....		37		37		38.00
Miscellaneous inorganic analyses.....	7	7	7	7	42.00	54.00
Petroleum and products, copra, and similar materials.....		16		16		231.00
Histological examinations.....	1		1			10.00
Vaccine virus.....	18,315	15,900	18,315	15,900	816.50	554.50
Miscellaneous serums and vaccines.....	81,004	2,552	81,004	2,552	1,894.60	1,109.60
Supplies.....	16	1	16	1	80.00	5.00
Tikitiki extract.....	6		6		4.20	
Total.....	99,364	18,541	99,364	18,541	2,889.80	2,414.10
Philippine Senate:						
Photographic work.....	235		235		55.20	
Commission of Independence:						
Photographic work.....	35		35		7.00	
Philippine National Guard:						
Supplies.....	1		1		5.00	
Public Utility Commissioner:						
Miscellaneous inorganic analyses.....	5					

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
Miscellaneous:						
Metals and alloys.....	14	12	14	12	178.50	128.00
Clays, shales, limestones, limes, wall plasters, cements, and slags....	38	19	38	19	541.00	320.00
Rocks, minerals, natural pigments, and similar substances.....	26	8	26	8	211.00	130.00
Fertilizers.....	48	329	48	329	436.00	2,433.50
Soils and similar sub- stances.....	34	9	34	9	599.00	143.00
Coal analyses.....	11	65	11	65	283.00	1,095.00
Crude chemical and miscellaneous analy- ses.....	9	4	9	4	50.50	42.00
Paints and varnishes.....	1	10	1	10	12.00	280.00
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	4	8	4	8	7.00	28.00
Standard solutions (li- ters).....	8	10	8	10	37.70	50.00
Cements.....	639	212	639	212	2,612.45	882.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, steel, etc.....	228	102	228	102	362.00	199.00
Standardization and correction of units of measure.....	69		69		147.00	
Length.....		15		15		9.75
Capacity.....		2		2		6.00
Weight.....		33		33		124.00
Miscellaneous inorganic analyses.....	326	63	326	63	823.00	311.00
Urines, clinical, and toxicological analyses.....	503	414	503	414	1,601.03	1,325.34
Essential oils and es- sences.....	15	13	15	13	150.00	130.00
Petroleum and products, copra, and similar materials.....	563	645	563	645	3,161.50	3,823.50
Linseed and castor oils.....	4	6	4	6	18.00	111.00
Calorimetric tests of fuels.....	3		3		82.00	
Standardization of road materials.....	1		1		6.00	
Gastric juice, clinical examinations.....	3	1	3	1	45.00	5.00

TABLE 2.—Comparative table of routine work performed, etc.—Continued.

Customer.	Samples or units.		Cash work.			
	1921	1922	Samples or units.		Pesos.	
			1921	1922	1921	1922
<b>Miscellaneous—Continued.</b>						
Paper and similar materials.....	2	1	2	1	12.00	10.00
Foods, alcohols, and beverages.....	262	396	262	396	1,129.67	1,740.00
Foods, preservatives, and coloring matter.....	4	2	4	2	17.00	10.00
Medicines and similar articles.....	8	25	8	25	127.50	58.80
Miscellaneous organic analyses and examinations.....	219	22	219	22	534.00	143.00
Assays.....	80	97	80	97	362.50	329.00
Smelting and refining of gold (grams).....	7,040	13,945	7,040	13,945	110.00	445.65
Waters, chemical.....	22	18	22	18	438.50	415.00
Waters, biological.....	16	22	16	22	451.00	453.00
Fæces.....	198	149	198	149	581.00	131.04
Sputum.....	100	93	100	93	293.00	281.00
Blood.....	37	25	37	25	200.34	144.34
Cultures.....	39	30	39	30	447.33	161.32
Widal tests.....	68	40	68	40	204.00	135.00
Wassermann tests.....	261	158	261	158	2,610.00	1,580.00
Leprosy.....	8	1	8	1	24.00	3.00
Urines, biological.....	9	1	9	1	34.00	3.00
Gonococci.....	105	69	105	69	315.00	209.00
Histological examinations.....	11	6	11	6	110.00	53.34
Miscellaneous biological work and examinations.....	15	12	15	12	74.00	152.60
Vaccine virus.....	4,009	2,286	4,009	2,286	273.38	299.20
Miscellaneous serums and vaccines.....	1,080,337	1,172,119	1,080,337	1,172,119	14,207.28	16,152.99
Photographic work.....	3,686	3,954	3,686	3,954	1,382.36	901.03
Natural-history specimens.....	57	85	57	85	403.80	390.60
Shop work.....	4	1	4	1	47.10	2.50
Drafting.....	156	19	156	19	78.00	11.00
Miscellaneous work.....	586	120	586	120	9,292.01	5,878.65
Supplies.....	4,199	8,964	4,199	8,964	4,091.93	2,754.33
Tikitiki extract.....	690	723	690	723	489.40	511.80
Sales of publications.....					4,675.87	3,892.72
Refunded, work not done, etc. (deducted).....					(55.00)	(205.70)
Power, gas, etc.....					39,208.70	33,739.15
<b>Total.....</b>	<b>1,104,775</b>	<b>1,205,363</b>	<b>1,104,775</b>	<b>1,205,363</b>	<b>93,533.35</b>	<b>82,245.35</b>
<b>Grand total.....</b>	<b>8,393,303</b>	<b>10,450,292</b>	<b>8,187,087</b>	<b>10,245,579</b>	<b>269,231.47</b>	<b>343,651.33</b>



TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1922 as compared with the fiscal years 1920 and 1921.

EXPENDITURES.

Item.	Fiscal year		
	1920	1921	1922
<b>Salaries and wages, etc.:</b>	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Salaries and wages, including accrued leave .....	280,196.09	345,364.47	338,752.53
Bonuses .....	32,345.96	24,075.65	
Travel expenses of personnel .....	12,000.00	14,654.30	9,028.90
Total .....	324,542.05	384,094.42	342,776.43
<b>Apparatus, supplies, etc.:</b>			
Consumption of supplies and materials .....	180,000.00	178,603.53	153,433.78
Apparatus and equipment, including books .....	23,049.57	131,945.85	23,429.40
Total .....	203,049.57	310,549.38	176,863.18
<b>Miscellaneous:</b>			
Postal, telegraph, telephone, and cable service .....	6,500.00	3,566.70	4,450.00
Freight, express, and delivery service .....	2,500.00	2,560.41	3,776.10
Printing and binding reports, documents, and publications .....	35,000.00	35,000.00	40,972.48
Illumination and power service .....	3,000.00	1,851.87	1,828.98
Miscellaneous service .....	9,000.00	10,605.64	10,170.66
Maintenance and repair of furniture and equipment .....	4,200.00	1,475.13	1,079.46
Total .....	60,200.00	55,059.75	62,277.63
<b>Distribution of tikitiki extract, antityphoid vaccine, and antidyenteric serum:</b>			
Salaries and wages .....	2,632.16	4,462.22	4,025.80
Bonuses .....	442.99	331.25	
Equipment .....	3,787.13	3,579.35	126.84
Consumption of supplies and materials .....	17,024.17	31,516.97	39,693.92
Other services .....	113.55	165.45	570.77
Total .....	24,000.00	40,055.24	44,417.38
<b>Grand total .....</b>	<b>611,791.62</b>	<b>789,758.79</b>	<b>626,384.57</b>

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1922 as compared with the fiscal years 1920 and 1921—Continued.

## INCOME.

Item.	Fiscal year—		
	1920	1921	1922
	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Receipts from operation .....	219,857.10	264,487.61	339,760.01
Sales of supplies .....	83.44	12.26	65.53
Sales of fixed assets.....	3,794.00	3,392.00	1,575.38
Other .....	1,023.43	810.90	2,250.41
Total .....	224,757.97	268,702.77	343,651.33
Appropriation account:			
Appropriated .....	772,160.00	735,925.00	598,820.00
Allotted by the Emergency Board .....		41,800.00	29,682.33
Reduction by the Emergency Board .....		(47,500.00)	
Brought forward for equipment .....	10,264.65	107,215.08	26,536.29
Total .....	782,424.65	837,440.08	655,038.62

## MISCELLANEOUS ACCOUNTS (1922).

Item.	Available.	Expended.	Balance.
	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
Construction of Serum Laboratory, Act No. 2786 .....	8,084.16	6,683.61 <sup>a</sup>	1,400.55
Publicity service for the Philippine Food Commission (allotted by the Emergency Board).....	1,738.80		1,738.80
Total .....	9,822.96	6,683.61	3,139.35

<sup>a</sup> Includes ₱1,330.68 reverted during the year.

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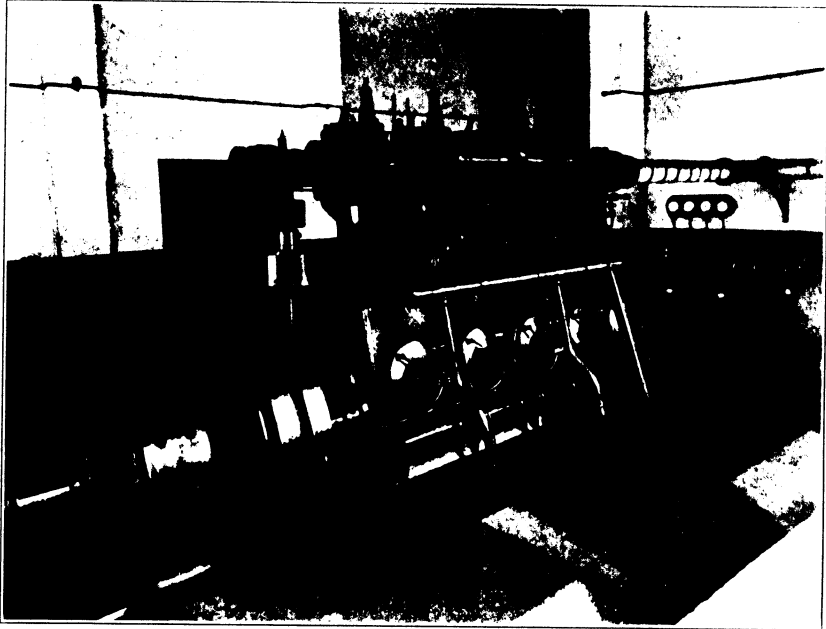


Fig. 1. The new 180-horsepower Busch-Sulzer Diesel engine and the new 120-kilowatt dynamo.

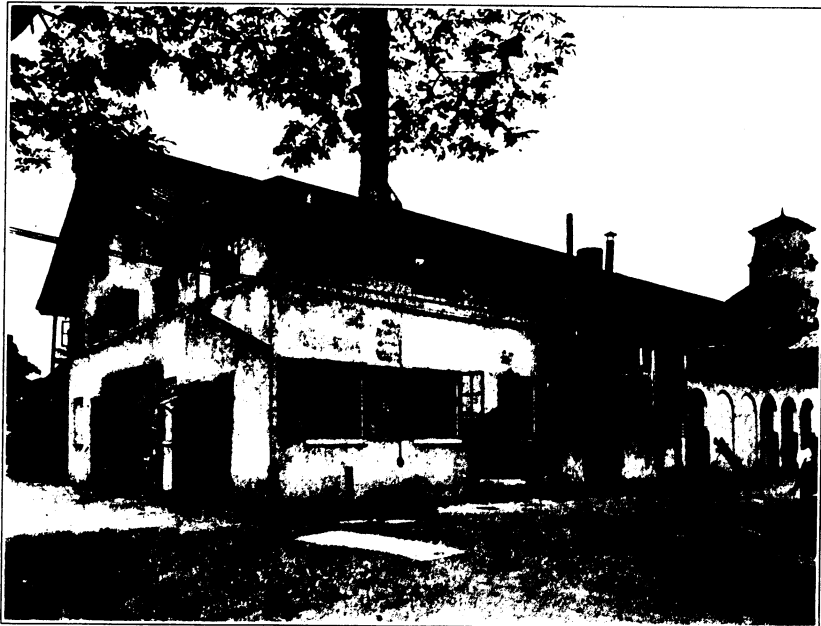


Fig. 2. The Bureau of Science power house; the nearest corner was rebuilt to house the new Diesel oil engine and dynamo.



PHILIPPINE BUREAU OF  
SCIENCE REPORTS

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# TWENTY-FOURTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

## PHILIPPINE ISLANDS

INCLUDING A SUMMARY OF  
TWENTY-SECOND AND TWENTY-THIRD  
ANNUAL REPORTS

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

WM. H. BROWN

DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1925



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## TWENTY-FOURTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE.

MANILA, *December 31, 1925.*

SIR: I have the honor to submit the following report of the Bureau of Science covering the fiscal and calendar year 1925.

During the year 1925 the activities of the Bureau of Science, from the standpoints of routine, research, and coöperation with other entities, have been greatly increased, and great improvements have been made in the material condition of the plant. More routine work was done for the Government and for private individuals than in any previous year, and the income exceeded that of any past year.

Among the outstanding achievements of the Bureau in the way of routine was the production during the last four months of the year of sufficient cholera vaccine to vaccinate 3,000,000 people. During the year we furnished free of charge 46,120 bottles of tikitiki extract for the cure of infantile beriberi.

### EXPENDITURES, INCOME, AND FREE WORK

The expenditures for the year 1925 were ₱633,730.93. The cash income amounted to ₱388,697.76, while free work to the value of ₱1,472,870.64 was done for other Government entities. The cash income and the value of the free work amounted to ₱1,861,568.40. Subtracting from this total the expenditures of the Bureau leaves a balance of ₱1,228,837.47, which represents the actual profit to the Philippine Government of operating the Bureau of Science. The actual cost to the Government is the amount expended, ₱633,730.93, minus the actual income, ₱388,697.76, leaving ₱245,033.17, for which the Bureau did ₱1,472,870.64 worth of free work, or ₱6.01 worth for each peso expended by the Government.

The income for the year was ₱38,401.81 greater than in 1924, and the expenditures were increased by only ₱13,209.72. The amount of free work for other Government entities was increased over that for 1924 by ₱665,547.44. This increase was largely due to the fact that the Bureau supplied the Philippine Health Service with ₱581,782 worth of vaccines free of charge. Most of the vaccine was used in the campaign against cholera.

In addition to the free work mentioned above, the Bureau of Science gave at the Bureau a total of 938 Pasteur antirabic treatments, valued at ₱4,690, and sent to the provinces 875 treatments, valued at ₱4,375, or a total of ₱9,065. Each treatment consists of twenty-five injections, one daily.

Again, in addition to the free work mentioned above, the Bureau of Science determined free of charge for other Government entities and private parties innumerable specimens of plants, insects, rocks and minerals, and other materials, besides entering into numerous consultations and minor researches for the promotion of Government and private interests.

In the above description of the returns that the Bureau of Science makes to the Government, no mention has been made of the very valuable research undertaken and published in the Philippine Journal of Science which has been of great value both to the Government and to private interests and in the promotion of health conditions in the Archipelago as well as in increasing scientific knowledge.

Tables showing in detail the income and expenses of the Bureau and the work performed are given at the end of this report. Table 1 shows the amount of routine work performed and supplies manufactured and disposed of during the fiscal year 1925 as compared with that for the fiscal year 1924 by number or quantity and by value, arranged by subdivisions of the Bureau of Science. Table 2 gives similar data arranged according to the entities for which the work was performed. Table 3 is a comparative statement showing expenditures and income during the fiscal year as compared with the fiscal years 1923 and 1924.

#### RESEARCH

The amount of research turned out and published has been increased so much that it has been necessary to issue the Philippine Journal of Science in three volumes for the year instead of in two as heretofore. The Bureau of Science publications reach all parts of the world and give it greatest reputation in

foreign countries. Among the outstanding accomplishments along research lines during the year are the following:

#### Biology.

Investigation of bacillary dysentery, including serological grouping of various strains of *Bacillus dysenteriae*; study of the constancy of the types of *B. dysenteriae*; study of qualitative antigenic properties of various strains of *B. dysenteriae* with the view to explaining the serologic grouping and selecting the most suitable for the production of superior antidysenteric serum.

Study of pathogenesis of pneumococcic pneumonia in Philippine monkeys with the view to determining the pathogenesis of pneumonia in man.

Study of infection, superinfection, and immunity to yaws in experimental animals and comparative study of therapy in this disease by various drugs and preparations.

Serologic studies on patients receiving the Pasteur treatment. Experimental study with the view to detecting certain factors that influence the results of serologic reactions.

Experimental proof of the independence from each other of some serologic reactions.

#### Botany.

Pharmacological study of *Chenopodium* (*Chenopodium ambrosioides*) and *dita* (*Alstonia scholaris*).

Study of the chemically active principles of *Artobotrys suaveolens*, *Grewia erecta*, and *Gymnema tingens*.

#### General zoölogy.

A monograph of the pachyrrynchid group of the Brachyderinæ, Curculionidæ.

*Macroxenos piercei* (Strepsiptera) a new genus and species of wasp parasites of the Philippine Islands.

New and rare Philippine Lepidoptera.

#### Fisheries.

Taxonomic studies of various groups of Philippine fishes, particularly monographs of the Pomacentridæ and Gobiidæ.

#### Inorganic chemistry.

Study of Philippine sands, gravels, and rocks as building aggregates.

Results of paint exposure tests.

Comparative service tests of various imported coals used for locomotives.

Surface tests of lubricants.

Volumetric determination of silver in silver and copper alloys.

#### Soils and fertilizers.

Chemical properties of Philippine guano.

The nitrifying power of Philippine soils in relation to bacteria in the fermentation of tobacco.

**Organic chemistry.**

Study of the by-products of the coconut-oil industry, particularly the waste products from the hydrogenation of coconut oil.

Study of the chemical aspects of various classes of rice.

Investigation in canning and preservation of Philippine fruits and vegetables.

**Geology and mines.**

Geological reconnaissance of Zambales.

Geological reconnaissance of Surigao.

Detailed geological survey of the Angat-Novaliches region.

Contributions to Philippine petrography.

Philippine gold placers.

**COOPERATION***United States Army Medical Department Research Board.*—

During the year 1925 the United States Army Medical Department Research Board continued to occupy quarters in the Bureau of Science. After completing his work on dengue fever, Col. J. F. Siler left the Islands. Maj. A. P. Hitchens was assigned as medical adviser to the Office of the Governor-General, after which the amount of the work which he could do in the Bureau was greatly lessened.

The outstanding accomplishment of the year was the completion of the study of dengue fever in all its phases by Col. J. F. Siler, Maj. Milton W. Hall, and Maj. A. P. Hitchens. This is an exceedingly valuable and extensive research which has contributed much to our knowledge of the disease. The results will be published in the January-February number of the Philippine Journal of Science. Since the preparation of this paper Major Hall has continued his search for the causative agent.

Late in the year Col. E. B. Vedder arrived as the senior member of the Board. He has commenced work on beriberi and on the transmission of leprosy, and results so far obtained are very promising.

Capt. R. A. Kelser, of the Veterinary Corps, has been trying new methods of treatment of epidemic lymphangitis, and it is believed that a treatment will be developed that will greatly shorten the period of disability caused by this infection. Captain Kelser has also been investigating the method of transmission of surra, and the results of this work are also most encouraging.

*Rockefeller Foundation.*—Dr. G. R. Lacy, assistant to the Director, finished his work and left early in the year. No one has as yet been appointed to succeed him.

The Bureau of Agriculture has continued to assign men to work in the Bureau of Science on plant diseases. A number of problems have been investigated, and an interesting paper has been prepared on the deterioration of Manila hemp due to mold action.

#### INDUSTRIAL FELLOWSHIPS

The most important fellowship work done during the past year has been in connection with industrial fellowship No. 12 with the Cordage Institute and industrial fellowship No. 15 with the Manila Railroad Company.

*Cordage Institute fellowship.*—Work was begun under the Cordage Institute fellowship in March and after a study of the situation it was decided to concentrate the first investigations on the causes of and possible remedies for weak fiber, which has been gradually increasing here during the past few years and, unless eliminated or at least held down to a possible minimum, threatens seriously to impair the high position held by Manila hemp (abacá) as the premier cordage fiber of the world—a monopoly of the Philippine Islands. Dr. P. L. Sherman, on account of his excellent training and his great familiarity with Philippine problems, was selected to carry on this work.

The first four months were devoted to collecting all available data on deteriorated, weak, and perished fiber, its principal place of origin, physical and chemical characteristics, behavior on storage, etc. In as much as the largest part of this inferior fiber was found to come from the Bicol provinces the next three months were spent in making a canvas of that district with the object of studying at first hand the districts of fiber production; the species and varieties of plants from which the fiber was derived; and the methods of its manufacture, transportation, and storage. During this period also soils, fibers, and botanical specimens were collected, so that physical, chemical, and botanical examinations could be made on authentic material.

Little chemical or botanical work has been done on Manila hemp, and the laboratory field of research on this subject is very large and complicated; consequently, the work is far from completion, but the following summary shows what has been accomplished and along what lines further work will proceed.

The fibers commercially known under the name of "Manila hemp" are made to contain, knowingly or otherwise, fibers of certain hybrid species or varieties resulting from the crossing of true abacá (*Musa textilis*) with varieties of banana, all of

them having weaker fiber than true abacá, as is shown by the hundreds of tensile-strength tests made on the collected material.

Owing to lack of labor and facilities for the proper production, drying, and storage of the fiber, large quantities are allowed to ferment while still fresh; the chemical and biochemical work done on this material has shown the presence of products of fermentation that not only cause deterioration in color and a dissolving and hence weakening of the fiber itself, but also prepare food for molds and other fungi to complete the subsequent work of destruction.

The physical and chemical analyses made of representative samples of surface soil from the various districts of the Bicol provinces which have been under hemp cultivation for the last hundred years, more or less, mark the beginning in the collection of the necessary data to establish the characteristics of typical abacá soil as compared with sugar and coco soils. The results of these soil analyses show the Bicol hemp areas to be exceedingly rich in humus and other plant foods; this is due to the fact that 95 per cent of the crop is returned to the soil, as neither cultivation nor fertilization has ever been attempted.

The investigations conducted with the view to improving the quality and quantity of fiber produced from the Bicol region show that the areas under crop are diminishing rather than increasing; that with very few exceptions the methods used in harvesting, stripping, drying, and storing the fiber are antiquated and require much improvement if any advancement in quality of fiber is to be made; that in the marketing, inspecting, and grading of the fiber there are many abuses and malpractices which must be completely abated if Government grades and commercial house marks are to be guaranteed without much loss to everyone; that lack of fair dealing and coöperation between the various commercial interests engaged in the abacá industry is responsible for much of the trouble now in evidence; and that a thorough overhauling of the methods and management of this industry is strongly indicated.

Although this is one of the most valuable Philippine industries, one that ranks high in the industries of the world, it has few or almost no by-products to give it added value and profits. This fact has been kept in view while the chemical investigations have been in progress and, although it is too soon to make any statement as to progress and results, it can be authoritatively stated that the by-products are there.



*Manila Railroad fellowship.*—In accordance with an agreement entered into by and between the Director of the Bureau of Science and the Manager of the Manila Railroad Company, and approved by the Honorable the Secretary of Agriculture and Natural Resources, industrial fellowship No. 15 was created and Dr. T. Dar Juan began work under this agreement on July 16, 1925. Several experiments and practical tests were conducted on a few classes of the most important materials and supplies used daily by the company, such as water for boiler purposes, fuels, lubricants, and paints. The following is an outline of the work done:

Samples of water from all the watering stations along the various lines of the company were examined and analyzed to determine their suitability for boiler uses. The Manila Railroad Company has now a complete record of the quality of these waters. A boiler compound has been prepared and is being tested.

Laboratory analyses and steaming tests of various coals available in the local market were made to determine their relative fuel value and to ascertain their storing properties and the quality of coal best suited for the different types of engine owned by the company. In order to facilitate unloading of coal delivered to certain coaling stations of the company, the relation between volume and weight of various coals of known mechanical analysis has also been determined. Many analyses and actual service tests of lubricants were made.

Paints of known composition are being prepared for a study of the effect of weather and other conditions under which they are being used by the company.

#### AQUARIUM

As in past years, the Bureau of Science continued to operate the Aquarium in the bastion of Real Gate of the Walled City where a considerable variety of interesting and curious fishes and other marine animals are displayed for the benefit of the public and tourists. During the year there were 17,435 paid admissions, 2,801 free admissions to elementary students, and 580 half-fee admissions to high-school students. The continued interest in the Aquarium is shown by the fact that there was an increase in the income of ₱407.03 over that of the preceding year, while the number of free admissions was increased by 813, and of half-fee admissions by 250. The expenditures were decreased by ₱249.47.

## HOME CANNING AND FOOD PRESERVATION

The division of organic chemistry has done excellent work in the preparation of simple recipes for home canning and preservation of Philippine fruits and vegetables. The work of popularizing this activity was begun at the Carnival of 1925 when the Bureau of Science had an exhibit and distributed pamphlets giving recipes. After the Carnival the work was continued by instruction to housewives at the Bureau of Science. Many ladies were instructed in the art of canning and they have made good progress in canning and in instructing others. The Legislature in 1925 appropriated the sum of ₱15,000 for the extension of this work. It is planned to have extensive exhibits in the Philippine Carnival of 1926 and to prepare a publication which will make recipes available to the general public. After the Carnival demonstrators will be sent to various provincial towns.

## IMPROVEMENTS

At the beginning of the year the Bureau of Science plant had become so crowded that room was not available for much urgently needed work. Considerable improvement in this direction was made by the repair of the old animal house, so that it provided eight good laboratory rooms. The animal house had reached such a stage of dilapidation that it was practically unserviceable for any purpose. The conversion of this old building into a well-equipped laboratory allowed us to bring the portion of the inorganic chemistry division which was in the main building to the six rooms which were nearest to the cement-testing laboratory. This concentrated the division of inorganic chemistry. The section of entomology was also moved from the main building into the repaired building. This had the advantage of putting the valuable entomological collections in fire-proof quarters and providing the entomological work with greatly needed additional space. This shifting allowed us to concentrate the biological laboratories which were in three separate locations in the main building, and also to put all the storerooms together. The division of organic chemistry and the division of soils and fertilizers were given additional space.

The old shed back of the engineering division, which was used as a coal shed and carpenters' shop, was in an exceedingly dilapidated condition. This was so remodeled as to furnish an excellent coal bin, a room for grinding coal and other ma-

terials, space for the circular saw, and excellent quarters for carpentry work.

All of the animals were removed from near the main building and placed in much more sanitary quarters in sheds in the far corner of the Bureau of Science grounds.

#### PERSONNEL

The most important changes in the personnel took place in the division of general, inorganic, and physical chemistry. Dr. T. Dar Juan, chief of the division, resigned on July 15 to accept appointment as fellow in the Bureau in connection with industrial fellowship No. 15 with the Manila Railroad Company. Mr. F. D. Reyes was appointed chief of the division to succeed him. Dr. V. G. Lava, physical chemist, resigned on October 15 to accept appointment in the College of Agriculture, and Mr. Jose C. Espinosa was reinstated in the service to take over the work of Dr. Lava. Messrs. Gil Opiana, Salvador del Mundo, and Feliciano Roque were appointed assistant chemists in this division.

Dr. H. Elliot Foote, in charge of the vegetable-oil work in the division of organic chemistry, resigned on June 1 and Mr. Ramon Feliciano was appointed to take his place. Late in the year Dr. A. J. Hermano arrived from the United States to take charge of drug analyses.

Mr. José R. Montilla was added to the scientific staff of the division of fisheries.

#### BIOLOGY AND SERUM LABORATORY

*Personnel.*—Dr. G. R. Lacy, who was assigned to this laboratory by the Rockefeller Foundation for some time, left for the United States. Besides much valuable advice with respect to the performance of routine work, particularly on typhoid fever, Doctor Lacy during his sojourn in the Philippines conducted investigations as to the source of typhoid infection in Manila. Furthermore, he contributed to the knowledge of dysentery bacilli by serologically grouping various strains of the Shiga type of *B. dysenterix* with monovalent serum. Dr. A. W. Sellards, of the Harvard Medical School, also left during the year, having worked for a year on various phases of the problem of yaws in the Philippines. A rather extensive piece of experimental work has been accomplished by him in coöperation with the chief of the division on experimental pneumococcus pneumonia in Philippine monkeys.

The division of biology and serum laboratory has been partly reorganized. The fact that all members of the staff of this division and their offices are now on one floor makes the coöperation of the members and the supervision of the junior personnel much easier. The investigation on bacillary dysentery has been continued, and some of the results have been published.

Maj. K. Morishima, who was assigned by the War Department of the Imperial Japanese Government to study tropical diseases at the Bureau of Science, returned to Japan at the end of his term. The result of his work on the constancy of types of *B. dysenterix* has been presented for publication. In his stead, arrangements having been made by the Japanese Government through the Office of the Governor-General of the Philippine Islands, Lieut. Surgeon K. Yasuyama arrived to pursue studies in tropical medicine at the Bureau of Science. The progress of his studies has been reported in the semiannual report forwarded through the Governor-General's Office to the Navy Department of the Imperial Japanese Government.

The chief of the division was recommended by the Director of Science and appointed by the Governor-General as an official delegate to the Sixth Congress of the Far Eastern Association for Tropical Medicine, where valuable interchange of ideas and experience with men from other tropical and subtropical countries was had.

Experimental work on bacillary dysentery has been going on directed by the chief in coöperation with the other members of the division. The most striking finding was that arrived at by experimental qualitative antigen analysis of a large number of strains of *B. dysenterix*. These findings have explained not only the serologic grouping as found by Doctor Lacy, but also the superior quality of the dysenteric serum which is being prepared at the Bureau of Science by the use of selected dysentery cultures, the qualitative antigen property of which has been thoroughly investigated and become known. Besides the work on bacillary dysentery, experimental work on yaws has been carried on, first, jointly with Doctor Sellards and Doctor Lacy and other members of the staff of the division on human beings; then studies, particularly concerning immunity and superinfection, were continued by Doctor Schöbl with the help of the junior staff. The disease as it presents itself in Philippine monkeys has been studied. The anatomical regions favorable for transmission of the disease to animals were considered.

This study brings out a very interesting point in that it explains certain phases of the disease as it occurs in human beings. At least five or six of the various clinical presentations known or suspected to be due to yaws in human beings have been reproduced in experimental animals. Not only primary yaws but generalized yaws, various forms of frambœsides, and tertiary lesions have been produced in animals by special arrangement of experimentation. The etiology of a disease known in the tropics as "gangosa" has been definitely settled, as this disease was produced by inoculation of yaws into experimental animals.

*Provincial laboratories.*—Great improvement has been made in the provincial laboratories, particularly in the laboratory in Cebu. It has been the policy to put experienced and senior members of the staff in charge of these laboratories. It was possible to do this at the laboratory in Cebu during the past year. The laboratory in Iloilo made a very good showing during the year, rendering services both to the Government and to private parties.

*Serum laboratory.*—The serum laboratory as in the past has been engaged in the production of standard and reliable products. The policy has been and will be to refrain from preparing spectacular biologic products that await even the experimental stage. The greatest bulk of the work was, therefore, as in the past, the preparation of smallpox vaccine, anti-dysenteric serum, typhoid vaccine, and cholera vaccine. The amount of cholera vaccine produced in the second half of the year is unprecedented in the history of this laboratory or of any laboratory of its size. In the last four months of the year enough vaccine was produced to vaccinate 3,000,000 people against cholera.

#### BOTANY

The number of plants collected has not been so large as in previous years because the common and well-identified plants have been neglected and the efforts of the collectors have been directed to finding new and rare species. The identification of the collections is intrusted to Mr. Elmer D. Merrill. The commoner plants as well as the botanical specimens that are received from other Government bureaus and from private persons are identified by Doctor Guerrero, who also answers questions relating to the economic or therapeutic properties of plants.

The Bureau of Forestry continues sending to this Bureau specimens that are collected by its rangers.

Mr. Merrill has published in the Philippine Journal of Science descriptions of new species, not only from the collections made in the Philippines but also from the collections made in Borneo by Mr. A. D. E. Elmer.

Botanical specimens collected in the Islands during 1925 are as follows:

Mount Pulog, Benguet .....	294
Casiguran .....	676
Palawan (McGregor) .....	73
Capiz .....	364
Mindoro .....	133
Baguio and Taal (Wells and Lopez) .....	13
Various parts (Clemens) .....	200
Baguio (McClure) .....	223
Various localities (Bureau of Forestry).....	239
	<hr/>
Total .....	2,215
	<hr/>
Phanerogams .....	1,965
Cryptogams .....	250

Plant specimens were received from the Malay Peninsula, Strassburg, India, Buitenzorg, Rotterdam, etc.

The section of medicinal, poisonous, and economic plants has obtained or collected many species during the year, and among them appear various poisonous ones.

Dr. Jose K. Santos, attached to the division of botany, aside from the ordinary routine work, has devoted part of his time to making histologic studies of Philippine drugs. His paper on the localization and distribution of the secretory glands of the essential oil of *Chenopodium ambrosioides* is an important piece of work because it disproves the belief that only fruits are to be used in the extraction of the volatile oil used in therapeutics as a vermifuge remedy. Not less worthy is the correction of the deficient and erroneous interpretation of several authors in the histological description of the bark of *dita* (*Alstonia scholaris*).

Dr. Joaquin Marañon, biochemist assigned to the section of medicinal and poisonous plants, has begun a series of analytical tests to determine accurately the active principles of some drugs not yet chemically studied, such as those derived from *Artabotrys suaveolens*, *Rourea erecta*, *Gymnema tingens*, and other plants which have been previously investigated rather incompletely and with doubtful results.

*Plant diseases.*—Mr. F. B. Serrano has conducted field and laboratory experiments on heart rot and root rot of abacá and has studied the deterioration of abacá (Manila hemp). A paper on the latter subject was completed. Minor problems investigated and work done by Mr. Serrano are isolation and inoculation of fungi from diseased papaya fruits, isolation of a fungus of the genus *Nectria* from ornamental plants, spraying for the control of coconut blight, isolation of a *Colletotrichum* from atis (*Anona squamosa*), making histological preparations from specimens of diseased abacá, isolation and inoculation of two new diseases of agave, and isolation of a fungus (*Helminthosporium*) from henequen hemp. Mr. Clara has continued his study of a tobacco disease in La Union; the organism responsible for the trouble seems to be *Fusarium oxysporum*. Minor problems undertaken by Mr. Clara are a fungus disease of santol seedlings, apparently a species of *Phytophthora*, and the isolation of the organism causing the anthracnose disease of mango fruits.

#### GENERAL ZOOLOGY

A large collection of natural-history specimens, especially birds, was made in Palawan during August to November, and a small collection was made at Balete Pass, Luzon. Some progress was made in the identification of old collections and in the preparation of illustrations of birds. Numerous orders for routine taxidermic work were executed. Much of the time of the chief was expended on the copy for Bureau publications and in routine office work.

The investigations of the locust problem in the Philippine Islands, particularly with reference to endemic breeding places, were continued. Experiments on a small scale in broadcasting ipil-ipil seeds on cogon lands were carried on and demonstrated to be successful. It was recommended that the Bureau of Agriculture make experiments on a large scale by means of aëroplanes, but due to lack of funds these experiments could not be carried out.

Extensive experiments in breeding injurious boring beetles were carried on during the whole year and many new and unreported species were collected as well as data referring to their host plants. The material was mounted and labeled, and a large part of it was forwarded to specialists for determination. General entomological collecting, during which spe-

cial attention was given to the more injurious insects, was carried on during field trips to the following places:

Benguet and region of Mount Pulog, Mountain Province, February 13 to March 20; mountains near Casiguran, April 24 to June 27; Mount Banahao, Laguna region, July and August; Cebu (ten days); Sibulan, Lake Dako, Oriental Negros (sixteen days); Siquijor, August 13 to October 5. Short trips were taken for the collection of white ants, or termites, and several parasites were found with these insects. Many wood specimens infected with wood-boring beetles were obtained in the Lake Naujan and Puerto Galera region, Mindoro, November 17 to December 21. Many of the insects collected during the above-mentioned trips were mounted and labeled and added to the entomological collection.

During the year, fifty-two entomological papers, by many authors, were published in the Philippine Journal of Science, and some of these papers are based on Bureau of Science specimens. The following papers were published by Mr. Schultze during the year: A monograph of the pachrrynchid group of the Brachyderinæ, Curculionidæ, Part III; *Macroxenos piercei* (Strepsiptera), a new genus and species of wasp parasite of the Philippine Islands; New and rare Philippine Lepidoptera.

#### FISHERIES

On January 1, Mr. Montalban reported for duty from Formosa. On January 8, Doctor Herre, Mr. Montalban, Mr. Lopez, and Mr. Bravo went to Baguio to secure a shipment of black bass which they took to Lake Lanao, Mindanao, where the bass were planted in a tributary of the lake. If these fish become established they will add a very valuable and much-needed food fish to that region. The latter part of March Doctor Herre and Mr. Lopez proceeded to Canton, China, and from thence into the interior, where a shipment of carp was secured. These carp were placed in the new pond on the Bureau of Science grounds, and a sufficient number of them have lived and thrived to warrant the belief that in another year we shall have quantities of carp for distribution. Both these trips were made under considerable difficulties and involved an enormous amount of hard work, carried on almost continuously day and night while conveying fish. On the return trip from Lanao, Mr. Montalban spent many weeks in investigating the importance of the sardine industry at Estancia, Iloilo Province, and the general



fishery conditions in Iloilo, Capiz, and Antique Provinces. As a result of his labors we have a much better grasp of the situation and the steps necessary to improve the catch of fish and its preservation. Mr. Montalban also made an extensive trip through the eastern Visayas with a Japanese motor-boat crew, obtaining from them several hundred pesos worth of free transportation and an excellent knowledge of their valuable methods of fishing. Mr. Montalban revisited Panay during the rainy season and made further valuable collections and studies of conditions at Estancia and received more transportation from the Japanese. In May Doctor Herre and Mr. Lopez made a brief trip to Tacloban, Leyte, the adjacent part of Samar, and the north-central part of Leyte. From August 15 to September 26 Doctor Herre was on the lighthouse tender *Corregidor*, visiting the Visayas, Sulu Islands, Balabac, Palawan, and southeastern Luzon as far north as Polillo. On this voyage he visited important points not touched ordinarily by commercial vessels. He was accompanied by Mr. Bravo who made many colored sketches.

The division personnel was increased by the accession of Mr. Jose Montilla, a graduate of the College of Fisheries, Seattle, Washington. The latter part of the summer was spent by him in investigating Manila Bay fisheries, particularly the baños industry of Rizal, Bulacan, Pampanga, and Bataan Provinces, the Japanese beam trawlers of Manila Bay, and the coast fisheries between Manila and Cavite. As a result we have a clearer idea and greater knowledge of the very important Manila Bay fisheries than before. During the same period Mr. Lopez made a prolonged trip with Japanese motor-boat fishermen to the islands northwest of Mindoro, and later he visited the route traversed by Jagor in Bulacan Province and collected fishes of the Angat and Quangua River basins. Later he made a trip to Taal Lake. During November and December a hasty survey was made by Mr. Montalban and Mr. Montilla of the ipon industry of the Ilocano provinces and Cagayan Valley. Mr. Montalban visited points from Abra River to Alaminos, Pangasinan, and after two weeks in the field returned to Manila. Mr. Montilla proceeded to Laoag and then to Aparri, not returning until late in December. Much valuable information was obtained throwing light on the life history of the ipon and upon the lax way the fish regulations are enforced in many localities. The ipon industry in Abra River is worth ₱300,000 or more

annually, and if this industry is to be saved we must expend far more study upon its problems.

During all these trips an enormous amount of material was secured bearing upon studies of the gobies and the ipon industry. The problem, which seemed small at first, has grown enormously. Maximo Ramos collected valuable specimens in Zambales and near Casiguran. From Dr. J. W. Chapman, Silliman Institute, two consignments of specimens of the greatest rarity and scientific interest were received. From Major Johnson, provincial governor of Lanao, and Mr. Walkup, of the Bureau of Lands, a valuable series of Lake Lanao fishes was received. Two large consignments of reptiles and fishes were received from the authorities of British North Borneo. These were determined and are now being returned, the Bureau of Science retaining for its collection such specimens as seem necessary. The authorities in Borneo have promised to send us a full representative collection of their fishes.

Several papers by Doctor Herre were published in the Philippine Journal of Science. Doctor Herre and Mr. Montalban spent much time in the preparation of various papers dealing with Philippine fishes. Mr. Montalban's review of the Pomacentridæ and Doctor Herre's of the Gobiidæ are the most complete and most important studies ever made of these groups. Doctor Herre and Mr. Montalban have also prepared papers upon the Chætodontidæ, or butterfly fishes, the catfishes, and the Hepatidæ, or tangs. This division now has three young men working as artists; they are doing very satisfactory work and deserve great credit for what they have done. Mr. Montilla has been devoting much of his time while in Manila to the study of the Aquarium and improvement in feeding conditions. The Aquarium greatly needs overhauling. The old distributing tank is leaky and likely to fail at any time. The exhibition tanks are too small for showing large fishes or flat fishes, and are of very poor design. The need for the construction of more and better tanks is urgent. The exhibit could be vastly improved with practically no additional expense for operating it. Two trips were made to Calapan for the purpose of obtaining Aquarium specimens, one just before the Carnival and the other in November.

The fisheries collection has grown enormously in the past year, and it takes practically the entire time of one person to enter upon the record and properly label the accessions.

## INORGANIC CHEMISTRY

*Personnel.*—Mr. Gil Opiana, formerly instructor in the College of Agriculture in Los Baños, was appointed assistant chemist on January 3. Dr. T. Dar Juan, former chief of the division, resigned on July 15 to be a fellow in industrial fellowship No. 15. Mr. F. D. Reyes was appointed chief of division on July 16. On October 6, Mr. Jose C. Espinosa was reinstated in the service to take over the work of Dr. V. G. Lava who resigned on October 15 to accept an appointment in the College of Agriculture in Los Baños. On October 16 Mr. Salvador del Mundo, formerly instructor of the College of Liberal Arts, and Mr. Feliciano Roque, a graduate in chemical engineering from the State University of Minnesota, were given temporary appointments as assistant chemists.

*Cement laboratory.*—An important activity of the cement laboratory is the physical and chemical testing of the cements used in construction work by or for the Insular, provincial, or municipal governments. In addition to the testing of cement, the different classes of sand and gravel available near the locality of the proposed construction are tested to determine which available materials are best suited to the work. The quality of the resulting concrete is likewise determined by testing the crushing strength of concrete specimens taken at the place of construction by Government inspectors, in order to ascertain if the different ingredients have been properly mixed and in the proportions called for. The Bureau of Science has certainly been instrumental in improving not only the quality of the cement offered in the Philippines but also the quality of concrete made throughout the Islands. In 1924 the number of specimens tested was 15,345, and in 1925 it was 17,263.

*Fuel analyses.*—Coal sampled and analyzed amounted to 99,064 tons which was about 10,000 tons less than the previous year; this includes 69,320 tons for the Manila Railroad Company and 29,774 tons for the Bureau of Supply. The penalties imposed for delivering coal below the guaranteed standard amounted to ₱14,153. In addition to the above, coal and other fuels were tested for private firms and individuals.

*Water and mineral analyses.*—Approximately the same amount of routine work has been accomplished this year as in previous years. Some work of an industrial nature performed during the year deserves special mention, such as (a) the comparative tests made on the effect of turpentine and its substitute (known

in the market as mineral turpentine) on the drying qualities, strength, and weather-resisting properties of paints, with which they are generally incorporated; (b) a rapid and economical method of clarifying, for boiler purposes, turbid river water, containing very fine silt in suspension. Assistance was also rendered the Bureau of Health in its efforts to solve hygienic and sanitary problems.

*Investigation work.*—Due to an increase in personnel more time was available for the senior members to conduct investigation work.

An article entitled The purchase of coal under specification by the Philippine Government was recently completed. The following articles are now being prepared for publication:

Philippine sand, gravel, and crushed rock as concrete aggregates.

This work is a compilation of the most reliable data on Philippine concrete aggregates which have been tested in the Bureau of Science for the last fifteen years. The results of tests are discussed from both the theoretical and the practical points of view. The aim is to give the public, particularly engineers and contractors, reliable information on the suitability of the sand and gravel deposits of the different provinces of the Philippine Islands.

Results of paint-exposure tests. In this work, the protecting qualities and resistance of paints, especially commercial ready-mixed paint, under Philippine weather conditions, are presented and discussed.

Comparative service tests of various imported coals as fuels for locomotives. This work was carried out in coöperation with the Manila Railroad Company during 1924 and 1925.

Service tests of lubricants.

The volumetric determination of silver in silver-copper alloys.

#### SOILS AND FERTILIZERS

*Personnel.*—Considerable difficulty has been encountered in securing adequate personnel for this division, especially for the enforcement of the fertilizer law and for investigations. The division has been fortunate in securing the services of Mr. E. del Prado, assigned temporarily as chemist and fertilizer inspector at Iloilo during the sugar season. His salary is paid by the Philippine National Bank. Through the courtesy of the Bureau of Agriculture, it has heretofore been possible to employ the plant inspector at Iloilo to serve as fertilizer inspector during the year. However, owing to the large amount of inspection for plant diseases, it is rather difficult for one man to do the work of the two positions during the period when the fertilizer business

is brisk. It will always be necessary to have one man definitely assigned for fertilizer inspection during the sugar season. The other members of the division continue as during last year.

*Routine.*—The routine work of the division continues to increase in view of the demand for fertilizer and a greater desire to know soil conditions or the purpose of improving the productive capacity of the lands. In spite of the shortage of personnel a large volume of work was accomplished due to the interest and the spirit of coöperation among the members of the division.

*Commercial fertilizers.*—In connection with the enforcement of the fertilizer law every effort is being made to place the fertilizer business upon a solid and properly regulated basis. During the year just closed about 30,000 tons of fertilizer were used, valued at approximately three and one-half million pesos. The use of fertilizer for the sugar industry is well established so that a steady demand is bound to take place every year. Considerable pioneer work is also being done in the use of fertilizer for rice growing. Some tests have indicated that the farmers obtain from 100 to 200 per cent increase with the use of fertilizer, and it is to be expected that its use for rice growing will increase. Since the enforcement of the fertilizer law about forty-six brands of fertilizers have been registered and every effort has been made, with the limited means at the Bureau's command, to meet the necessary inspection work in order that the fertilizer consumer may be protected. The personnel at present is inadequate to carry out fully the fertilizer-control work.

*Insecticide and fungicide control.*—The chemical control work on insecticides and fungicides is at present limited, in view of the fact that the farmers are not familiar with the use of chemical sprays for insect pests and fungous diseases. However, some samples have been received indicating that there is some attempt to introduce this material to combat plant enemies. As the farmers become familiar with combatting plant diseases, a larger increase in the amount of work in insecticide and fungicide materials can be expected.

*Galvanized iron roofing.*—Galvanized iron continues to be the principal roofing material for permanent and semipermanent buildings. As recommended last year the suggestion is made that manufacturers be required to stamp on each sheet of galvanized iron the brand, the name of manufacturer, the gauge of sheet, and the amount of zinc coating. Most of the manufac-

turers already have the brand stamped on the sheet. The gauge and the amount of zinc coating should be stamped, in order that the buyer may know readily the kind of galvanized sheet he is buying. This would greatly reduce the practice of mixing galvanized sheets indiscriminately for fraudulent purposes.

*Coöperation with fertilizer factories.*—From time to time this division has been called upon to render technical service to some of the local factories engaged in the manufacture of fertilizer. The guano exploitation has grown hand in hand with the local fertilizer industry. This division has helped foster the use of guano to a large extent by indicating its method of exploitation and its utilization by proper mixing with chemical ingredients. In the sale of guano the price is dependent upon the analysis of this laboratory and effective service has been rendered in umpire work so as to give adequate valuation to local fertilizer materials. On several occasions controversies on the superiority of one class of fertilizer over another have been presented for information and settlement.

*Coöperation with the National Bank.*—The Philippine National Bank, under which a number of sugar centrals are administered, has frequently called upon this division to help in the preparation of specifications for fertilizers to be supplied to the hacenderos. Recently an arrangement was made, as indicated elsewhere in this report, by which the fertilizer inspector stationed at Iloilo is paid by the bank to collect samples for chemical control of this division. Furthermore, all fertilizers supplied to the hacenderos who purchase through the crop loan office of the National Bank must be analyzed by the Bureau of Science, and a penalty is imposed in case the fertilizers supplied do not conform to the guaranteed composition. In view of the fact that the fertilizer purchased through this channel will likely amount to one and a half million pesos in value, the services rendered in protecting the hacenderos is of considerable value.

*Coöperation with the Bureau of Agriculture and other entities.*—This division is in close touch with the experimental work of the Bureau of Agriculture. For that Bureau many soils and fertilizers are analyzed, fibers are classified with respect to moisture content, and soils are analyzed to determine the cause of abacá and other economic-plant diseases. Analyses of soils have been made for the Bureau of Forestry in connec-

tion with some of its exploration work in distant sections of the Islands, and for the industrial fellowship connected with the investigation of abacá deterioration.

*Investigations.*—In spite of the large volume of routine work to be done some papers have been completed while others are still under way, as follows:

The chemical properties of Philippine guanos. Completed.

The nitrifying power of some Philippine soils. Practically completed.

Bacteria concerned in the fermentation of tobacco.

#### ORGANIC CHEMISTRY

*Personnel.*—Dr. H. Elliot Foote resigned on June 1. Resignations will occur from time to time for the reason that commercial firms in the Philippines pay higher salaries than the Government does.

Both research and routine have progressed in a satisfactory manner. There has been a steady increase in analytical work and in the demand for services of the personnel for consultation relative to commercial problems and for expert testimony in courts.

By a careful application of analyses to the enforcement of the Food and Drug Laws, adulteration and misbranding are gradually being eliminated. However, much more work could be done in the enforcement of these laws provided more diligent collecting and submitting of samples were done by the authorities appointed for that purpose.

*Research.*—Under industrial fellowship No. 13, Mr. Sengson has been stationed at Pulpandan, Occidental Negros, for the past year under the supervision of Mr. Walker, of the Sugar Centrals Agency.

An exceptionally fine piece of work on the by-products of the coconut-oil industry, particularly on the waste products from the hydrogenation of coconut oil, was completed this year by Mr. Brooke. These products contain a certain percentage of ketone, particularly methyl *n*-nonyl ketone, and other compounds which may be of interest to the trades, particularly those firms in the United States and in foreign countries that use rare ketone compounds for intermediates and for synthetic processes.

In coöperation with the work of the United States Army Medical Department Research Board this division performed analyses showing the chemical aspects of various classes of rice in their application to food in cases of beriberi.

Further investigation of the camphor industry was completed.

Investigations in canning and preserving Philippine fruits and extension work in instructing housewives of the Philippines in this important branch of home economics was placed on a firm foundation for the next year by the grant of an appropriation by the Philippine Government of ₱15,000 for this purpose.

There has been great activity among the Filipino people in the establishment of small soap factories throughout the Islands. This division has directed the establishment of several hundreds of such plants during the year. These factories seem to be scattered throughout the Islands in the smaller towns of the mountainous regions.

Much research of a minor nature has been done on the best means of manufacturing certain food products such as hams, lards, lard substitutes, breadstuffs, beverages, and condiments, so that they could be manufactured cheaply in a wholesome manner and in conformity with the food laws.

Research on medicinal plants has been continued and some very interesting alkaloids and glucosides have been found. Plant investigation leads primarily to the discovery of valuable Philippine plants that can be used for medicinal purposes and whose classification can be incorporated into a Philippine pharmacopœa.

Many unknown complex organic substances were received for investigation as to their commercial utilization and market value. In many cases this work of the laboratory resulted in development of industries and in financial gain to those interested in the products.

Chemical investigation of the various starches and their yields from Philippine plants relative to the establishment of commercial starch factories has shown that many of the plants have starches that might be used as substitutes for well-known starch preparations found on the market.

Many reports have been rendered on such Philippine industries as the shredded-coconut manufacture, coconut-oil products, lumbang oil and paint manufacture, and varnish making. Problems in removing the discoloration in shredded-coconut products have been solved, the suitability of various resins for varnish making has been determined, and valuable advice has been given to the manufacturers of paint oils from lumbang nuts.



This division has also trained employees of commercial firms in methods of chemical control which have been established in their factories.

Much valuable consultation and investigation work has been given to the Chemical Warfare Service and the Quartermaster Department of the United States Army. The Quartermaster Department is investigating the problem of storage of food-stuffs in the Philippines from the standpoint of keeping qualities under tropical conditions. This division is performing the chemical work which will decide whether or not the methods of packing their products is the most feasible for long storage under tropical conditions.

In general, the analytical work, research, and advice of this division have considerably raised the standard of food and drug products used throughout the Islands, have improved the methods of manufacture in the industries, and have helped to develop the natural resources and to find use for the manufactured products of the same. Likewise, the division has considerably enhanced the value of waste or by-products of various Philippine industries.

*The manufacture of tikitiki extract.*—The manufacture of tikitiki extract has continued practically as in the past. This branch needs the closest attention and improvement. As stated for years past in our annual reports, tikitiki extract is being manufactured in a plant which is wholly inadequate for the purpose from both the standpoint of increased production and that of efficiency in operation.

#### GEOLOGY AND MINES

*Personnel.*—No change occurred in the staff of this division during the year.

*Routine work.*—The varied services rendered by the members of the staff both to the public and to other Government entities consisted in the usual consultations on geological and mining subjects, the examination and identification of rocks and minerals, the study of drilling samples for the Bureau of Public Works and the Metropolitan Water District, and the regular work of assaying, smelting, refining, and drafting. Two hundred fifteen samples of ores and thirty-six samples of gold bullion were assayed for gold and silver or for gold only. Previous to being assayed some of the bullion samples submitted were

either smelted or refined. In addition to these there were submitted five samples of bullion, gold scraps, and gold amalgam for refining, and two samples of ores for amalgamation tests. The kinds and the amount of work done by the draftsmen are as follows:

Maps .....	13
Sketches .....	293
Blue prints .....	85
Tracings .....	79
Miscellaneous .....	447
	<hr/>
Total .....	917

*Field work.*—The field expenses of the following trips were borne by the Bureau of Science: Geologic reconnaissance of the Zambales Mountains, by Messrs. Elicaño and Abad, from February 26 to June 13; geologic reconnaissance of the Diuata Mountains, by Messrs. Elicaño and Abad, from August 26 to November 2; visit to the Sibuguey Coal District, by Doctor Faustino, from January 11 to February 2; geologic reconnaissance of southeastern Negros, by Doctor Faustino, from November 19 to December 9. The following trips were undertaken at the expense of other entities: Geologic reconnaissance of areas in northwest Leyte, by Doctor Faustino, from March 4 to March 15, field expenses paid by the Banisilan Oil Company; valuation of mining improvements in Batan Island, by Doctor Faustino, from July 11 to July 17, field expenses paid by the Bureau of Lands; examination of gypsum mines in Batangas, by Mr. Alvir, from June 4 to June 10, field expenses paid by the Philippine Gypsum Corporation; several short trips to the Novaliches water reservoir site, by Mr. Alvir, field expenses borne by the Metropolitan Water District; and special detail with the Cebu Portland Cement Company in connection with diamond-drilling operations. The last-mentioned work was undertaken by Doctor Faustino, his salary and all field expenses having been paid by the Cebu Portland Cement Company from April 1 to June 17 and from August 27 to August 30.

*Publications and research.*—The following publications relating to geology and mining were issued during the year: *Geology and Mineral Resources of the Philippine Islands*, by W. D. Smith; *The Mineral Resources of the Philippine Islands for the years 1921, 1922, and 1923*. In compliance with a verbal request of Lieut. W. Prior, U. S. N., a report of the Philippine coal deposits and their exhaustion was prepared and submitted by Doctor

Faustino to the Joint Army and Navy Procurement Board. This paper has been revised and submitted for publication in the Philippine Journal of Science.

The following papers are under preparation:

- Bibliography of Philippine conchology, by Doctor Faustino.
- Fossil corals of the Philippines, by Doctor Faustino.
- Geologic reconnaissance of southeastern Negros, by Doctor Faustino.
- A geologic study of the Angat-Novaliches region, by Mr. Alvir.
- Contribution to Philippine petrography: Part I, Bulacan, by Mr. Alvir.
- Philippine gold placers, by Mr. Abad.
- Geologic reconnaissance of Zambales Province, by Mr. Elicaño.
- General reconnaissance of Surigao, by Mr. Elicaño and Mr. Abad.

Mr. Abarquez, in charge of the assay work, is carrying on an investigation on the separation of platinum from gold in the assay of these metals.

**LIBRARY**

The year has been a period of steady and normal growth in size and usefulness. The following figures give a summary of the growth and operations of the library as compared with the previous year:

	1924	1925
Publications used in the library.....	28,969	34,099
Publications charged out.....	10,806	10,418
Registered attendance.....	6,818	9,250
Bound volumes added.....	1,875	2,120
Unbound publications added.....	5,944	6,214
Bound and unbound volumes, parts and pamphlets, December 31.....	86,485	88,703
Expenditures for books..... pesos	3,081.81	4,231.07
Expenditures for binding (approximate)..... do.	5,625.00	8,250.00
Inquiries received.....	122	104
Bibliographies prepared.....	21	19
Do..... pages	73	159
Titles classified.....	772	847
Titles reclassified.....	69	91
Cards prepared and filed.....	6,705	8,867
Books mended.....	415	596
Pamphlet binders made.....	322	659
Publications fumigated.....	817	789
Cuts added.....	187	350
Cuts circulated.....	139	148
Total cuts, December 31.....	6,689	7,089
Total subscriptions, December 31.....	406	418
Total exchanges, December 31.....	596	621

*Personnel.*—There were several resignations and appointments of library apprentices. Mr. José M. Munda, who was given a temporary appointment to take an inventory of the library,

resigned on February 6. Miss Eloisa Rivera, a graduate in library science, was given a temporary appointment on April 22.

*Book orders.*—Three requisitions for books amounting to an estimated cost of ₱4,231.07 were approved for direct purchase. Most of the books have already been received.

*Additions.*—Two thousand one hundred twenty bound volumes were added during the year, 245 more than were accessioned during 1924; this number, added to the total reported for last year, 55,940, makes a total of 58,060. After deducting the bound books transferred to the library of the University of the Philippines (485), lost and paid for (2), missing on inventory (64), destroyed by fire while in the possession of patrons (4), and donated (1), the total is 57,504 bound volumes. At the close of 1924 there were 30,545 unbound volumes and parts; 5,414 were withdrawn from the shelves for binding during 1925; 6 were transferred to the library of the University of the Philippines; 1 was lost and paid for; 86 were donated; and 53 were found missing on inventory. The number of unbound volumes and parts added during the year was 6,214. The total number of unbound volumes and parts at the close of the year after deducting the withdrawals and adding the accessions was 31,199. The total number of bound and unbound volumes and parts at the close of the year was 88,703.

*Use of the library.*—During the year 10,418 publications or books were charged and 10,475 were returned. Renewals of long-standing charges were made. As a result more publications were returned than were charged out. In the reading room, 18,223 bound volumes, 12,574 serials, and 3,302 pamphlets were used, a total of 34,099.

The number of publications circulated shows a decrease of 1,983 below the record for 1924, while the number of publications used in the reading room, which is the largest for any year in the history of the library, shows an increase of 4,432 over that of 1924. This increase shows a healthy tendency in a reference library. Forty-one boxes and packages of books were sent to the College of Agriculture, Los Baños: 10 to Cullion Leper Colony, and 7 to other places. The registered attendance was 9,250, an increase of 2,432 over that of 1924.

*Binding.*—Three hundred volumes were at the bindery on January 1; 1,500 were bound as against 1,400 in 1924; 400 volumes were at the bindery at the end of the year.

*Classification and cataloguing.*—Good progress has been made in classification and cataloguing, in spite of the fact that no

additional help has been given to the cataloguer, the need for which has been felt for years. The work is much in arrears. We have hundreds of publications that must be reclassified so that they will be more readily accessible to our patrons. We have 80 boxes of Library of Congress cards, analytics (author, subject, and title entries) for many of our serials, waiting for work. When worked out, the material hidden in many of these serials, which without these analytics in our catalogue may never see the light of day, will be accessible to our patrons.

The following table gives in comparative form the work for 1924 and 1925:

	Titles.		Bound volumes.		Unbound volumes.		Pamphlets.		Parts.		Cards.	
	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925	1924	1925
Classification and cataloguing (new material).....	772	847	336	298	227	279	539	526	94	158	3,145	4,062
Reclassification and cataloguing.....	69	91	273	210	10	37	67	47	140	10	282	349
Total.....	841	938	609	508	237	316	606	573	234	168	3,427	4,411
Printed cards prepared and filed.....											3,278	3,888
Reference cards.....												278
Miscellaneous cards.....												290
Total cards filed in official catalogue.....											6,705	8,867

The congestion of cards, of several years standing, in our old catalogue cabinet has been relieved by the acquisition of a new cabinet made in the Bureau. The catalogue guide cards of 5,000 divisions ordered from the Library Bureau two years ago were filed in the new catalogue cabinet at the time when the cards were transferred. We now have every reason to be proud of our card catalogue.

*Reference work.*—Better organization and increased efficiency marked the year in reference work. As has already been stated, the number of publications consulted in the reading room is the largest for any year in the history of the library. Nineteen typewritten bibliographies on important subjects were prepared during the year. Four of the typewritten bibliographies were compiled in answer to requests received from Brazil, Japan, Singapore, and the United States. Eighty-five references which required some search were answered. Requests for informa-

tion which can readily be answered by the use of the library catalogue or the general reference books are very numerous and are not recorded. A complete list of 430 currently received medical periodicals was compiled for the first time. This list has proved very helpful in our work.

In coöperation with the colleges and universities in the city, help has been given to some graduating students in their method of search for references for their theses.

*Cuts.*—The number, care, and use of cuts are as follows:

On hand December 31, 1924.....	6,689
Added .....	350
On hand December 31, 1925.....	7,039
Prepared for the shelves.....	326
Circulated .....	143

*Duplicates.*—The duplicate publications, which had accumulated for years, have finally been disposed of as follows:

	Copies.
(1) University of the Philippines Library.....	7,594
(2) College of Agriculture Library.....	1,605
(3) Philippine Health Service.....	2,924
(4) Bureau of Forestry Library.....	151
Total .....	12,274

Before these duplicates were given away almost a month was spent by three apprentices in checking them with the shelf list, to see that none was needed to replace library copies, and to decide which to retain for future use.

#### PUBLICATIONS

*The Philippine Journal of Science.*—The Philippine Journal of Science was published monthly, in three volumes for the year. Each volume consists of four numbers and is separately paged and indexed.

The following table shows the number of pages, plates, and text figures contained in Volumes 26, 27, and 28:

	Volume 26, January to April, 1925.	Volume 27, May to August, 1925.	Volume 28, September to December, 1925.	Total.
Pages.....	592	610	629	1,831
Plates.....	31	29	51	111
Text figures.....	4	17	18	39

Copy for the numbers for January to June, 1926, has been sent to the printer; page proof for January and February numbers and galley proof for March, April, and May numbers were received from the printer by the close of the year.

The following are the titles and the names of authors of the papers published in the Philippine Journal of Science during 1925:

VOLUME 26, JANUARY TO APRIL

*No. 1, January, 1925*

- BROOKE, WALTER L. The essential oil of calantas wood.
- WELLS, A. H., and FAUSTINO GARCIA. Chemical and pharmacodynamic investigation on *Strophanthus letei* Merrill.
- WADE, H. W. Complaints of patients under antileprosy treatment, III. Comparison of creosoted and noncreosoted chaulmoogra ethyl ester preparations.
- BROWN, WILLIAM H., and RAYMOND KIENHOLZ. *Cycas chamberlainii*, a new species.
- COCKERELL, T. D. A. Some Philippine bees.
- ESAKI, TEISO. New or little-known water striders from the Oriental Region.
- GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, I. Einleitung sowie die Gattung *Byrsax* Pascoe.
- TAYLOR, EDWARD H. Additions to the herpetological fauna of the Philippines, IV.
- HERRE, ALBERT W. C. T. Notes on Philippine sharks, II. The great white shark, the whale shark, and the cat sharks and their allies in the Philippines.

*No. 2, February, 1925*

- SCHULTZE, W. A monograph of the pachyrrhynchid group of the *Brachyderinæ*, *Curculionidæ*: Part III. The genera *Apocyrtidius* Heller and *Metapocyrtus* Heller.

*No. 3, March, 1925*

- SCHÖBL, OTTO, and JOSE ANDAYA. Cholera vaccination; its effectiveness as evidenced by the presence of antibodies in the blood of vaccinated persons.
- MANALANG, CRISTOBAL. Agglutinin formation following the use of Castellani's glycerol-vaccine.
- MALLOCH, J. R. The anthomyiid genus *Dichætomyia* Malloch (Diptera) in the Philippines.
- HUSTACHE, A. Contribution a l'étude des *Ceuthorhynchini*.
- HERRE, ALBERT W. C. T. A new species of cardinal fish from the Philippines.
- OSHIMA, MASAMITSU. A review of the carangoid fishes found in the waters of Formosa.

ROHWER, S. A. New thynnid wasps from the Oriental and Australian Regions.

GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, II. Die Gattungen *Atasthalus*, *Bolitoxenus*, *Bolitonæus*, und *Sumbawia*.

*No. 4, April, 1925*

MERRILL, ELMER D. Additions to our knowledge of the Philippine flora, I.

BROOKE, WALTER L. The nicotine content of Philippine tobacco stems.

SCHÖBL, OTTO. Semiselective antiseptic effect of the vapors of vegetable oils, essential oils, their constituents, and similar compounds.

MALLOCH, J. R. Some Far Eastern Muscidæ (Diptera).

MUIR, F. *Parandes*, a new cixiid genus (Homoptera, Fulgoroidea).

FOUTS, ROBERT M. Descriptions of three new Hymenoptera from the Philippine Islands.

SCHWARTZ, BENJAMIN. Internal metazoan parasites collected from ruminants in the Philippine Islands.

GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, III. Die Gattungen *Bradymerus*, *Chaetopsia*, *Danodema*, und *Dicraeosis*.

INDEX.

VOLUME 27, MAY TO AUGUST

*No. 1, May, 1925*

KUSAMA, HIROSHI. A note on the viability of *Bacillus dysenteriae*.

CALLENDER, G. R., and THEODORE BITTERMAN. An epidemiological study in leprosy.

MERRILL, ELMER D. New species of Philippine plants collected by A. Loher.

HAYASAKA, I. *Magellania dickersoni*, a new species of brachiopod.

MOSER, J. New Philippine Cetoniidæ.

ALEXANDER, CHARLES P. New or little-known Tipulidæ from the Philippines (Diptera), Part II.

GAHAN, A. B. A second lot of parasitic Hymenoptera from the Philippines.

FRISON, THEODORE H. The bumblebees of the Philippine Islands (Bremidæ: Hymenoptera).

SPAETH, FRANZ. Zwei neue *Cassida*-Arten aus den Philippinen.

GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, IV. Die Gattungen *Phloepsidius*, *Dysantes*, *Basanus*, und *Diaperis*.

BAKER, C. F. Nomenclatorial notes on the Jassoidea, III.

*No. 2, June, 1925*

MERRILL, ELMER D. Five new species of Chinese plants.

HERRE, ALBERT W. C. T. A supplement to poisonous and worthless fishes.

COCKERELL, T. D. A., and NORMA LE VEQUE. Bees from Samar, Philippine Islands.

PATTON, W. S. Diptera of medical and veterinary importance, I. Types of older authors in continental museums.



- MUIR, F. The genus *Andes Stål* (Cixiidae: Homoptera).  
 SCHWARTZ, BENJAMIN. Helminth parasites of hogs in the Philippine Islands.  
 SCHULTZE, W. *Macro xenos piercei* (order Strepsiptera), a new genus and species of wasp parasites of the Philippine Islands.  
 LEE, H. ATHERTON. The comparative resistance to foot rot of various citrus species as root stocks.  
 GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, V. Die Gattung *Ceropria*.

*No. 3, July, 1925*

- HERRE, ALBERT W. C. T. A new Philippine sea robin, family Peristediidae.  
 TAYLOR, EDWARD. Notes on the chlorination of the Manila water supply.  
 SCHÖBL, OTTO, and JOSE RAMIREZ. The fallacy of the test for lactose fermenters as an indicator of faecal pollution of waters.  
 SUMULONG, MANUEL D. Effects of castration in immature guinea pigs.  
 DE LEON, WALFRIDO, and LAMBERTO LEIVA. Echinococcus cyst of the human lung.  
 HUSTACHE, A. Curculionides nouveaux des Philippines et l'Orient.  
 PATTON, W. S. Diptera of medical and veterinary importance, II. The more important blowflies, Calliphorinae.  
 FERRIS, G. F. Third report upon Diptera pupipara from the Philippine Islands.  
 GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, VI. Die Gattungen *Ischnodactylus*, *Hoplocephala*, und *Martianus*.

*No. 4, August, 1925*

- RODRIGUEZ, JOSE N. The disturbances of cutaneous sensibility in leprosy.  
 MANALANG, C. A hookworm campaign in Cebu.  
 SCHWARTZ, BENJAMIN, and ELOISE B. CRAM. Horse parasites collected in the Philippine Islands.  
 HERRE, ALBERT W. C. T. Two strange new fishes from Luzon.  
 KREKICH-STRESSOLD, H. Anthicidae of the Philippines, I.  
 BAKER, C. F. Nomenclatorial notes on the Jassoidea, IV.  
 GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, VII. Die Gattung *Platydemia* Castelnau und Brulle.

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- SCHWARTZ, BENJAMIN. Intestinal nodules in chickens due to heterakid larvæ (*Heterakis beramporia* Lane).  
 TUBANGUI, MARCOS A. Metazoan parasites of Philippine domesticated animals.  
 CRAWFORD, D. L. Notes on Psyllidae.  
 FISHER, W. S. A new species of *Sambus* from Manila (Coleoptera: *Buprestidae*).

WHEELER WILLIAM MORTON, and JAS. W. CHAPMAN. The ants of the Philippine Islands. Part I, Dorylinæ and Ponerinæ.

WILEMAN, A. E. Notes on Japanese Lepidoptera and their larvæ: Part VIII.

GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indomalayischen Gebietes, unter Berücksichtigung der benachbarten Faunen, VIII. Die Gattungen Anisocara, Spiloscapa, Menimus, Labidocera, und Pentaphyllus.

KARNY, H. H. Cricket-locusts (Gryllacridæ), chiefly from the Philippine Islands.

*No. 2, October, 1925*

VAZQUEZ-COLET, ANA. Contribution to the question of dysentery carriers in the Philippine Islands.

LAVA, V. G. The possible use of Philippine coals for liquid fuel.

FISHER, W. S. New Malaysian Cerambycidæ: subfamily Lamiinæ.

FLEUTIAUX, ED. Deux Melasidæ nouveaux des Philippines.

WILEMAN, A. E. Notes on Japanese Lepidoptera and their larvæ: Part IX.

KLEINE, R. Dritter Beitrag zur Kenntniss der Lycidæ: Die Gattung Leptotrichalus.

*No. 3, November, 1925*

LACY, G. R. A report of typical and atypical Bacillus dysenteriæ Shiga, with special reference to agglutination reactions.

FERRIS, G. F. Fourth report upon Diptera pupipara from the Philippine Islands.

BAKER, C. F. Remarks on certain Indo-Malayan Fulgora, with special reference to Philippine species.

MUIR, F. A few species of Oliarus from China (Fulgoroidea, Homoptera).

ALEXANDER, CHARLES P. New or little-known Tipulidæ from the Philippines (Diptera), Part III.

SPAETH, FRANZ. Die Gattung Prioptera Hope (Coleoptera: Cassididæ).

MENOZZI, CARLO. Nouvelles fourmis des Philippines.

*No. 4, December, 1925*

WELLS, A. H., F. AGCAOILI, and MARIA Y. OROSA. Philippine citrus fruits.

SANTOS, JOSÉ K. A pharmacognostical study of Chenopodium ambrosioides Linnæus from the Philippines.

SUMULONG, MANUEL D. Structural characteristics of double-yolked eggs and the relation of the membranes of twin embryos resulting from a double-yolked egg.

LAIDLAW, F. F. Two new species of dragon flies (Odonata) from the Philippine Islands, with remarks on the genus Heliogomphus.

SCHULTZE, W. New and rare Philippine Lepidoptera.

SPAETH, FRANZ. Neue Hoplionota-Arten (Coleoptera, Chrysomelidæ, Cassidinæ) aus den Philippinen, II.

KLEINE, R. Brenthiden der entomologischen Sammlung des Bureau of Science, sowie einige neue Arten aus der Böttcher'schen Ausbeute.

LABOISSIERE, V. Description de trois espèces nouvelles de Galerucini des Philippines.

ERRATA.

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The articles published during 1925 cover a wide range of subjects. The following enumeration is a rough classification of the subjects treated:

Subject.	Articles.	Pages.
Entomology.....	52	1,110
Medicine, including veterinary medicine.....	19	265
Ichthyology.....	8	127
Chemistry.....	6	128
Botany.....	6	138

The following table shows the number of names on the mailing list of the Philippine Journal of Science for 1925, as compared with 1924:

	1924	1925
Paid subscriptions.....	269	255
Exchanges.....	588	617
Review subscriptions.....	34	34
Free.....	55	57
Total.....	946	963

*Special publications.*—Publication No. 18 of the Bureau, An Enumeration of Philippine Flowering Plants, Vol. 1, fascicle 4, was issued March 21, 1925.

Publication No. 19 of the Bureau, Geology and Mineral Resources of the Philippine Islands, by Warren D. Smith, was issued April 18, 1925.

Publication No. 20 of the Bureau, Iloko Grammar, by Frances Crosby Bartter. The complete second galley proof was received from the printer by the close of the year.

The Mineral Resources of the Philippine Islands for the years 1921, 1922, and 1923 was issued September 28, 1925.

No press bulletins were issued during 1925.

*Miscellaneous work.*—One hundred forty-one printing jobs, including labels for various divisions of the Bureau, forms, envelopes, etc., against one hundred forty-two for 1924, passed through the publications division, for most of which it was necessary to read proof.

**RECOMMENDATIONS**

The Bureau of Science is in very great need of additional money, personnel, and space. The amount of work the Bureau can do for the advancement of science and industry of the

Islands will naturally be directly in proportion to the money, personnel, and space available. For many years it has been planned to add a new wing to the Bureau. This should be done as soon as possible, as the work can expand but little in the present quarters.

It is particularly desirable that the Bureau of Science have a revolving fund to buy supplies to be used in the manufacture of such of its products as are sold. The present system of taking the money for these supplies out of the appropriation has the result that every time the Bureau increases its production its income for other purposes is decreased.

Respectfully submitted,

WM. H. BROWN,  
*Director, Bureau of Science.*

To the Honorable  
THE SECRETARY OF AGRICULTURE  
AND NATURAL RESOURCES.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivisions of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1924	1925	1924	1925	1924	1925	1924	1925
General, inorganic, and physical chemistry:								
Metals and alloys.....	30	20	140.50	174.00	3	24	28.00	229.00
Rocks, minerals, natural pigments, and similar substances.....	16	36	112.00	265.00	7		77.00	
Clays, shales, limestones, limes, wall plasters, and slugs.....	11	2	73.00	21.00		2		21.00
Coal analyses.....	78,158	26	7,354.76	2,982.49	3,849	35	1,136.80	5,159.14
Calorimetric tests of fuels		4		110.00				
Paints and varnishes.....	7	17	119.00	209.00	3	10	45.00	100.00
Waters.....	87	66	1,958.00	1,533.00	177	140	2,935.00	2,879.00
Crude chemical and miscellaneous analyses.....	6	18	80.50	197.50		1		8.00
Standard solutions..... liters	9	27	33.50	121.27	83		408.00	
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	27	43	105.00	117.50	69	40	145.00	132.00
Cements.....	5,362	5,113	9,209.40	8,887.65	7,943	8,337	7,889.80	9,454.30
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	1,524	1,591	2,805.00	2,975.00	979	2,451	1,155.00	2,746.00

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivisions of the Bureau of Science.	Cash work.			Free work.		
	Samples or units.			Samples or units.		
	1924	1925	Pesos.	1924	1925	Pesos.
General, inorganic, and physical chemistry—Ctd.						
Standardization and correction of units of measure—						
Length.....	17	22	10.20	11	340	6.60
Capacity.....	7	23	6.60	12	3	7.20
Weight.....	134	170	307.00	34	22	30.00
Miscellaneous inorganic work and analyses.....	85	11	225.35	5	2	20.00
Total.....	85,480	7,189	22,539.81	13,175	11,407	13,882.40
Soils and fertilizers:						
Soil analyses.....	42	10	455.00	39	181	1,443.00
Commercial fertilizers.....		86	1,014.00	1		12.00
G-rano, copra cake, ashes, and similar materials.....	494	330	3,611.50	191	50	2,276.00
Insecticide, fungicide, sea-water tests, and other miscellaneous analyses.....		45	164.00			
Fertilizer registration and tag sales.....	323,249	147,205	10,764.11			
Total.....	323,785	147,676	14,830.61	230	232	3,719.00
Organic chemistry:						
Urines, clinical and toxicological analyses.....	687	854	2,080.00	200	336	832.00
Essential oils and essences.....	13	5	130.00		1	10.00
Petroleum and copra products and similar materials.....	725	642	4,399.80	42	27	368.00
Linseed and castor oils.....	8	3	157.00		3	60.00

Gums, resins, and similar materials.....	5	1	42.00	25.00					
Paper and similar materials.....	1	4	5.00	55.00					6.00
Gastric juice, clinical examinations.....	1		15.00		4			60.00	
Foods, alcohols, and beverages.....	476	268	1,998.30	1,334.67	5,852	7,175	59,074.00	77,373.00	
Food preservatives and coloring matters.....	3	7	9.00	54.00	19	88	120.00	860.00	
Medicines and similar articles.....	25	57	302.00	327.00	310	634	2,845.00	5,199.00	
Miscellaneous organic analyses and examinations.....	31	18	237.40	135.00	7	14	85.00	144.00	
Tikitiki extract.....	1,327	1,687	915.42	1,214.16	54,800	46,120	38,350.00	32,284.00	
<b>Total.....</b>	<b>3,302</b>	<b>3,546</b>	<b>10,290.92</b>	<b>10,363.33</b>	<b>61,234</b>	<b>54,400</b>	<b>101,744.00</b>	<b>117,864.00</b>	
<b>Mines:</b>									
Assays.....	86	249	331.00	846.00					
Smelting and refining of gold and other precious metals.....	2,804	16,733	201.80	504.37					
Drafting.....	1	1	.50	5.00	123		77.00		
<b>Total.....</b>	<b>2,891</b>	<b>16,983</b>	<b>533.30</b>	<b>1,355.37</b>	<b>123</b>		<b>77.00</b>		
<b>Biological laboratory:</b>									
Feces.....	237	361	735.00	1,142.00	31,036	37,137	147,917.00	416,469.00	
Sputum.....	107	105	295.00	295.14	56	314	158.00	942.00	
Blood.....	59	71	326.38	413.76	368	250	1,308.00	1,519.00	
Cultures.....	15		75.34		3,255	15	16,325.00	75.00	
Widal tests.....	22	37	79.00	114.90	155	162	542.00	486.00	
Wassermann tests.....	227	330	2,270.00	3,305.14	1,188	959	11,880.00	9,500.00	
Leprosy.....	3	5	9.00	15.00	42	27	126.00	81.00	
Urines.....	11	27	33.00	82.32	2,408	797	12,047.00	3,969.00	
Gonococci.....	132	99	396.00	297.00	520	336	1,560.00	1,008.00	
Waters, biological.....	45	29	436.00	290.00	4,888	7,889	48,830.00	68,430.00	
Histological examinations.....	6	17	60.00	170.00	12	10	120.00	100.00	
Rats for plague.....					93,688	53,206	235,111.00	212,977.00	
Miscellaneous biological examinations.....	24	47	154.00	249.00	4,168	3,326	41,031.00	29,816.00	
<b>Total.....</b>	<b>888</b>	<b>1,128</b>	<b>4,868.72</b>	<b>6,374.26</b>	<b>106,376</b>	<b>104,428</b>	<b>567,015.00</b>	<b>745,462.00</b>	

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivisions of the Bureau of Science.	Cash work.			Free work.		
	Samples or units.		Pence.	Samples or units.		Pence.
	1924	1925	1924	1924	1925	1924
Serum section of the biological laboratory:						
Vaccine virus.....	3,365,384	3,549,315	49,618.26			
Miscellaneous sera and vaccines ..... ampules, cc., and units.....	5,414,800	4,820,454	173,682.68	598,205	2,932,560	119,661.00
Total.....	8,780,184	8,369,769	223,300.94	598,205	2,932,560	119,661.00
Miscellaneous:						
Photographic work.....	4,820	5,869	2,020.65	1,963	870	769.20
Natural-history specimens.....	30	37	223.42			
Shop work.....	1	4	1.15	809		455.00
Miscellaneous work.....	31	7	13,836.97			
Supplies and equipment.....	26,078	17,631	4,320.96			
Sales of publications.....			3,790.73			
Refunded work, not done, etc. (deducted).....			(229.65)			
Power, gas, etc.....			29,967.42			
Total.....	30,960	23,548	53,931.65	2,772	870	1,224.20
Grand total.....	9,227,490	8,569,839	330,295.95	781,114	3,103,897	807,322.60
			386,697.76			1,472,870.04



TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1924	1925	1924	1925	1924	1925	1924	1925
Bureau of Agriculture:								
Standard solutions.....		3		15.00				
Soil analyses.....					27	181	938.00	6,296.00
Commercial fertilizers.....						1		12.00
Guano, copra cake, ashes, and similar materials.....					8	50	80.00	188.00
Petroleum and copra products and similar materials.....								
Foods, alcohols, and beverages.....					18		97.00	
Miscellaneous organic analyses and examinations.....					67	32	552.00	348.00
Photographic work.....	111		2	59.20		12		120.00
Supplies and equipment.....	10			12.85				
Total.....	121		5	71.55	115	276	1,667.00	6,964.00
Bureau of Coast and Geodetic Survey:								
Standardization and correction of measures of weight.....						1		25.00
Bureau of Commerce and Industry:								
Foods, alcohols, and beverages.....					1		10.00	
Waters, chemical.....						1		15.00
Waters, biological.....					1		10.00	
Photographic work.....	10	122	2.00	88.10				
Total.....	10	122	2.00	88.10	2	1	20.00	15.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1924	1925	1924	1925	1924	1925	1924	1925
Bureau of Customs:								
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....					31	17	65.00	54.00
Petroleum and copra products and similar materials.....					2	3	12.00	75.00
Food preservatives and coloring matters.....					4			40.00
Medicines and similar articles.....					55	321	320.00	1,629.00
Waters, biological.....					53	18	530.00	180.00
Photographic work.....	13			3.80				
Total.....	13			3.80	141	363	927.00	1,978.00
Bureau of Education:								
Clays, shales, limestones, limes, wall plasters, and alga.....						2		21.00
Waters, chemical.....						1		25.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....					8		12.00	
Waters, biological.....						4		40.00
Photographic work.....	106			42.60				
Supplies and equipment.....	17		86.50	33.00				
Tikiki extract.....	10			7.00				
Total.....	17	123	86.50	82.60	8	7	12.00	86.00

Bureau of Forestry:							
Soil analyses.....						8	360.00
Photographic work.....	60	36.69					
Supplies and equipment.....	5	5.00					
Total.....	60	36.69	5.00			8	360.00
Bureau of Internal Revenue:							
Standardization and correction of units of measure—							
Length.....						11	6.60
Capacity.....						12	7.20
Weight.....						34	30.00
Essential oils and essences.....						1	10.00
Foods, alcohol, and beverages.....						5	90.00
Food preservatives and coloring matters.....						1	10.00
Medicines and similar articles.....						5	35.00
Photographic work.....	12	6.40					
Total.....	12	6.40				72	168.80
Bureau of Justice:							
Medicines and similar articles.....						15	75.00
Blood.....						6	450.00
Total.....						21	525.00
Bureau of Labor:							
Supplies.....	1	5.00					
Bureau of Lands:							
Photographic work.....			52.00				
Bureau of Non-Christian Tribes:							
Foods, alcohol, and beverages.....						1	25.00
Photographic work.....	2	.40					
Total.....	2	.40				1	25.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1924	1925	1924	1925	1924	1925	1924	1925
Bureau of Posts:								
Metals and alloys.....								50.00
Medicines and similar articles.....						10		25.00
Photographic work.....	24		16.00			1		
Total.....	24		16.00			11		75.00
Bureau of Printing:								
Metals and alloys.....					2	2	16.00	24.00
Bureau of Prisons:								
Waters, chemical.....								25.00
Soil analyses.....						1		10.00
Urines, clinical and toxicological analyses.....						1		3.00
Facces.....					3,075	2,045	16,996.00	10,225.00
Blood.....					339	1	1,126.00	3.00
Widal tests.....						3		9.00
Wassermann tests.....					51	53	510.00	530.00
Gonococci.....					495	335	1,485.00	1,005.00
Waters, biological.....					6	7	60.00	70.00
Histological examinations.....						5		50.00
Miscellaneous biological examinations.....					1		3.00	

Vaccine virus.....	1,900	7,500	64.00	105.00					
Miscellaneous sera and vaccines.....ampules, cc., and units.....	24,012		54.00						
Total.....	25,912	7,500	118.00	105.00	3,970	2,449	20,218.00	11,892.00	
<b>Bureau of Public Works:</b>									
Rocks, minerals, natural pigments, and similar substances.....		1		6.00	2		15.00		
Paints and varnishes.....					2	5	30.00	20.00	
Waters, chemical.....	40	27	925.00	705.00	131	121	2,010.00	2,255.00	
Cements.....	2,995	3,666	4,787.00	6,277.00	37	461	43.30	662.80	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	1,130	1,194	2,071.00	2,389.00	970	2,451	1,138.00	2,746.00	
Miscellaneous inorganic work and analyses.....					5		20.00		
Waters, biological.....					56	6	560.00	60.00	
Supplies and equipment.....	3	2	11.52	5.40					
Total.....	4,168	4,890	7,794.52	9,382.40	1,203	3,044	3,816.30	5,743.80	
<b>Bureau of Quarantine Service:</b>									
Flies.....					4	2,180	20.00	10,900.00	
Rats for plague.....					967	845	5,165.00	3,380.00	
Vaccine virus.....	7,350	5,900	78.00	65.00					
Miscellaneous sera and vaccines.....ampules, cc., and units.....		50		20.00					
Photographic work.....		9		4.80					
Tikiti extract.....	1		.70						
Total.....	7,351	5,959	78.70	89.80	971	3,025	5,185.00	14,280.00	
<b>Bureau of Supply:</b>									
Metals and alloys.....	9	3	36.00	30.00		7		29.00	
Coal analyses.....	6,702		606.00		3,848	25	1,120.80	1,995.30	
Paints and varnishes.....	1	2	8.00	16.00					
Waters, chemical.....					4			100.00	
Standard solutions.....liters.....	1		2.50						

## THE BUREAU OF SCIENCE

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.			Free work.		
	Samples or units.		Pesos.	Samples or units.		Pesos.
	1924	1925	1924	1924	1925	1924
Bureau of Supply—Continued.						
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	16	6	66.00	24.00	3	40.00
Cements.....	788	641	1,244.00	712.50	7,580	7,846.50
Standardization and correction of units of measure—						
Length.....					340	221.00
Capacity.....					3	16.00
Weight.....					21	20.00
Miscellaneous inorganic work and analyses.....	3		12.00			
Petroleum and copra products and similar materials.....	3	18	60.00	375.00	20	196.00
Linseed and castor oils.....					3	60.00
Foods, alcohols, and beverages.....	3	4	45.00	28.00	47	141.00
Paper and similar materials.....					2	6.00
Miscellaneous organic analyses and examinations.....		12		60.00	2	24.00
Waters, biological.....					5	50.00
Miscellaneous biological examinations.....					3	150.00
Vaccine virus.....	10		1.00			
Miscellaneous sera and vaccines..... ampules, cc., and units.....	240,555	133,646	1,039.60	1,262.40		

Supplies and equipment.....	854	2,858	239.25	77.60				
Tikliti extract.....	400	270	280.00	189.00				
Total.....	249,345	137,460	3,639.36	2,774.50	11,848	7,989	9,494.30	10,898.60
Executive Bureau:								
Photographic work.....	119	10	19.05	2.05				
Philippine Constabulary:								
Standard solutions..... liters.....	1		3.00					
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....					20	18	40.00	56.00
Miscellaneous inorganic work and analyses.....						2		20.00
Medicines and similar articles.....					7	5	40.00	45.00
Urines, clinical and toxicological analyses.....						2		75.00
Sputum.....						1		3.00
Blood.....						3	75.00	225.00
Vaccine virus.....	1,250	3,050	22.50	30.50				
Miscellaneous sera and vaccines..... ampules, cc., and units.....	24,187	27,807	130.00	1,450.00				
Photographic work.....	1		.50					
Supplies and equipment.....	30	90	1.50	4.50				
Total.....	26,469	30,947	157.50	1,485.60	28	31	155.00	424.00
Philippine Health Service:								
Waters, chemical.....					24	16	510.00	359.00
Urines, clinical and toxicological analyses.....					174	328	744.00	1,268.00
Gastric juice, clinical examinations.....						1	15.00	
Foods, alcohols, and beverages.....					5,721	7,135	58,233.00	76,885.00
Food preservatives and coloring matters.....					19	83	120.00	810.00
Medicines and similar articles.....					19	27	150.00	290.00
Feces.....					27,261	32,340	127,612.00	392,484.00
Sputum.....					56	313	168.00	939.00
Blood.....					27	239	104.00	766.00
Cultures.....					3,255	15	16,325.00	75.00
Widal tests.....					155	159	542.00	477.00
Wassermann tests.....					1,137	906	11,370.00	9,060.00





Miscellaneous biological examinations.....					1			10.00
Vaccine virus.....	6		.60					
Miscellaneous sera and vaccines.....ampules, cc., and units..	1,319,759	1,481,641	3,860.80	1,336.00		543	782	306.20
Photographic work.....						850	1,000	595.00
Tikitiki extract.....						1,404	1,757	1,054.20
<b>Total.....</b>	<b>1,319,765</b>	<b>1,481,647</b>	<b>3,861.40</b>	<b>4,336.60</b>				<b>1,125.00</b>
<b>City of Manila:</b>								
Standardization and correction of units of measure—								
Capacity.....		7		4.20				
Weight.....		39		96.30				
Metals and alloys.....	1		1.50					
Cements.....		5		17.00				
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	199	337	280.00	433.00				
Petroleum and copra products and similar ma- terials.....						4	1	25.00
Medicines and similar articles.....		13		39.00		6		50.00
Blood.....							1	75.00
Miscellaneous biological examinations.....								240.00
Supplies and equipment.....		630		31.50				
<b>Total.....</b>	<b>200</b>	<b>1,031</b>	<b>281.50</b>	<b>621.00</b>	<b>15</b>	<b>2</b>	<b>315.00</b>	<b>80.00</b>
<b>Metropolitan Water District:</b>								
Cements.....		251		836.75				
Standard solutions..... liters.....	6	19	27.50	81.27				
Soil analyses.....	24	1	125.00	25.00				
Waters, biological.....						1,098	1,165	10,960.00
Supplies and equipment.....		703		31.50				11,650.00
<b>Total.....</b>	<b>30</b>	<b>974</b>	<b>152.50</b>	<b>1,055.52</b>	<b>1,098</b>	<b>1,165</b>	<b>10,980.00</b>	<b>11,650.00</b>

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1924	1925	1924	1925	1924	1925	1924	1925
Board of Pharmaceutical Examiners and Inspectors:								
Medicines and similar articles.....						209		
Provinces and municipalities:								
Waters, chemical.....	19	14	445.00	320.00				
Crude chemical and miscellaneous analyses.....		1		25.00			260	2,150.00
Standardization and correction of units of measure—								
Length.....	12	20	7.20	12.00				
Capacity.....	6	6	3.60	6.30				
Weight.....	88	80	91.00	101.00				
Urine, clinical and toxicological analyses.....		1		20.00		6		160.00
Medicines and similar articles.....	12	19	75.00	95.00				
Miscellaneous organic analyses and examinations.....	3		30.00					
Waters, biological.....	18	8	180.00	80.00				
Miscellaneous biological examinations.....	4		80.00					
Miscellaneous sera and vaccines..... ampules, cc., and units.....	30		30.00					
Natural-history specimens.....		1		120.00				
Supplies.....	12		13.20					
Total.....	204	150	922.00	779.30		6		160.00

United States Army and Navy:									
Metals and alloys.....	2		21.50						
Rocks, minerals, natural pigments, and similar substances.....	1			6.00					
Coal analyses.....	1		35.00						
Paints and varnishes.....	1			5.00					
Waters, chemical.....	1		8.00						
Crude chemical and miscellaneous analyses.....	3	11	75.00	117.00					
Cements.....	2		30.00						
Standardization and correction of measures of weight.....	1		25.00						
Petroleum and copra products and similar materials.....	3	19	36.00	125.00					
Foods, alcohols, and beverages.....	1	10	24.00	111.00					
Medicines and similar articles.....					3			15.00	
Miscellaneous biological examinations.....		2		20.00					
Vaccine virus.....	26,250	12,650	1,248.50	1,287.50					
Miscellaneous sera and vaccines.....ampules, cc., and units.....	80,532	62,217	3,763.60	10,256.60					36.60
Photographic work.....						118			
Supplies and equipment.....	116	32	5.80	3.00					
Total.....	106,912	74,943	5,272.40	11,931.10	3	118	15.00		36.60
Office of the Governor-General:									
Medicines and similar articles.....						1			10.00
Miscellaneous organic analyses and examinations.....		1		6.00					
Facces.....						10			50.00
Photographic work.....	2		13.00						
Total.....	2	1	13.00	6.00		11			60.00
University of the Philippines:									
Cements.....		12		13.20					
Facces.....					599	562	2,987.00		2,810.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1924	1925	1924	1925	1924	1925	1924	1925
University of the Philippines—Continued.								
Vaccine virus.....	1,600	600	60.00	6.00				
Miscellaneous sera and vaccines.....ampules, cc., and units.....	44,012	24,012	100.00	60.00				
Photographic work.....	354	661	115.75	287.76				
Supplies and equipment.....	5	6	17.50	30.00				
Total.....	45,971	25,291	293.75	368.96	599	562	2,987.00	2,810.00
Public Welfare Commissioner:								
Waters, biological.....								
Miscellaneous sera and vaccines.....ampules, cc., and units.....		1,000		2.00	526	50	210.40	20.00
Tikitiki extract.....					42,950	38,320	30,065.00	26,824.00
Total.....		1,000		2.00	43,476	38,373	30,275.40	26,874.00
Philippine Library and Museum:								
Photographic work.....	18	6	9.60	3.20				
Supplies and equipment.....		2		13.00				
Total.....	18	8	9.60	16.20				
Philippine Islands Antituberculosis Society:								
Waters, biological.....					13		180.00	

Miscellaneous:						
Metals and alloys.....	18	17	81.50	144.00	5	126.00
Rocks, minerals, natural pigments, and similar substances.....	16	34	112.00	258.00		
Clays, shales, limestones, limes, wall plasters, and slugs.....	11	2	78.00	21.00		
Coal analyses.....	71,445	26	6,713.76	2,982.49	10	3,163.84
Calorimetric tests of fuels.....	4			110.00		
Paints and varnishes.....	6	14	111.00	188.00	5	80.00
Waters, chemical.....	27	25	580.00	508.00	1	25.00
Crude chemical and miscellaneous analyses.....	3	6	6.50	55.50	1	8.00
Standard solutions..... liters	1	5	.50	25.00		
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	11	37	39.00	93.50	2	16.00
Cements.....	1,577	538	3,148.40	1,031.20	296	419.20
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....		60	454.00	153.00		
Standardization and correction of units of measure—						
Length.....	5	2	3.00	5.60		
Capacity.....	1	10	3.00	51.20		
Weight.....	45	51	191.00	276.00		
Miscellaneous inorganic work and analyses.....	82	11	213.35	194.50		
Soil analyses.....	18	9	330.00	255.00		
Commercial fertilizers.....		86		1,014.00		
Guano, copra cake, ashes, and similar materials.....	494	330	3,611.50	2,234.00		
Insecticide, fungicide, sea-water tests and other miscellaneous analyses.....		45		164.00		
Fertilizer registration and tag sales.....	323,249	147,205	10,764.11	4,827.50		
Urines, clinical and toxicological analyses.....	687	863	2,080.00	2,722.00		
Essential oils and essences.....	13	5	130.00	45.00		
Petroleum and copra products and similar materials.....	719	605	4,303.80	3,885.50	20	320.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1925, as compared with the fiscal year 1924, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.						Free work.		
	Samples or units.		Pesos.		Samples or units.		Pesos.		Pesos.
	1924	1925	1924	1925	1924	1925	1924	1925	
Miscellaneous—Continued.									
Linseed and castor oils.....	7	3	142.00	46.00					
Gums, resins, and similar materials.....	5	1	42.00	25.00					
Paper and similar materials.....	1	4	5.00	55.00					
Gastric juice, clinical examinations.....	1		15.00						
	472	254	1,929.30	1,195.67					
Foods, alcohols, and beverages.....	3	7	9.00	51.00					
Food preservatives and coloring matters.....	13	25	227.00	193.00					
Medicines and similar articles.....	28	5	207.40	69.00					
Miscellaneous organic analyses and examinations.	86	249	331.00	846.00					
Assays.....									
Smelting and refining of gold and other precious metals.....	2,804	16,733	201.80	509.37					
grams.....									
Faces.....	237	361	735.00	1,142.00					
Spitum.....	107	105	295.00	295.14					
Blood.....	59	71	326.38	413.76					
Cultures.....	15		75.34						
Widal tests.....	22	37	79.00	114.90					
Wasserman tests.....	227	380	2,270.00	3,305.14					
Leprosy.....	3	5	9.00	15.00					
Urines.....	11	27	33.00	82.32					
Gonococci.....	132	99	396.00	297.00					
Waters, biological.....	27	21	256.00	210.00					
Histological examinations.....	6	17	60.00	170.00					

Miscellaneous biological examinations.....	20		74.00	229.00		
Vaccine virus.....	4,468	2,659	437.66	331.88		
Miscellaneous sera and vaccines..... amputees, cc., and units.....						
Photographic work.....	1,090,018	1,023,689	1,751.91	19,786.89		
Natural-history specimens.....	3,763	4,619	809.93	1,061.73		
Shop work.....	30	36	223.42	218.00		
Drafting.....	1	4	1.15	4.70		
Miscellaneous work.....	31	1	.50	6.00		
Supplies and equipment.....	24,946	12,928	13,836.97	6,949.54		
Tikiki extract.....	926	1,407	3,891.09	1,649.28		
Sales of publications.....			634.72	1,018.16		
Refunded, work not done, etc. (deducted)			3,790.73	3,402.87		
Power, gas, etc.....			(229.65)	(92.10)		
			29,967.42	27,898.57		
<b>Total.....</b>	<b>1,527,093</b>	<b>1,213,729</b>	<b>95,782.49</b>	<b>92,710.81</b>	<b>340</b>	<b>4,158.04</b>
<b>Grand total.....</b>	<b>9,227,493</b>	<b>8,569,839</b>	<b>330,295.95</b>	<b>388,657.76</b>	<b>781,114</b>	<b>1,472,870.01</b>
						<b>807,322.60</b>

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1925 as compared with the fiscal years 1923 and 1924.

## EXPENDITURES.

Item—	Fiscal year—		
	1923	1924	1925
Salaries and wages, etc.:	<i>Pesos</i>	<i>Pesos</i>	<i>Pesos</i>
Salaries and wages including accrued leave.....	312,339.72	322,119.71	351,497.17
Travel expenses of personnel.....	8,105.02	10,147.10	11,069.16
Total.....	320,444.74	332,266.81	362,566.33
Apparatus, supplies, etc.:			
Consumption of supplies and materials.....	131,375.82	173,022.29	145,756.80
Apparatus and equipment, including books.....	13,522.01	7,265.41	20,192.48
Total.....	144,897.83	180,287.70	165,949.28
Miscellaneous:			
Postal, telegraph, telephone, and cable service....	6,161.77	7,580.54	8,381.16
Freight, express, and delivery service.....	2,358.25	2,619.96	3,515.30
Printing, and binding reports, documents, and publications.....	43,389.66	34,900.00	34,900.00
Illumination and power service.....	2,238.06	1,749.04	1,764.44
Miscellaneous service.....	7,720.41	14,214.65	13,597.16
Maintenance and repair of equipment.....	5,400.62	2,173.90	1,872.95
For the acquisition and transportation of certain species of fish desired for cultivation.....			2,000.00
Uncollectible debts.....	20.02	29.10	55.31
Total.....	67,288.79	63,267.19	66,086.32
Distribution of tikitiki extract, antityphoid vaccine, and antidysenteric serum:			
Salaries and wages, including accrued leave.....	3,860.18	3,206.99	4,555.38
Consumption of supplies and materials.....	42,608.59	39,930.31	33,054.74
Other service.....	927.80	1,562.21	1,388.29
Total.....	47,396.57	44,699.51	38,998.41
Special fund:			
Developing home canning and food preservation industry, Act 3231:			
Salaries.....			121.29
Consumption of supplies and materials.....			9.30
Total.....			130.59
Grand total.....	580,027.93	620,521.21	633,730.93

## INCOME.

Receipts from operation.....	356,604.07	317,739.37	386,102.68
Sales of supplies.....	326.07	2,160.93	31.06
Sales of fixed assets.....	1,038.17	2,073.59	1,954.87
Other income.....	8,524.56	8,322.06	1,609.15
Total.....	366,492.87	330,295.95	388,697.76
Appropriation account:			
Appropriation.....	596,426.00	615,400.00	622,220.00
Allotted by the Emergency Board.....	12,257.54	11,969.46	13,938.27
Brought forward for equipment.....	28,704.05	26,880.37	17,659.10
Special fund, Act 3231.....			15,000.00
Total.....	637,387.59	654,249.83	668,817.37



## SUMMARY OF TWENTY-SECOND AND TWENTY-THIRD ANNUAL REPORTS OF THE BUREAU OF SCIENCE, FOR THE YEARS 1923 AND 1924

The expenditures and income of the Bureau of Science for 1923 and 1924 are shown in Table 3 of the twenty-fourth annual report.

### PERSONNEL

During absences of Director E. D. Merrill, Dr. T. Dar Juan was acting director from April 26 to May 5, 1923; Dr. A. W. Herre was acting director from July 23 to October 6, 1923; and Mr. V. Elicaño was acting director from November 5, 1923, to March 12, 1924, when the present director was appointed. Mr. E. D. Merrill resigned as director on March 7, 1924.

The division of soils and fertilizers was created on July 1, 1923, to handle agricultural chemistry, soils, and allied subjects and all chemical work in connection with the enforcement of the fertilizer law and the fungicide and insecticide law. The personnel of the division when created consisted of Mr. A. S. Argüelles, chief; Mr. Mariano Tirona, chemist; Mr. Isaias Olayao, junior chemist; and Mr. E. Purisima, scientific assistant. Mr. Rufino Isidro, agronomist, was detailed to the division from the Bureau of Agriculture.

Dr. Liborio Gomez, chief of the biological laboratory, and Dr. Regino Navarro, assistant bacteriologist, transferred to the College of Medicine and Surgery on May 1 and March 1, respectively, 1923. Dr. Otto Schöbl, chief of the serum laboratory, was designated acting chief of the biological laboratory. Dr. George R. Lacy, of the International Health Board, was assigned to the biological laboratory on June 1, 1923. During 1923 Mrs. C. N. Leach was a volunteer worker on problems connected with the typhoid epidemic. Dr. Onofre Garcia reported for duty on March 23, 1923, after his post-graduate work in bacteriology in the University of Chicago, the University of Illinois, and the Bureau of Laboratories of New York City and New York State. Mr. H. A. Lee, mycologist, left the Bureau on March 31, 1923, leaving the work in plant pathology and mycology mostly in the hands of technical employees detailed

from the Bureau of Agriculture; the work was in charge of Dr. N. G. Teodoro from June, 1923. Mr. Mauro Baculi, junior botanist, succeeded Mr. Marcelo Braulio, who resigned on October 15, 1923. Mr. G. M. Reyes, assistant plant inspector, resigned on October 31, 1923; and Mr. Mariano Medalla, assistant plant pathologist, resigned on November 15, 1923. The contracts of Dr. H. I. Cole and Mr. Bernard Nelson, organic chemists, terminated on February 18 and February 19, 1923, respectively, and their positions were filled by the appointment of Dr. H. E. Foote and Mr. W. L. Brooke, on May 16 and June 28, respectively. Mr. Ramon Abarquez, a pensionado of the Bureau of Science, returned to Manila in August, 1923, and was appointed mining engineer and metallurgist. Mr. Antonio D. Alvir, a pensionado, returned in October, 1923, and was appointed geologist.

Dr. Mariano Basaca left for the United States as a pensionado on August 15, 1924.

Dr. Jose K. Santos and Dr. Joaquin Marañon, of the University of the Philippines, were appointed to part-time positions in the Bureau in 1924.

Mr. H. R. Montalban, pensionado, returned to the Bureau in December, 1923.

Mr. Isidoro Sañiel, assistant librarian, who had been studying in the United States, returned to the Bureau in 1923.

Mr. Jose C. Espinosa, chemist, resigned on November 15, 1924. Prof. Amando Clemente, of the University of the Philippines, working in the Bureau on a half-time basis, resigned on December 1, 1924.

Dr. M. M. Alicante, pensionado, returned to Manila in 1924 and was appointed soil biologist in the Bureau of Science the same year.

Dr. L. A. Faustino, geologist, returned from the United States and reported for duty on July 8, 1924. Mr. L. F. Abad, mining engineer, returned to the Bureau on July 21, 1924.

Miss Mary Polk, librarian, died on April 12, 1924. Mr. C. B. Perez was appointed librarian.

#### RESEARCH

Among the research problems on which work was completed and articles written and published are the following:

##### Biology.

Investigation of specific problems in leprosy.

Study of blood cultures of typhoid-fever patients and stools of food handlers.

Studies of *Balantidium coli* and of *Entamoeba histolytica*.  
 The microscopic diagnosis of balantidial dysentery and certain nonspecific intestinal lesions.  
 Various phases of the hookworm problem.  
 Chemotherapeutic study of chaulmoogra oil and related products.  
*Bacillus dysenterix* carriers in the Philippines.  
 Serologic study of leprosy, showing a constant nonspecific reaction.  
 The bacteriological flora of the Manila water supply and the effect of long exposure of lactose fermenters to water.  
 Normal agglutinins in sera of various animals, possible donors of agglutinate sera.  
 Experimental pneumonia in Philippine monkeys.  
 Variations of the several types of *Bacillus dysenterix*, showing their inconstancy.  
 Serological study of various groups of *Bacillus dysenterix*.  
 Transmission of leprosy in animals.  
 Development of a nonspecific serum reaction in yaws.  
 Study of immunity in yaws.  
 Experimental study of dengue.

#### Botany.

*Merrillosphaera africana* of Manila.  
 Distribution of the Dipterocarpaceæ.  
 Diagnoses of Hainan plants, II.  
 Plants from Banguay.  
 Diseases of abacá, sugar cane, and rice.

#### General zoölogy.

Study of wood-boring beetles.  
 A method of illustrating insect wings.  
 A new Philippine paussid and notes on *Pachyrrhynchus*.  
 Contribution to the Coleoptera fauna of the Philippines.  
 Monograph of the pachyrrhynchid beetles.  
 Birds of Ilocos Province, Luzon.

#### Fisheries.

Study of the ipon industry in the Ilocos provinces.  
 Study of the sardine industry of Estancia, Panay.  
 Reconnaissance of Bicol River and lakes Bato and Buhl.  
 Notes on Philippine sharks.  
 Some rare Philippine eels.  
 Distribution of Philippine Cyprinidæ.  
 Distribution of Philippine fresh-water fishes.  
 Poisonous and worthless fishes.

#### Inorganic chemistry.

Studies on the properties of Philippine tobaccos.  
 Experiments in making paper pulp and paper from local raw materials.  
 The suitability of Baguio siliceous sinters for making sand-lime brick.  
 A color test for distinguishing abacá from canton and maguey.  
 Experiments showing the practicability of molding sawdust into briquettes without a binder.  
 The value of Philippine coal dust in liquid fuels.

**Soils and fertilizers.**

Chemical and physical analyses of soils of experiment stations and typical lands of Bulacan Province.

**Organic chemistry.**

Study and introduction of the fusel-oil industry.

A cheap substitute for calantas wood for the manufacture of cigar boxes.

Successful canning of Philippine fruits and vegetables.

Improved methods of fermentation in the distilling industry.

Recovery of waste products in the coconut industry.

Demonstration that camphor can be produced in the Philippines.

Method of bleaching rattan on a commercial scale.

Study of the essential oil of calantas wood.

The cause of discoloration of buildings by the use of ipil wood and methods for its prevention.

The possibility of the extraction of nicotine from tobacco waste for the manufacture of insecticides.

Chemical and pharmacodynamic investigation of *Strophanthus letzi*.

The food value of Philippine fruits and vegetables.

The Philippine citrus-fruit industry.

Investigations leading to specifications for rope oils.

Introduction of chemical control into the catch industry.

**Geology and mines.**

Field work on the geology and structure of the Angat region.

Geology of Manila and vicinity; a report to the Earthquake Committee.

Geology of northwestern Leyte.

Geologic reconnaissance in Leyte and Mindoro.

The mineral Resources of the Philippine Islands for 1921, 1922, and 1923.

Recent Madreporaria of the Philippines.

**COOPERATION**

The United States Army Medical Department Research Board has occupied laboratory space and continued working on local medical problems during 1923 and 1924.

Drs. C. N. Leach and G. R. Lacy, of the International Health Board, worked in coöperation with the Bureau of Science and the Philippine Health Service.

Several fellowships, involving coöperation between the Bureau and various scientific units and commercial bodies were established.

## IMPROVEMENTS

In 1924 the assay laboratory was completely remodeled and made much more nearly fire-proof with concrete walls. A large concrete fish pond, 36 meters long and 26 meters wide, was built in the corner of the Bureau of Science grounds near the dispensary of the Philippine General Hospital. A second story was placed in the herbarium rooms. The interior of the main building was completely repainted for the first time since its construction.



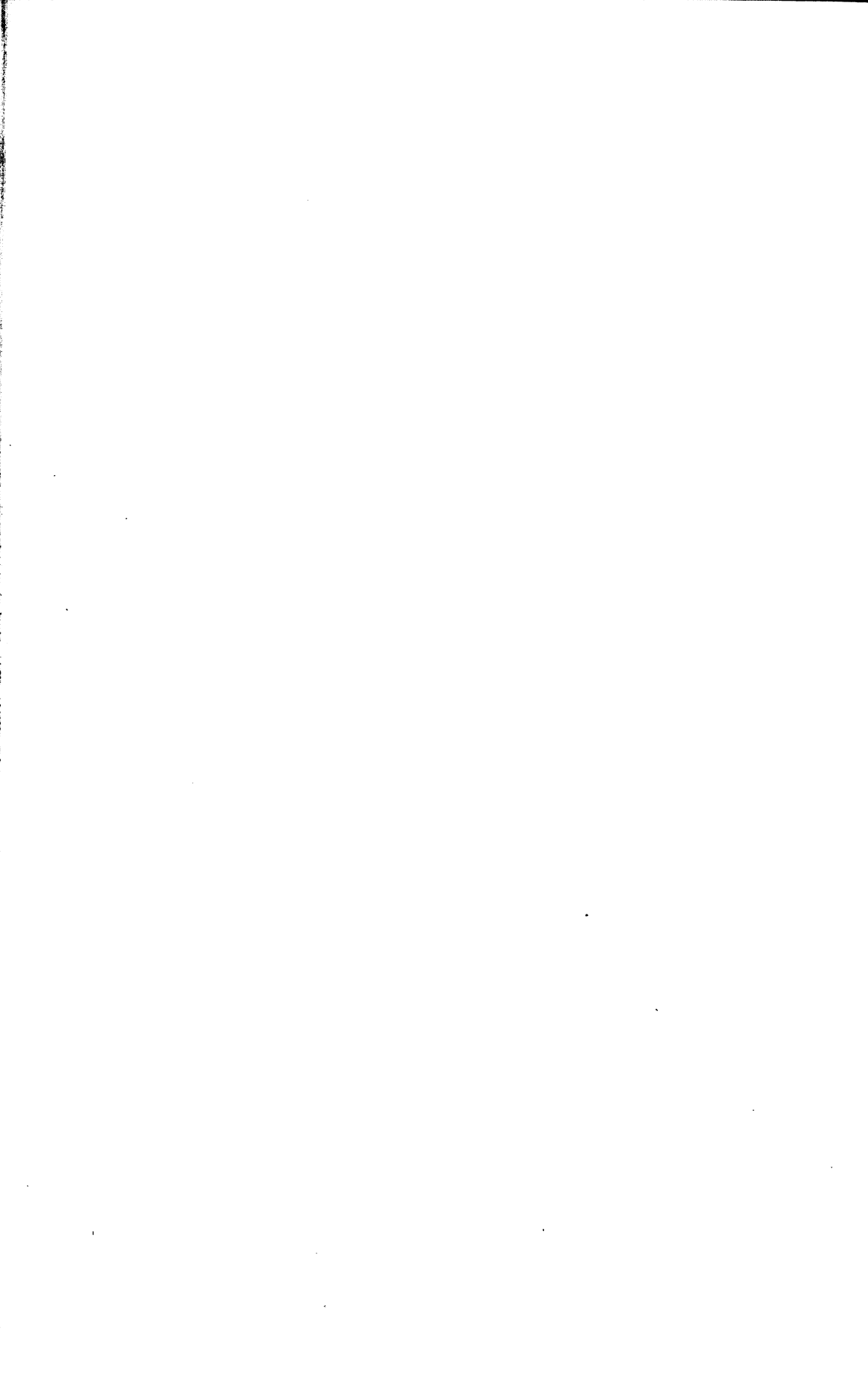
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PHILIPPINE BUREAU OF  
SCIENCE REPORT

35  
1936

never published  
except in excerpts  
in 26, 1937



# TWENTY-SIXTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

INCLUDING AN EXCERPT FROM  
THE TWENTY-FIFTH ANNUAL REPORT

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

WILLIAM H. BROWN  
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1927



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# TWENTY-SIXTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE.

MANILA, *February 10, 1928.*

SIR: I have the honor to submit the following report of the Bureau of Science covering the fiscal and calendar year 1927. The year has been one of great activity both in research and routine work. The first part of the report deals with the Bureau as a whole, while in the latter part the work of the various divisions is given more in detail.

## EXPENDITURES, INCOME, AND FREE WORK

The expenditures for the year 1927 were ₱722,556.10 as against ₱665,718.32 for the year 1926. The increase was due to the expenditure of special funds for special projects; that is, for the development of home canning and food preservation and for the reorganization of the division of fisheries. These two items entailed an additional expense of ₱51,300 out of the total increase of ₱56,800 so that outside of the special activities the expenditures of the Bureau were increased by ₱5,500.

The cash income amounted to ₱391,079.99 as compared with ₱377,154.31 for the previous year. The income for 1927 was larger than for any previous year and ₱14,000 greater than in 1926.

The free work done for other Government entities would have had a cash value of ₱1,686,082.70 according to the Bureau of Science schedule of charges. The cash income and the value of free work amounted to ₱2,077,162.69. Subtracting from this the total expenditures of the Bureau, including expenditures from special funds, leaves a balance of ₱1,354,606.59 which represents the actual profit to the Government of operating the Bureau of Science. The actual cost to the Government is the amount expended, ₱722,556.10, minus the total income, ₱391,079.99, which leaves ₱331,476.11; for which the Bureau

did ₱1,686,082.70 of free work, or ₱5.09 worth of free work for each peso expended. The free work mentioned above includes only the actual tests and examinations made and supplies furnished to other Government entities and does not take account of the fact that a considerable proportion of the funds of the Bureau of Science are expended in ways that are valuable to the people of the Philippine Islands and for which no financial returns can be calculated. Among such items are the expenditure of ₱22,800 for the development of home canning and food preservation; ₱43,000 from the special fund for the development of the fisheries industries, money spent for the free distribution of tikitiki extract, for the prevention of rabbies, and sums spent for the study of insect pests and plant diseases. Neither does it take into account the large amount of research which is of advantage to the public.

Tables showing in detail the income and expenses of the Bureau and the work performed are given at the end of this report. Table 1 shows the amount of routine work performed and supplies manufactured and disposed of during the fiscal year 1927 as compared with that for the fiscal year 1926 by number or quantity and by value, arranged by subdivisions of the Bureau of Science. Table 2 gives similar data arranged according to the entities for which the work was performed. Table 3 is a comparative statement showing expenditures and income during the fiscal year as compared with the fiscal years 1925 and 1926.

#### ROUTINE

The amount of routine done by the Bureau has been steadily and rapidly increasing for several years. This is due to a considerable extent to the increased appreciation of the work of the Bureau of Science by other Government entities and by the public. The amount of routine work done at present not only exceeds that of any past period but I believe it is also safe to say that it is done in a more accurate and satisfactory manner than at any previous time since the Bureau was established. The great amount of routine work performed is shown in detail in Tables 1 and 2 at the end of this report. The Bureau of Science does work and manufactures supplies, mostly free of cost, for practically all Insular Government entities. Brief mention is made below of some of the large items for various entities.

*Philippine Health Service.*—The Bureau of Science manufactures vaccines and sera in large quantities for the Philippine Health Service. The Bureau of Science sold to the Philippine Health Service 2,114,000 doses of cholera, typhoid, and combined cholera and typhoid vaccine and 2,841,000 doses of vaccine virus and furnished free of cost 2,078,000 units of cholera, typhoid, and combined cholera and typhoid vaccine. In addition considerable amounts of other products were either sold or furnished free to the Philippine Health Service. During the year there were no epidemics and the Philippine Health Service took smaller amounts of vaccines and sera than in the previous year. The amount of cholera, typhoid, and combined cholera and typhoid vaccines furnished free to the Philippine Health Service decreased by more than 2,000,000 doses, while the amount of vaccine virus sold decreased by more than 600,000 doses.

The Bureau of Science serves as a laboratory for the Philippine Health Service. During the year there were examined free for the Health Service 40,000 samples of fæces, 6,600 samples of foods, alcohols, and beverages, 7,900 samples of water, and 57,271 rats for plague. In all, free examinations for the Philippine Health Service were made on 117,583 samples.

The enforcement of the pure-food law is in the hands of the Philippine Health Service, and all analyses and examinations made in connection with the enforcement of this law are conducted by the Bureau of Science for the Philippine Health Service.

*Public Welfare Commissioner.*—The Office of the Public Welfare Commissioner was furnished free with 48,580 bottles of tikitiki extract for the cure of beriberi. These had a sales value of ₱34,006.

*Bureau of Quarantine Service.*—The samples collected by the Bureau of Quarantine Service are sent to the Bureau of Science for analysis. More than 14,000 free examinations for that service were made during 1927.

*Board of Pharmaceutical Examiners and Inspectors.*—The Bureau of Science serves as a laboratory for the Board of Pharmaceutical Examiners and Inspectors and makes all analyses for them in connection with the enforcement of the drug law.

*Bureau of Supply.*—The Bureau of Supply buys many articles on specifications, and these articles are tested by the Bureau of Science. During 1927 more than 10,000 such examinations were made without charge for the Bureau of Supply.

*Bureau of Public Works.*—The Bureau of Science examines free of charge all samples of cement, concrete, and artesian-well water for the insular projects of the Bureau of Public Works. During 1927 more than 5,000 such examinations were made. A much larger number of samples was submitted by the Bureau of Public Works for analysis or test for provincial or municipal projects.

#### RESEARCH

The important research done by the Army Medical Department Research Board and that in connection with the Rockefeller Foundation are mentioned under the heading of Coöperation. The work done in connection with the abacá fellowship and the Manila Railroad fellowship is described under the heading of Industrial Fellowships.

The Bureau of Science has been actuated, as in the past, by the belief that the most-lasting benefits are obtained not from routine work, however important this may be, but by the establishment of new principles and improved practices which result from investigation. With this idea in mind, as much time and money has been devoted to research as was possible. The greatly increased appreciation of the routine work of the Bureau by both Government entities and the public greatly increased the demand on the time of our technical staff for the performance of routine work. The great increase in routine work also requires extensive space and an increase in equipment. In spite of the demand of routine, emphasis has been laid on research and the accomplishments along this line have not been small. In fact, it is doubtful if they have been greater for any previous year. The most outstanding accomplishments along research lines are the following:

##### Medical biology.

Experiments on yaws added greatly to the knowledge of and gave the first comprehensive picture of the etiology, clinical manifestations, and immunity of this widespread and important tropical disease. The results are embodied in a paper which is one of the greatest contributions ever made by the Bureau to the science of medicine.

A new disease of cattle was studied and the causal organism, a pleomorphic, gas-forming, bipolar bacillus, was isolated and described.

Choleralike vibrios isolated from water and from human beings were compared and no difference noted. The choleralike vibrios studied were isolated from dug wells in Navotas and from Manila Bay and Pasig River.



Improved methods of culturing the dysentery bacillus enable the bacteriologist to make a bacterial diagnosis in the afternoon if the specimen is submitted before 9 o'clock in the morning and to determine the type of dysentery bacillus involved in twenty-four hours. Heretofore it has been possible to make rapid diagnosis only by means of secondary methods which are unsatisfactory.

#### Botany.

For the first time the active principle of makabuhay, *Tinospora reticulata*, the best-known and most widely used unofficial medicinal plant in the Philippines was isolated.

Pharmacological studies were made of *Datura alba* and *Datura fastuosa* from the Philippines and of *Tinospora rumphii* and *Tinospora reticulata*.

Experiments on bunchy-top disease of abacá confirmed the belief that this disease is similar to if not identical with the Australian bunchy-top disease of bananas, which is due to a filterable virus transmitted by plant lice. This information promises to furnish a practical method of controlling the disease.

Extensive studies were made of a serious pineapple disease. The causal organism was isolated and promising methods of controlling the disease were devised.

Considerable information was obtained on rice, rubber, and tobacco diseases and on the organisms that cause the rot of standing timber.

#### General zoölogy.

A catalogue of Philippine beetles was prepared and is in process of publication.

The biology and life history of the large Philippine wood scorpion was worked out in considerable detail.

Several new birds were described and a large number of new insects collected.

#### Fisheries.

Greatly improved methods of smoking, salting, and pickling fish were devised. During the coming year these methods will be applied commercially on a large scale at Estancia, Panay, which is one of the principal fishing districts of the Philippines.

An extensive study was made of the bañgos fish-pond industry and a paper describing the results prepared.

Considerable numbers of new fishes were described and monographs prepared on ten families of fishes.

#### Organic chemistry.

A considerable number of new compounds were made from the acids of lumbang and chaulmoogra oils. The chemical properties of these new compounds were studied.

Considerable progress was made in the study of the vitamin content of Philippine foods.

An extensive study was made of the chemical composition at various stages of ripening of both Hawaiian and native pineapples grown in the Philippines.

Studies were also made of the coloring matters of higher fractions of cracked gasoline and the effect of the solvent upon the rotation of active compounds.

In coöperation with Colonel Vedder an intensive investigation was made to determine a standard for beriberi-preventing rices. This work is discussed under the heading of coöperation.

General, inorganic, and physical chemistry.

Very valuable data were obtained as a result of thousands of tests of the mechanical properties of the principal Philippine commercial woods.

Extensive and valuable results were obtained from a study of paint materials for tropical use.

Much work has been accomplished on the regional variation in the chemical composition of Philippine waters and the relation between the chemical characteristics of the water and the geology of the region.

A study of the lime industry of the Philippines was completed.

Soils and fertilizers.

An important study was completed on the nitrifying power of Philippine soils.

In coöperation with the Cordage Institute an investigation was conducted on the relation between the tensile strength of abacá fiber and the character of the soil. This work is discussed in connection with the abacá fellowship.

Geology and mines.

In coöperation with Dr. Bailey Willis a study was made of the major structural geologic problems of the Philippines.

An extensive investigation was made of the geology and mineral resources of Zambales Range which is the western cordillera of Luzon.

A monograph on recent corals of the Philippines was published, and considerable work was done on fossil corals.

A study was made of the geology of central Panay with special reference to the underground-water resources.

#### COÖPERATION

*United States Army Medical Department Research Board.*—As in the past the United States Army Medical Department Research Board continued to occupy quarters in the Bureau of Science. Coöperation with the board has been a great help to the Bureau of Science and the results of its work are of great value not only to the Bureau but to the Philippines at large. The Bureau of Science has placed its facilities at the disposal of the board and the appreciation of the board, expressed both verbally and in writing, has been very gratifying. During the year there was no change of personnel, the board being com-

posed of Lt. Col. Edward B. Vedder, Maj. Paul A. Schule, and Maj. Raymond A. Kelsner. The board does no routine work, its activities are confined to research. The more-important lines developed during the year were as follows:

Col. E. B. Vedder in collaboration with Mr. R. T. Feliciano, of the Bureau of Science, conducted an elaborate investigation to determine a satisfactory standard of beriberi-preventing rices. Beriberi is a deficiency disease, and its occurrence is largely due to the eating of highly polished rice. The result of the investigation is quite satisfactory and offers a very practical means of determining whether or not a given rice is suitable from the standpoint of beriberi prevention. This work will be particularly useful where rice as a diet is furnished by an individual or an organization to a large number of people.

Major Kelsner succeeded in developing a greatly improved form of vaccine against rinderpest, which is the great cattle scourge of the Islands. The vaccine previously used had to be ripened for an indefinite time before it became safe to administer. The time during which it retained its potency was short and variable. The vaccine developed by Major Kelsner can be used as soon as prepared, is more active than the vaccine previously used, and has excellent keeping qualities. The use of this vaccine should go a long way toward ridding the Islands of rinderpest, and indeed it seems to make it feasible to exterminate the disease from the entire Archipelago.

Tests performed by Major Kelsner have shown that red iodide of mercury is valuable in the treatment of epizoötic lymphangitis, a disease of horses that is very prevalent in the Philippines.

An experimental and epidemiological study of the manner in which leprosy is transmitted has been conducted by Colonel Vedder. The work so far has been negative, but will be continued and results of some value are expected even if the major questions remain unanswered.

The study of dengue fever has been continued by Major Schule. Though cultural attempts have not been successful, studies of preparations from the dissection of known infective mosquitoes have yielded some information as to the nature of the virus. Also further information has been secured on the mechanism of transmission by *Aedes egypti*.

*Rockefeller Foundation.*—The Bureau of Science was very fortunate indeed in securing the loan of Dr. Earl B. McKinley from the Rockefeller Foundation. Doctor McKinley arrived in Manila and began work in the Bureau of Science in June, 1927. Doctor McKinley's wide experience has proved very useful to the Bureau. Several junior members of the staff are working in coöperation with him on important problems. This work is mentioned in the part of this report dealing with the division of biology and serum laboratory. During the year Doctor McKinley continued his investigation begun in Belgium, and later continued at Columbia University, upon experimental encephalitis. He investigated the presence of *Spirochæta icterohæmorrhagiæ* in wild rats caught in and around Manila and began some fundamental studies upon rinderpest. He has continued the preparation of a treatise on filterable virus diseases of man, animals, fowls, insects, fishes, and plants. It is the intention to publish this as a monograph from the Bureau of Science.

*Philippine Government.*—The Bureau of Science is in active coöperation with practically all branches of the Government, as can be seen from the tables at the end of this report. The following special projects may be mentioned:

*Bureau of Agriculture.*—The Bureau of Agriculture has continued to assign men to work in the combined laboratory of plant pathology. Details of this work are given under the section of Mycology. Also, the Bureau of Agriculture has continued to assign a man to work in our soils laboratory. During the year Dr. Otto Schöbl, chief of the division of biology and serum laboratory, acted as technical adviser to the Bureau of Agriculture rinderpest vaccine laboratory.

*Bureau of Forestry.*—Very satisfactory progress was made in the coöperative work with the Bureau of Forestry on the preparation of a publication on the useful trees of the Philippines. This will appear in three or four volumes, the first of which is about ready for the printer, while much progress has been accomplished on the other volumes.

*Metropolitan Water District.*—As in past years the Metropolitan Water District has supplied a chemist particularly for the chemical examination of the water of Manila. This chemist makes several examinations daily of the chlorine of the city water, while a bacteriologist of the Bureau of Science examines

the water several times each day for bacterial content. The results of these examinations are highly satisfactory and indicate that the city water as it comes from the tap is very safe for drinking and other domestic purposes.

#### INDUSTRIAL FELLOWSHIPS

The principal work in connection with industrial fellowships was done on industrial fellowship No. 12 with the Cordage Institute and industrial fellowship No. 15 with the Manila Railroad Company.

*Cordage Institute Fellowship.*—This fellowship agreement was entered into in November, 1924, and Dr. P. L. Sherman was appointed fellow in March, 1925. The results of the work in connection with this fellowship have been gratifying and promise to be of great advantage to the abacá industry. The principal results accomplished have been along three lines; namely, the relationship between soil conditions and the quantity and quality of hemp produced, the relation between the tensile strength and the acidity of fiber, and the cause of the deterioration of abacá.

The work on the relation between soil conditions and the quality of hemp produced has progressed so far that a paper on the abacá-soil conditions in two districts of the Philippine Islands and their relation to fiber production has been submitted for publication. This investigation dealt particularly with the comparison of soil conditions and the hemp produced in the Bicol provinces and in Davao. In the former region, hemp has been produced for a very long time and the fiber now grown is, in general, of a poorer quality than that produced in Davao where the cultivation of abacá is a comparatively recent industry. The results of the investigation indicate that the relatively poorer or weaker fiber in the Bicol region is due to the exhaustion of the soil, particularly in regard to lime and potash, and to a high acidity of the soil. The fiber from the more-acid soil in the Bicol region is weaker than the fiber from the less-acid soil of Davao.

An examination of a large number of samples has shown that in general the more acid the fiber the weaker it is. The results of the experiments bring out various aspects of this problem. A paper describing the results has been submitted for publication in the *Philippine Journal of Science*.

An examination of the cause of the deterioration of abacá fiber has shown that the principal cause of deterioration, particularly the early and rapid deterioration, is bacterial fermentation which can be prevented by rapid drying of the fiber. The bacteria that cause this fermentation are widespread and are very numerous on abacá plants, particularly on dead parts. When fiber is not dried rapidly these bacteria infect the fiber and cause deterioration. The bacteria produce acids that cause the deterioration of the fiber, and experiments have shown that when these acids are placed on good fiber they will cause deterioration even without the presence of bacteria. The knowledge obtained concerning the bacteria that cause deterioration and the action of these bacteria and the acids produced by them should go a long way toward preventing the deterioration of abacá fiber.

Results such as those reported above are calculated to produce an improvement in the quality of abacá and are exceedingly important at the present time when Philippine abacá appears to be on the verge of severe competition with abacá grown on an extensive scale on new lands, particularly in Sumatra where cleaning is done by machine.

*Manila Railroad Fellowship.*—As in the two previous years, the work on this fellowship was conducted by Dr. T. Dar Juan. In addition to research activities Doctor Dar Juan conducted or supervised the control analysis of coal, cement, lubricants, and other miscellaneous materials. The annual report of the general manager of the Manila Railroad Company for the year 1926 contains the following comment:

The fellowship created in coöperation with the Bureau of Science occupied by Dr. Timoteo Dar Juan, and referred to in the report for 1925, continued in force throughout 1926 with very satisfactory results. Laboratory fees alone, if paid as formerly directly to the Bureau of Science, would have amounted to the sum of ₱13,396.30 as against an outlay of ₱8,884 under the fellowship, and Doctor Dar Juan has also conducted a number of special investigations and initiated new processes that have been of substantial benefit to the Company.

As the same work was continued during 1926 it is believed that the results for that year will be equally satisfactory to the Manila Railroad Company.

*Investigations.*—Special lines of investigations were as follows:

Comparative service and steaming tests of various coals available in large quantities in the local market were made. The

selection of coal has been governed by the results obtained. The results of the tests are now being prepared for publication so that they will be available to the public in general.

Exposure tests and analyses of paints sold in the local market were made. The object of this work was not only to guide the Manila Railroad Company in the purchase of paints but also to determine what paint materials are most serviceable under tropical conditions. This matter is of great interest from the standpoint of Government purchases, and it is hoped that before long the work will result in the purchase of paint materials on specifications rather than by brand, as the former method should be cheaper and more generally satisfactory.

The relative efficiency and consumption of different brands of gasoline sold in the local market were determined. Here again the purchases of the railroad have been governed by the results of the tests. The principal object was to correlate the consumption and efficiency with data obtained from laboratory tests.

Of less-general interest but of value to the railroad is the large amount of work on the study of the comparative consumption of fuel by different types of locomotives used by the railroad and of the consumption of fuel at different loads of the new three-cylinder engines purchased by the Manila Railroad Company.

#### PUBLICATIONS AND LIBRARY

The Philippine Journal of Science, embodying the results of the research work of the Bureau, was issued in three volumes with an aggregate of 1,511 pages, 157 plates, and 111 text figures. The contents of the three volumes are given later in this report under the heading Publications.

The Philippine Journal of Science is sent to 919 paid subscribers and exchanges, while 109 copies are distributed free for review, to associate editors, and to other parties. The total mailing list is 1,028. This is distributed as follows: Philippines, 94; remainder of Asia, 185; Europe, 293; North America, 359; South America, 25; Africa, 29; Australia and neighboring islands, 43. These figures show that the journal is widely distributed to scientific institutions in all parts of the world.

Two monographs were issued during the year, three are in proof, and one is being prepared for the printer. The biennial publication on the mineral resources was issued for the years 1924-1925. This publication took the form of a twenty-fifth

anniversary number and contains a summary of Philippine geology and mineral resources. Two popular bulletins, one press bulletin, and an annual report were also issued during the year.

The library has continued to grow in size and usefulness and has maintained its high standard of excellence. During the year 14,521 volumes were added to the library, making a total of 108,808 volumes at the close of the year. The library receives 2,234 scientific periodicals of which 442 are paid subscriptions, 907 exchanges, and 884 free. The number of publications used and charged out was 55,896, or a daily average of 154 publications. The number of visitors recorded was 12,593.

#### HOME CANNING AND FOOD PRESERVATION

During 1925 and 1926 the division of organic chemistry of the Bureau of Science carried on experiments and extension work on the preservation and canning of Philippine fruits and vegetables. By special act, the Seventh Philippine Legislature in 1926 created a division of food preservation in the Bureau of Science. The demonstration work of this new division has been highly satisfactory, but the demand for demonstrations and also a lack of space have greatly hampered the experimental work. However, ninety-six new recipes have been added to those on hand in 1926. The bulletin on food preservation has continued to be very popular, and it is planned to revise it soon so as to include the new recipes. During the year, demonstrations were given in the Bureau of Science and demonstrators were sent to ninety-one towns in seventeen provinces. Special demonstrations were given to 490 women in Manila and 13,070 women in the provinces. The Philippine Carnival of February, 1927, in coöperation with the division of food preservation of the Bureau of Science held a very successful home-canning contest. The Carnival Association awarded a very handsome silver cup to the successful province and ₱1,000 in prizes to the successful individuals, while the Pacific Commercial Company gave special prizes amounting to ₱175.

#### AQUARIUM

As in past years, the Bureau of Science continued to operate the aquarium in the bastion of Real Gate of the Walled City where a considerable variety of interesting and curious fishes and other marine animals are displayed for the benefit of the public and tourists. During the year there were 17,759 paid



admissions, 5,601 free admissions to elementary students, and 904 half-fee admissions to high-school students.

#### IMPROVEMENTS

The principal improvement was the construction of a series of concrete experimental fishponds on the grounds of the Bureau of Science. These have already proved very useful. They contain introduced fishes which are under experimentation with a view to their introduction into fresh waters of the Philippines and into pond culture. The ponds are run at very little expense. The water is aerated by the plants growing in the ponds, so that the necessity of changing the water is avoided. Practically all the water required is obtained from rains. Owing to the nearness of the ponds to the Bureau of Science it is not necessary to have extra personnel and special watchmen to care for them. The location of the ponds on the grounds of the Bureau enables the personnel of the division of fisheries to experiment with them with great convenience and little loss of time.

The exterior of the Bureau of Science main building was painted for the first time since its construction.

New cooling tanks were built on the grounds of the Bureau of Science for the cooling of water that passes through the engines and the distilling and refrigerating plants. After being cooled the water is returned and used again. This improvement will effect a saving of several thousand pesos per annum.

The cold-storage facilities at the Alabang serum laboratory were greatly improved by the construction of an extra refrigerating chamber in which large quantities of vaccines and sera can be kept. Another improvement at Alabang was the construction of additional water-storage tanks. The addition has changed conditions so that what was before an inadequate water supply is now sufficient for our needs.

#### PERSONNEL

The great increase in the demand made by other Government entities and private individuals has necessitated an increase in the number of employees. The total number of employees on the pay roll as of December 31, 1927, was three hundred twenty-three. One hundred twenty-three of these composed the technical staff, thirty-two were clerical, and one hundred sixty-eight were laborers, including janitors, carpenters, gardeners, watchmen, helpers, and others.

## REPORT BY DIVISIONS

## BIOLOGY AND SERUM LABORATORY

*Personnel.*—Dr. Numeriano Vinteres was appointed junior bacteriologist in place of Dr. Julian Gonzaga, resigned. The position of one bacteriologist became vacant.

*Coöperation.*—The Rockefeller Foundation generously loaned the services of Dr. Earl B. McKinley to the Bureau of Science. Doctors Basaca and Bañuelos were assigned to do special work on bacteriophage, dysentery, and rabies under his direction. The work of Doctor McKinley is discussed more in detail earlier in this report under the general heading of Coöperation.

The chief of the division served as technical adviser for the Bureau of Agriculture rinderpest-vaccine laboratory. Recommendations and suggestions were given, in particular as to the testing of biologic products for sterility and safety.

Lieut. Surg. K. Yasuyama, Imperial Japanese Navy, finished his two-year assignment to the Bureau of Science for the purpose of studying tropical medicine. Doctor Yasuyama participated in certain investigations, and the results of his experiments were published jointly with the chief of the division or independently. Upon the return to Japan of Doctor Yasuyama, Lieut. Col. B. Tanabe was assigned for a year to study certain tropical diseases in the Philippines. He arrived in June, 1927, and commenced the study of the distribution and possible host of *Schistosoma japonicum* in the Philippines. Aside from this work he was engaged with the chief of the division in the study of yaws, especially the possibility of immunization.

Doctors Schöbl and Basaca gave assistance in the instruction in the School of Hygiene and Sanitation, University of the Philippines.

*Routine work.*—Practically the same amount of routine work was accomplished this year as during the previous year. The amount of work done is evident from the tables at the end of this report.

The amount and kind of routine work of the biological laboratory is naturally regulated to a great extent by the demand made by other Government entities and varies from year to year as emergencies such as epidemics and outbreaks occur. In the past year there was no large outbreak of infectious disease. The following summarized figures show that even without any unusual demand the amount of work performed by the division of biology and serum laboratory is very great.

*Summary of routine work of the biological laboratory during 1927.*

	Examinations or units.	Value in pesos.
<b>Cash work:</b>		
Examinations made in Manila.....	2,032	10,735.54
Vaccines and sera sold from central office.....	7,092,880	285,472.95
Cebu laboratory examinations and sales.....	353	3,225.02
Iloilo laboratory examinations and sales.....	843	6,974.97
<b>Total.....</b>	<b>7,096,108</b>	<b>306,408.48</b>
<b>Free work:</b>		
Examinations for Government entities in Manila.....	140,373	1,107,378.00
Vaccines and sera.....	2,078,322	421,034.00
Cebu laboratory examinations.....	2,774	9,957.50
Iloilo laboratory examinations.....	10,599	59,275.50
<b>Total.....</b>	<b>2,232,068</b>	<b>1,597,645.00</b>

In the above table the work is expressed both in terms of units and of value in pesos according to the Bureau of Science schedule of charges. These figures show that the actual cash income from the operation of the division of biology and serum laboratory was over ₱300,000, that more than 7,000,000 units of vaccines and sera were sold, and that the Bureau of Science furnished free to other Government entities more than 2,000,000 units of vaccines and sera and more than 140,000 free examinations. The total value of free examinations, vaccines, and sera furnished other Government entities was in excess of ₱1,597,000.

The Bureau of Science has on hand a sufficient stock of its principal biologic products to meet any emergency that is likely to occur. At present there are on hand 4,000,000 doses of cholera vaccine, 4,000,000 doses of typhoid and paratyphoid vaccine, 116,000 doses of smallpox vaccine, 84,000 doses of dysenteric vaccine, 150 liters of antidysenteric serum, 3,200 doses of antitetanic serum, 50 liters of normal horse serum, 8 liters of antirabic vaccine, besides, smaller amounts of other biologic products.

Two biologic products have been added to the list of those previously manufactured. First, antidysenteric sensitized vaccine which in the past was only in the experimental stage, was manufactured on a large scale during the year for the Philippine Health Service and other Government units. Approximately 260 liters of this product were produced between July and December, 1927. Of this amount approximately 180 liters

were supplied to the Philippine Health Service, about 700 cubic centimeters to the Philippine Constabulary, and 500 cubic centimeters to the United States Naval Medical Supply Depot. The methods of preparing this vaccine have been improved, and the product has proved satisfactory. It has been used chiefly to vaccinate persons who have been in contact with dysentery patients and promises to be important in the control of the spread of the disease.

The other new product is antirabic vaccine for veterinary purposes. Due to the spirit of coöperation of Doctor Villa, city veterinarian of Manila, the compulsory vaccination of licensed dogs has become routine practice. We are supplying the city veterinarian monthly with 2 to 3 liters of the vaccine for his service with the city. Experiments show that this vaccine can be prepared on a large scale at less cost than previously.

Several important changes were made in the equipment of the serum laboratory. A new water tank was built which gives assurance of plenty of water for cleaning and washing purposes in the serum stable. Water that has been wasted can now be utilized, and the expenses connected with pumping can be reduced. An auxiliary tank was placed near one of the buildings that has suffered from lack of water because of its location on high ground.

The addition of a large new refrigerating compartment at Alabang enlarged the storage capacity to such an extent that we can keep on hand the large quantities of vaccine previously mentioned.

*Field work.*—During this year, more than ever, the provinces realized the importance of the examination at the source of supply of waters used or to be used for drinking purposes. Numerous trips were made to the provinces by various members of the staff to perform such examinations. This procedure is very satisfactory, and the waters, in the majority of cases, were found to be of good quality; that is to say, they meet the standard of not more than 500 colonies per cubic centimeter and absence of *B. coli*.

As in the past, members of the division have been sent to assist the health officer in charge of leper trips in the capacity of microscopist diagnosticians. These trips were made at the request of the Philippine Health Service as frequently as was deemed necessary by that service.

The chief of the division was recommended by the Director of the Bureau and appointed by the Secretary of the Department, to attend the VII Congress of the Far Eastern Association of Tropical Medicine at Calcutta. This trip was very instructive due to the great courtesy of the British Indian Government, which supplied all facilities at their command so that the delegates might see the activities of the various branches of the medical service, including the laboratories in British India.

*Provincial laboratories.*—The provincial laboratories under the jurisdiction of the Bureau of Science at Cebu and Iloilo have continued to perform, whenever called upon, the necessary laboratory work for the Philippine Health Service and private practitioners. The equipment of these laboratories was greatly improved by the installation of electric refrigerators, one in each. This arrangement enables the laboratories to serve as distributing centers of biologic products. The physicians in these two cities and the neighborhood need no longer wait several days while the products are being obtained from Manila. Sufficient stock is kept in each laboratory for ordinary purposes and even for emergency.

*Research.*—The most noteworthy accomplishment of the year was the work on yaws by Doctor Schöbl. The experiments on the etiology of the various clinical manifestations and on immunity in many of its phases were continued and gave a very comprehensive picture of the etiology, clinical manifestations, and immunity of the disease. The results are embodied in a paper now in press on experimental yaws in Philippine monkeys. This paper is one of the most outstanding ever produced by the Bureau of Science and will be a classic in medical literature.

Dr. Onofre Garcia studied and described a new lymph-gland disease of cattle. This was caused by a pleomorphic and gas-forming bipolar bacillus. Doctor Garcia also investigated the serologic relationship of choleralike vibrios isolated from water and from human beings.

The work on concentration and purification of curative sera has been continued. The scope is being increased gradually so as to introduce this product for the use of Government units and others that may be interested.

The work on antidyenteric vaccine, bacteriophage, and rabies has been mentioned in other connections.

*Publications.*—The following papers were published during 1927:

Free toxin in the blood during the course of tetanus toxæmia, by K. Yasuyama and Otto Schöbl.

Inquiry into the serologic side-effects of the antirabic preventive treatment, by K. Yasuyama.

A pleomorphic and gas-forming bipolar bacillus isolated from the lymph glands of slaughtered cattle, by Onofre Garcia.

The following papers were submitted and are in process of publication:

Note on local terminology of certain manifestations of yaws, by Otto Schöbl.

Note on bacteriological diagnosis of bacillary dysentery, by Otto Schöbl and Rita Villaamil.

Experimental yaws in Philippine monkeys and a critical consideration of our knowledge concerning frambœsia tropica in the light of recent experimental evidence, by Otto Schöbl.

Viability of *Treponema pertenuis* outside of body and its significance in transmission of yaws, by K. Yasuyama.

Notes on the serological relationship of the choleralike vibrios isolated from human beings and from waters in Manila, by Onofre Garcia.

#### BOTANY

*Personnel.*—There has been no change in the personnel of this division.

*Coöperation.*—The division is in active coöperation with the Bureau of Agriculture by means of the plant-pathology laboratory maintained at the Bureau of Science to which personnel is assigned from the Bureau of Agriculture. The identification of plant specimens for the Philippine Health Service, and the Bureaus of Commerce and Industry, Forestry, and Agriculture is a regular function of this division.

An important project, in coöperation with the Bureau of Forestry, is the preparation of a treatise on the useful trees of the Philippines. This will appear in three or four volumes. The first volume is nearly ready for the printer, while much work has been done on the other volumes.

*Routine.*—Regular exchanges have been established with the Botanic Gardens of Singapore, Straits Settlements, and with the Department of Botany, College of Agriculture, Ithaca, New York.

*Field work.*—Botanical collections were made in Davao, Cullion, Balabac, and Cagayan Sulu. Approximately 6,786 specimens representing 1,031 species were collected, and 2,142 spec-

imens were received from the Bureau of Forestry and other collaborators, making a total of 8,929 specimens of phanero-gamic and cryptogamic plants. Fungi, lichens, and mosses contained in 180 packages are not included in the above figures.

*Medicinal plants.*—The bitter principle of makabuhay, *Tinospora reticulata*, was isolated in pure form by Doctor Marañon. This achievement was very gratifying, as many attempts have been made to isolate the active principle of this plant, which is probably the most widely used and highly valued of local unofficial medicinal plants. A very active and poisonous alkaloid was isolated in the pure state from *Artabotrys suaveolens*, while a study has been made of the total alkaloid content of the different parts of *Datura fastuosa* and *Datura alba*. Histological and microchemical investigations were conducted on *Tinospora rumphii*, *Tinospora reticulata*, and *Artabotrys suaveolens*. Information was collected concerning the therapeutic properties of ninety-one medicinal plants, twelve of which have toxic properties.

*Publications.*—The following papers were published during 1927:

The bitter principle of makabuhay, *Tinospora rumphii* Boerlage, by Joaquin Marañon.

A pharmacognostical study on *Datura alba* Nees and *Datura fastuosa* Linnæus from the Philippines, by José K. Santos.

The following paper was submitted and is in process of publication:

Stem and leaf structure of *Tinospora rumphii* Boerlage and *Tinospora reticulata* Miers, by José K. Santos.

#### PLANT PATHOLOGY

*Personnel.*—The research work in plant pathology was continued according to the coöperative agreement between the Bureau of Science and the Bureau of Agriculture under the direction of the mycologist, Bureau of Science; the technical staff consists of three Bureau of Agriculture investigators detailed to the Bureau of Science, and the mycologist of the Bureau of Science.

*Routine.*—One hundred thirty-four routine pathological diagnoses were made for the Bureau of Agriculture and various correspondents. Nineteen of these were on rice, 9 on coconut, 6 on sugar cane, 6 on breadfruit, 5 on abacá and banana, 5 on corn, 4 on local citrus, and 3 on mango. The remainder were

on various hosts, in part on plants (particularly fruits) intercepted by the Plant Quarantine Service. The reports of a serious outbreak of corn smut (*Ustilago zaeae*) in Cebu and Leyte Islands and the wide distribution and destructiveness of *Sclerotium oryzae* on rice in Luzon deserve special mention. Many of the diseases diagnosed were of little economic importance.

*Abacá and banana diseases.*—Since the publication of Bureau of Agriculture Circular No. 190 the tentative conclusion has been reached that “bunchy top” and “heart rot” of abacá are the same, the latter being a final stage. The primary cause of “bunchy top” is now thought to be a filterable virus. This opinion is supported by successful inoculations by use of the aphid vector.

Variety tests conducted in two of the heavily infected regions of Luzon, at Silang, Cavite Province, and Longos, Laguna Province, indicate that a number of abacá varieties show partial resistance to the disease while canton and pacol, two related but inferior fiber plants of the same genus, are immune. The resistance of the partially susceptible varieties can be increased by the use of calcium phosphate or potassium sulphate, but fertilizers containing only nitrogen were not satisfactory, although certain complete fertilizers containing nitrogen, phosphoric acid, and potash (10 : 6 : 2) gave favorable results. In spite of ameliorating factors thorough eradication still appears to be the only permanent solution.

The aphid *Pentalonia nigronervosa*, which transmits abacá bunchy top, also appears responsible for the spread of banana bunchy top, a disease that is particularly severe on the sabá and latundan varieties.

*Pineapple disease.*—Much attention has been given during the year to a serious pineapple fruitlet rot present in the Islands, particularly in the Smooth Cayenne variety recently introduced. The etiology of the disease and partial methods of control have been worked out. The causal agent is a bacterium of the genus *Arwinia*. The results of the study have been submitted for publication in the Philippine Journal of Science.

*Rice diseases.*—Field investigations in various rice-producing provinces of Luzon indicate that the sclerotial stem rot (*Sclerotium oryzae*) is the most serious disease of this crop, being particularly severe during the past season on account of climatic conditions highly favorable to the development of



the disease during the susceptible stage of the plant. Ilocos Norte Province appeared to suffer the most. Laboratory studies are in progress to delimit the strains of this fungus and to determine their virulence on different varieties of rice.

*Rubber diseases.*—A survey of the diseases of Hevea rubber in Mindanao and Basilan indicates that the plantations, although harboring several of the major diseases, are in general in a thrifty condition as a result of close inspection and early eradication of minor outbreaks.

*Tobacco diseases.*—The investigational work on tobacco diseases has been limited, first, to a study of a bacterial disease which appears to be wildfire and to a few tests of seed sterilizing agents against the organism at the Ilagan tobacco station in Cagayan Valley, Luzon, in which it was found that 1 : 1000 mercuric chloride proved somewhat superior to the same concentration of silver nitrate although retarding germination somewhat more; and, second, to general field observations, followed by laboratory studies, on a green spot of Sumatra wrapper at the tobacco station at Sarunayan, Cotabato Province, Mindanao, of which the causal fungus has not been fully identified.

*Miscellaneous diseases.*—A leaf disease of lanzone seedlings (*Lansium domesticum*) at the Singalong experiment station, Manila, was investigated. It is probably due to a species of *Gloeosporium* and was controlled by spraying with lime sulphur.

Studies on a disease of santol seedlings (*Sandoricum koetjape*), caused by *Phytophthora phaseoli*, at the Singalong experiment station, were completed and a paper submitted for publication in the Philippine Journal of Science. The disease was controlled by sterilization of the soil in the seed flats and the application of lime sulphur or Bordeaux mixture.

*Publications.*—The following papers were published during 1927:

Deterioration of abacá (Manila hemp) fiber through mold action, by F. B. Serrano.

Tobacco diseases in the Philippines, by F. M. Clara.

Anthrax disease of mango in the Philippines, by F. M. Clara.

The control of sugar-cane diseases, by G. M. Reyes.

Sugar-cane diseases and their control, by N. G. Teodoro and G. M. Reyes.

The mosaic disease of sugar cane, by G. M. Reyes.

The following papers were submitted and are in process of publication:

A Phytophthora disease of santol seedlings, by F. M. Clara.

Bacterial fruitlet brown-rot of pineapple in the Philippines, by F.

B. Serrano.

#### GENERAL ZOOLOGY

*Personnel.*—Mr. W. Schultze, entomologist, was granted accrued leave on March 22, 1927. He went to Germany, and resigned June 27, 1927. Two artists were given temporary appointments.

*Coöperation.*—Until he went on leave the entomologist continued his coöperation with the Bureau of Forestry in collecting and naming wood-boring beetles. The division of insects of the United States National Museum has offered to place unidentified specimens in the hands of specialists so as to facilitate the determination of unnamed insects. The death of Charles Fuller Baker, late dean of the College of Agriculture, will be felt in the loss of his extensive coöperative work in systematic entomology. Capt. L. L. Gardner furnished the ornithologist with transportation for several one-day field trips in Luzon.

*Routine work.*—The usual routine of mounting and labeling insects was continued, and a large accumulation of duplicate material was packed for shipment to the United States National Museum. All of the bird specimens were cleaned and found to be in excellent condition. The usual work of mounting birds, mammals, and other animals on private orders was continued as a convenience to the public. Much of the time and the attention of the ornithologist and the artists was consumed in the preparation of illustrations for the Philippine Journal of Science and monographs.

A very pleasing collection of Philippine birds has been placed in display cases in the hall of the main building. These have been greatly admired by the public.

*Field work.*—A large collection of birds and insects was made during an extended field trip in the vicinity of Mati, Davao Province, and specimens were collected on short trips to Bulacan, Laguna, and Batangas Provinces.

*Research.*—No research could be done in entomology due to the lack of personnel. The identification of bird specimens and the making of necessary drawings has been continued whenever the pressure of work on copy for the Bureau publications permitted.

*Publications.*—The following papers were published during 1927:

Biology of the large Philippine forest scorpion, by W. Schultze.  
New or noteworthy Philippine birds, V, by R. C. McGregor.

A catalogue of Philippine Coleoptera, by W. Schultze, was submitted and is in process of publication.

#### FISHERIES

*Personnel.*—Miss Lucia Manikis was employed as an assistant, starting work upon her graduation from the University of the Philippines. On the reopening of the university she was offered a position in the Department of Zoölogy, and was succeeded by Mr. Claro Martin, a zoölogy graduate from the same institution. Dr. Alfred Worm was given temporary employment from April to August, inclusive. He was assigned to field work and shortly after his return to Manila his connection with the Bureau ceased. Mr. Jose Mendoza entered the division on March 21 and was assigned to gather data upon the bañgos industry. At the end of the year he was transferred to the division of mycology and plant pathology. On December 6, Dr. Albert W. Herre, chief of the division, departed on accrued leave to visit the United States.

*Field work.*—An examination of the fish-preserving equipment at the plant of the Philippine Fruit Packing Company at Orion, Bataan, was made in January, and a hand press to be used for experiments on fish preservation was purchased from the company in March. From January to March the mullet fisheries of Cagayan River in Misamis Province were investigated, and the possibilities of planting fish in Bukidnon and Lanao were examined. In March a consignment of mosquito fish was sent to the Federated Malay States at the request of the Straits Rubber Company, Ltd., and Allied Companies, who paid the expense of transportation. Four hundred fifty-six fish were successfully delivered to the plantation near Telok Anson. In the same month a study was made of the fisheries of Pansipit River and Lake Taal, and in April a similar study was conducted on the fisheries of Lake Naujan. During parts of March and April specimens including rare ones were collected about Talisay, in Lake Taal. During the same period several trips were made to Pasig, Santa Cruz, and other towns about Laguna de Bay to consult with the provincial and municipal authorities concerning regulations to protect carp planted in the lake. Several trips were also made on Japanese motor

launches to various parts of the Visayan Islands and particularly to the Cuyo group, the purpose being to collect fish specimens and to study the method of fishing employed by Japanese fishermen. During the greater part of the time from late in March to the end of September an extensive investigation was made on the bañgos fishpond industry in the Manila Bay region and in Panay, Negros, and Cebu. Data upon the construction, operation, and biologic conditions of fishponds were obtained, and valuable information about the marketing conditions, financial returns, taxation, and other factors was also secured.

The tulinġan fisheries of Subic Bay were examined in April. A visit was made in this month to the Central Luzon Agricultural School at Muñoz to advise the superintendent on the construction of fishponds. During the same period carp were planted in Lake Paoay, Ilocos Norte, and the possibilities of planting carp in Abra, Ilocos Sur, and La Union Provinces were studied. A five-month trip starting in April was made to Malampaya Sound and Lake Mangwao for the purpose of collecting specimens and gathering data on fisheries. Part of the time, however, was spent at Bacuit for an examination into the condition of the business of gathering birds' nests.

A series of experiments on fish preservation was carried on at Estancia during the sardine season which started in May. In these, successful methods were worked out whereby the quality of the product was much improved over that heretofore made. A trip to Dumaguete was made in the latter part of May, to give advice to the manager of the Polo Plantation concerning the fishponds. The trip was made at the expense of the company. A consignment of carp was planted in Laguna de Bay on June 10, and another was sent to Pampanga River on July 11. From July 26 to August 15, another study of the fisheries of Lake Naujan was made. On August 28 a shipment of gurami was brought from Java, with the view of introducing this valuable food fish into the pond culture of the Philippines. On October 24, the Provincial Health Service of Davao was furnished with a consignment of mosquito fish for malaria control. Shortly after this trip, the Sulu fisheries from Siasi northward were investigated. Observations were also taken upon the workings of the new regulations controlling the pearling fisheries. Later in the year more specimens were collected at Balabac and Palawan.

*Coöperation.*—The trips to the various islands in the Sulu Archipelago, which enabled Doctor Herre to carry on investi-

gations there, were made possible through the courtesy of Governor Moore who furnished free more than ₱500 worth of transportation. The Japanese fishermen operating from Manila have in all cases willingly consented to let members of the staff go on fishing trips, without cost to the Bureau. The municipal president of Estancia, Policarpio Reyes, has offered the free use of his lot at Botongan, where our experimental nipa shack is located at present.

*The aquarium.*—The aquarium is in much better condition than at any time heretofore. The sea water in the tanks is much clearer than ever before, and a fairly satisfactory scheme of filtering has been evolved. The water is no longer turbid because its contamination by rain water during the typhoon season has been stopped. A better display of fishes has been effected, and the old labels have been replaced with new ones.

*Research and laboratory work.*—The most promising line of research was that conducted by Mr. Montalban on methods of preserving fish at Estancia. Practical and greatly improved methods of smoking, salting, and pickling were devised. The products have been tested by a considerable number of prominent people, and the comments have been very gratifying.

Many fish specimens have been added to the fish collection. The usual cataloguing of the specimens was performed by Mr. Lopez. A fine display of the chief food fishes, the poisonous and doubtfully edible fishes, the commonest edible shellfishes, the commercial sponges and shells has been prepared for the show cases along the hallway in the lower floor of the main building of the Bureau of Science. Mr. Montilla and Mr. Martin assisted in the classification of fishes. Whenever allowed by the pressure of other work, Doctor Herre and Mr. Montalban devoted their time to the preparation of monographs of families and descriptions of groups of Philippine fishes. Illustrations for the fish papers were prepared by Messrs. Pablo Bravo and Antonino Canlas who have rendered faithful and valuable service.

*Publications.*—The following papers were published during 1927:

A new genus and three new species of Philippine fishes, by Albert W. Herre.

The Philippine species of *Kuhliidæ*, by Albert W. Herre and Heraclio R. Montalban.

Philippine sparoid and rudder fishes, by Albert W. Herre and Heraclio R. Montalban.

The Philippine butterfly fishes and their allies, by Albert W. Herre and Heraclio R. Montalban.

*Hynnismomys*, a new Philippine pampano, by Albert W. Herre.

Four new fishes from Lake Taal (Bombon), by Albert W. Herre.

The Philippine band fishes, by Albert W. Herre.

The fisheries of Lake Taal (Bombon), Luzon, and Lake Naujan, Mindoro, by Albert W. Herre.

Philippine surgeon fishes and Moorish idols, by Albert W. Herre.

Gobies of the Philippines and China Sea, by Albert W. Herre.

Fishery resources of the Philippine Islands, by Albert W. Herre.

The following papers were submitted and are in process of publication:

Three new Philippine fishes, by Albert W. Herre.

The Philippine siganids, by Albert W. Herre and Heraclio R. Montalban.

The goatfishes, or Mullidæ, of the Philippines, by Albert W. Herre and Heraclio R. Montalban.

The Philippine gars or needlefishes, by Albert W. Herre.

A check-list of Philippine fishes, by Albert W. Herre.

Pomacentridæ of the Philippine Islands, by Heraclio R. Montalban.

Bañgos culture in the Philippine Islands, by Albert W. Herre and Jose Mendoza.

#### GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

*Personnel.*—The routine work of the division is performed by five chemists including the chief of division, two assistant chemists, and twenty-four assistants and laborers. There has been no change in the staff of the division with the exception that Mr. Feliciano Roque exchanged positions with Mr. Aurelio Cruz of the Philippine Health Service Laboratory in Culion with the previous approval of the authorities concerned. Mr. Roque left this Bureau on August 15, 1927, to take up his new position in Culion, while Mr. Cruz was appointed and reported for duty in the Bureau of Science on September 19, 1927.

*Routine.*—The amount of routine work demanded of the division of inorganic chemistry is very great and is bound to increase. During 1927 the volume of routine work was a third greater than in 1926.

According to regulations, all cement used by the Government must be tested before it can be employed in construction. Likewise samples of all concrete used in Government construction must be tested. A city ordinance of Manila requires the testing of all cement and the resulting concrete used in concrete construction, both private and Government. During the year 36,000 samples of cement and concrete were tested. The value of free work done for the Government in testing cement amounted to ₱18,000.

A prerequisite for the construction of water supplies for municipalities is that the water pass standard chemical and bacteriological tests. Many samples of water were submitted for chemical test by the Bureau of Public Works and the Philippine Health Service.

The work on fuel testing has increased steadily from year to year as the result of Executive Order No. 3, issued on January 27, 1922, by virtue of which all coal purchased by the Government and corporations financed by it must be tested by the Bureau of Science. For two Government institutions alone our fuel-testing laboratory sampled and tested during the year 108,604 long tons valued at ₱2,061,303. The total penalties imposed on deliveries made below the standard amounted to ₱20,627.

The work on standardization of weights and measures is carried out in accordance with Section 10 of Act No. 1519 of the Philippine Legislature. This act provides that the Bureau of Science shall be the official depository of the fundamental weights and measures for the Philippine Islands and that all comparisons of the secondary standards used by provinces and municipalities with the fundamental ones shall be made by the Bureau, upon the request of the Collector of Internal Revenue.

In the following table is given in detail the nature of the routine work done during the year under review as compared with 1926:

Nature of samples received.	1926	1927	
	Samples.	Samples.	Determinations.
<b>Water and general laboratory:</b>			
Rocks, ores, and minerals.....	37	29	49
Metals and alloys.....	56	29	102
Paints, oils, and varnishes.....	38	48	519
Crude chemicals and standard solutions.....	109	52	52
Waters.....	244	278	8,848
Miscellaneous.....	409	86	284
<b>Total.....</b>	<b>893</b>	<b>522</b>	<b>4,854</b>
<b>Weights and measures:</b>			
Measures of length.....	2	60	60
Measures of capacity.....	9	120	120
Weights.....	54	430	430
Scales and other weighing devices.....	9	30	30
Miscellaneous.....	89	15	23
<b>Total.....</b>	<b>163</b>	<b>655</b>	<b>663</b>

Nature of samples received.	1926		1927	
	Samples.	Samples.	Deter- minations.	
<b>Cement laboratory:</b>				
Portland cements (physical test).....		18,621	24,207	
Portland cements (chemical tests).....	14,433	298	1,192	
Concrete cubes and cylinders.....	5,418	11,050	11,050	
Steel rods and bars.....	27	30	89	
Ropes.....	43	207	418	
Cloth and other fabrics.....	66	37	182	
All others.....	31	40	240	
Total.....	20,137	30,283	37,378	
<b>Fuel laboratory:</b>				
Manila Railroad, coal.....	<sup>a</sup> 136	<sup>b</sup> 165	990	
Bureau of Supply, coal.....	<sup>c</sup> 60	<sup>d</sup> 66	396	
Fuel oil.....	11	9	18	
All other coal samples.....	8	29	174	
Total.....	215	269	1,560	
Grand total.....	21,408	31,729	44,455	

<sup>a</sup> 78,488 tons.<sup>b</sup> 93,522 tons.<sup>c</sup> 21,582 tons.<sup>d</sup> 14,866 tons.

*Research.*—The pressure of routine work has left too little time for research. Only two of the chemists, Mr. Aguilar and Mr. Espinosa, have been able to devote any considerable time to this activity. As things now stand investigation work is done in an intermittent manner when pressure of other work permits, a condition which is very unsatisfactory. Under the circumstances the results are gratifying.

Mr. Aguilar has completed an investigation of the radioactivity of artesian-well waters in Manila and vicinity; of the chemical characteristics of artesian-well waters of Bulacan Province and their relation to the geology of the region; and of the regional variation in the chemical composition of Philippine water supplies. The results of these investigations will be ready for publication in the near future.

Mr. Del Mundo has investigated the lasting qualities under local conditions of different inks as influenced by the chemical composition. As a practical result a modification of the United States Bureau of Standards formula has been found to be satisfactory and the Bureau of Supply now purchases inks on specifications based on this modified formula. The results will be published in the near future.



Mr. Reyes has continued the investigation of cogon and rice straw as raw materials for the manufacture of paper.

Mr. Espinosa has continued the work begun by this Bureau a number of years ago on the testing of the mechanical properties of the principal Philippine timbers. This work has entailed many thousands of tests and a great deal of calculation. So far this work has yielded two papers, one on the comparative strength properties of the principal Philippine commercial timbers, which was published during the year, and one on the strength properties in relation to specific gravity of Philippine woods. This work on Philippine woods should prove of great value to engineers and architects in the Philippines and also to exporters of Philippine wood. Mr. Espinosa has also half completed a study of the spike-holding properties and durability of railroad ties made from Philippine wood.

Mr. Aguilar has in progress two lines of investigation on paint material. The comparison of red lead with different proportions of inert pigment in linseed and lumbang oil as primers on metallic surfaces, and the weathering of paint by a rapid method with quantitative measurements of this weathering.

Doctor Dar Juan and Mr. Del Mundo are conducting experiments on the relative efficiency of different brands of kerosene. The work of Doctor Dar Juan in connection with the Manila Railroad fellowship has been mentioned earlier in this report under the general heading of Industrial Fellowships.

*Publications.*—The following papers were published during 1927:

Concrete value of Philippine sand, gravel, and crushed stone, by R. H. Aguilar.

Composition and comparative service value under Philippine conditions of some imported prepared paints, by R. H. Aguilar.

Notes on the analysis of phenol (carbolic acid), by Salvador del Mundo.

Comparative strength properties of the principal Philippine commercial woods, by Jose C. Espinosa.

Government coal purchases under specifications, by F. D. Reyes and T. Dar Juan.

The following papers were submitted and are in process of publication:

Strength properties in relation to specific gravity of Philippine woods, by Jose C. Espinosa.

The lime industry of the Philippine Islands, by F. D. Reyes.

## SOILS AND FERTILIZERS

*Personnel.*—Owing to the increasing amount of work of the division without a corresponding increase in personnel, some difficulty has been encountered in carrying on the enforcement of the fertilizer law and an adequate prosecution of investigation work. Mr. Rufino Isidro, who is employed by the Bureau of Agriculture, continues in his special assignment for soil analysis. The chief of the division was designated Acting Director of the Bureau from June 4 to June 29, 1927, while Mr. Tirona was assigned as acting chief of the division for the same period. Owing to the fact that the city of Iloilo has grown to be an important fertilizer center, it has been found essential to send a senior member of the division to Iloilo for the period of the active fertilizer season.

*Routine work.*—The routine work of the division continues to increase in view of the demand for fertilizer, especially in the sugar regions of the Islands and to a limited extent in the growing use of fertilizer in the rice region of central Luzon. There was also noted a strong desire on the part of many farmers to know the condition of their soil with a view to improving the productive capacity of the land. In spite of the shortage in personnel a considerable volume of work was accomplished due to the interest taken and to the spirit of coöperation among the members of the division. The analytical work accomplished during the year is shown in the following table:

Soil analyses .....	samples....	94
Commercial fertilizers .....	do.....	96
Guano, copra cake, ashes, and similar materials..	do.....	51
Insecticide, fungicide, sea-water test, and other miscellaneous analyses .....	do.....	47
Fertilizer tags sold.....	tags....	321,988
Registration of fertilizers.....		20
Fertilizers analyzed in accordance with Act 3067.....		346

*Coöperation.*—This division is frequently called upon to render technical advice to local fertilizer factories. The exploitation of guano has grown hand in hand with the growth of the local fertilizer industry. This division has helped foster the use of guano by indicating the method of exploitation and the utilization by proper mixing with chemical ingredients. We are frequently called upon to do umpire work and to give correct valuation to local fertilizer materials. Controversies on the merits of one class of fertilizer over another are referred to this laboratory for settlement.

This division is in close touch with the experimental work of the Bureau of Agriculture. A considerable number of soils and fertilizers were analyzed for that bureau. The work on fermentation and curing of tobacco leaves together with some fertilizer experiments on tobacco are still in progress.

Agricultural companies and private parties have frequently consulted this division with regard to the adaptability of crops to certain types of soils. The Metropolitan Water District on several occasions has called on this division to help in the agricultural evaluation of the lands expropriated by the district.

*Field work.*—Only a limited amount of field work could be undertaken during the year just closed on account of the shortage of funds available for travel. It is expected that more field work will be done in 1928 as additional funds have been granted in the 1928 budget. A soil survey of a section of the municipality of Tarlac, Tarlac, comprising some 2,500 hectares was completed. Another soil survey for a private concern of a portion of Santa Cruz de Malabon Estate covering some 1,100 hectares was also undertaken. The types of soils were indicated on a map, and the agricultural value of the various areas was considered.

*Research.*—The following investigations have been underway during the year: Artificial method of fermenting leaf tobacco; the effect of fertilizer upon the texture of Philippine tobacco; investigation on the physical analysis of soil with the view of finding a simpler, shorter, and more accurate method of separating the soil particles of different sizes and to determine the efficacy of the various clay deflocculants; and field fertilizer experiments in Cavite and Rizal Provinces.

*Publications.*—Nitrifying power of some Philippine soils, a paper by M. M. Alicante, was published during 1927.

The following papers were submitted and are in process of publication:

The abo-abo soil of Occidental Negros, by M. M. Alicante.

The occurrence of nitrification in acid soil, by M. M. Alicante.

#### ORGANIC CHEMISTRY

*Personnel.*—Mr. A. H. Wells, chief of the division, retired December 5, 1927. Dr. A. P. West, of the University of the Philippines, was appointed, effective December 15, 1927, to succeed him. Mr. Ray N. Allen was contracted as chemist from the United States, and started to work April 1, 1927. Dr. D. M.

Birosel, a graduate of Stanford University, was appointed temporarily as chemist, effective November 16, 1926, and as chemist from September 13, 1927.

*Routine work.*—There has been a considerable increase in routine work, especially in the enforcement of the Pure Food and Drugs Act, vegetable and mineral oil analyses, clinical and toxicological analyses, and various other analyses of complex nature for the various Government offices and for commercial houses. The total number of samples analyzed was 9,176. Much time was spent in consultation with interested persons, in giving expert testimony in courts, and attending meetings of the Board of Food Inspection, Board of Pharmaceutical Examiners and Inspectors, and the Beriberi Committee. The personnel has also trained private individuals in sugar analysis and other laboratory control work. Demonstrations in soap manufacture on a small scale were given from time to time.

The following tables give an idea of the number of various samples analyzed:

Nature of analyses.	Samples.
Urine, chemical, and toxicological analyses.....	834
Essential oils and essences.....	12
Petroleum and copra products and similar materials.....	739
Varnishes and linseed oil.....	1
Gastric juice, clinical examination.....	1
Foods, alcohols, and beverages.....	6,907
Food preservatives and coloring matters.....	59
Medicines and similar articles.....	594
Miscellaneous organic analyses and examinations.....	29
Total .....	9,176

*Coöperation.*—As usual this division actively coöperated during the year with the United States Army Medical Department Research Board, various Government entities, a number of private concerns, and private individuals, giving useful information, technical advice, and practical demonstrations. In coöperation with the Bureau of Health, this division has made effective the enforcement of the Pure Food and Drugs Law as can be seen in the many prosecutions against infractors.

*Manufacture of tikitiki extract.*—Tikitiki extract, 53,819 bottles, with a total cash value of ₣37,673.30, was manufactured; 48,580 bottles were delivered, free of cost, to the Office of the Public Welfare Commissioner for free distribution to the public, and the rest for sale in the Bureau of Science. The supplies and

materials used in the manufacture of tikitiki extract were valued at ₱10,286.13.

*Research.*—The members of the organic division have undertaken the investigation of various problems of practical importance in spite of the increased volume of routine work. The investigation on rice as regards the determination of a satisfactory standard for beriberi-preventing rices, started in 1925 in coöperation with the United States Army Medical Department Research Board, has been completed.

A study on the composition of Philippine-grown Hawaiian pineapples as well as of the native varieties has been completed and also an investigation on the composition and nutritive value of Philippine food fishes.

Further investigation on Philippine camphor is underway.

A study on the effect of the solvent upon the rotation of active compounds has yielded results. The usual way of making solutions for rotation work was not followed but a new method was devised to make the observed angle of rotation the basis of comparison. A study on mixed ethers has been started in the laboratory and the work has already resulted in one published paper.

An extensive study of Philippine starches is under way; to date, over eighty sources have been examined.

The division of organic chemistry is also undertaking a study on the food value of different varieties of rice with regard to the comparative increase in weight of rats, a study on the properties of the oil of tikitiki as regard vitamin E, vitamin content of some Philippine vegetables, and also a method for a biological standardization of tikitiki extract.

*Publications.*—The following papers were published during 1927:

An odoriferous oil and two new linolic tetrabromides from Philippine lumbang oil, by Simeona Santiago and Augustus P. West.

Reduction of linolenic and linolic bromides and rebromination of the free acids, by F. L. Smith and Augustus P. West.

Salts of alpha linolic tetrabromide (sodium, potassium, zinc, barium, calcium, and strontium) from Philippine lumbang oil, by Adelaida T. Oreta and Augustus P. West.

Salts of linolenic hexabromide (calcium, magnesium, strontium, and nickel) from Philippine lumbang oil, by Pedro R. Almoradie and Augustus P. West.

Chaulmoogryl amino benzoic acids and chaulmoogra anilides, by Simeona Santiago and Augustus P. West.

Salts of alpha linolic tetrobromide (cadmium, cobalt, copper, magnesium, and manganese) from Philippine lumbang oil, by Ceferino M. Jovellanos and Augustus P. West.

Alcohol addition products of the bromo derivative of mixed ethers and bromo derivative of diphenylisopropyl ether, by D. M. Birosel.

Esters of alpha linolic acid tetrabromide (methyl, ethyl, propyl, isopropyl, and allyl) from lumbang oil, by Irene de Santos and Augustus P. West.

The following papers were submitted and are in process of publication:

An investigation to determine a satisfactory standard for beriberi-preventing rices, by E. B. Vedder and R. T. Feliciano.

Chaulmoogryl derivatives of lactates and salicylates, by Simeona Santiago and Augustus P. West.

Esters of alpha linolenic acid hexabromide (isobutyl, amyl, *n*-propyl, and isopropyl) from Philippine lumbang oil, by Maria Luisa A. Vicente and Augustus P. West.

Composition of Philippine pineapples, by A. H. Wells, F. Agcaoili, H. Taguibao, and A. Valenzuela.

Composition and nutritive value of Philippine food fishes, by A. Valenzuela.

Notes on coloring matter in the higher fractions of cracked gasoline, by D. M. Birosel.

Reactions in phosgene, by D. M. Birosel.

Solvent effect upon the rotatory power of active compounds, by D. M. Birosel.

Relative vitamin A content of four Oriental foods, by Hartley Embrey Sherman.

Relative content of water-soluble B vitamin in thirty Oriental foods, by Hartley Embrey Sherman.

Certain proteins added to mungo bean, or to white or red Sorghum vulgare, increase the fertility of mice, by Hartley Embrey Sherman.

The chemical analyses of thirty-seven Oriental foods, by Hartley Embrey Sherman.

Relative water-soluble vitamin C content of nine Oriental fruits and vegetables, by Hartley Embrey Sherman.

Calcium, iron, and magnesium content of sixteen Chinese foods, by Hartley Embrey Sherman.

#### FOOD PRESERVATION

*Personnel.*—Miss Maria Y. Orosa was appointed acting chief of the division on January 3. The temporary appointment of Miss Presentacion Atienza as inspector was approved on January 7. On January 10, Misses Josefina Javier, Roberta Diokino, Magdalena Agcaoili, Patrocino Sales, Maxima Lumain, and Iluminada Ramos were given temporary appointments as senior demonstrators; likewise, temporary appointments as

junior demonstrators were given Misses Paciencia Esguerra, Tarcila Abad, Rosa de Belen, and Mr. Miguel Camagong on January 3; Misses Remedios M. de Ubago and Carolina Gonzales on March 16; Miss Lourdes S. Duterte on May 26; Misses Matilde Z. Rivera and Natividad Brodeth on June 2; and Miss Paciencia Regalado on September 6. Miss Rosa de Belen resigned on May 17, and Miss Iluminada Ramos on May 22. Miss Paciencia Esguerra was promoted to the position vacated by Miss Ramos, effective May 28.

*Coöperation.*—Coöperation was furnished a considerable number of companies and individuals who are manufacturing or who intend to manufacture canned Philippine fruits and vegetables commercially. This coöperation has resulted in several companies and individuals going into the business.

Special lectures and demonstrations were given to help domestic science and home economics teachers. It is very gratifying to know that food preservation is now being taught in schools and that a food preservation contest will be held among the city schools of Manila on February 18, 1928.

This division coöperated with the Philippine Carnival Association and provincial carnival associations, and exhibited and made practical demonstrations in provincial charity fairs and garden-day fêtes. A food-preservation contest was held during the last Philippine Carnival. A large silver loving cup was awarded by the Carnival Association to the winning province and ₱1,000 were distributed to the individual winners. The Pacific Commercial Company awarded ₱175 as special prizes to three individual winners. Seventeen provinces and eighty individuals joined the contest. Similar contests in food preservation were held in the various provincial carnivals. These contests serve to stimulate the Filipino people in saving the excess of fruits and vegetables grown in abundance and otherwise wasted, and in cultivating the spirit of independence in household economics.

*Routine work.*—The room of the Bureau of Science used for demonstrations is usually crowded with women from various districts of Manila, eager to learn the methods used in preserving native fruits and vegetables. Many prominent ladies, wives of high Government officials and of successful business men, together with other women in all walks of life have come with an earnest desire to learn the scientific methods of food preservation and have done the work with their own hands. About 490

women have taken lessons in the Bureau of Science laboratory. This does not include the hundreds of students from the city schools and those from the towns near Manila for whom special demonstrations were made during Saturdays.

*Field work.*—The demonstrators of this division spent most of their time in the provinces. One senior and one junior demonstrator usually went together to a province, after the proper arrangements with the provincial officials were made. The length of stay in each place depended on the coöperation given by the provincial and municipal officials and the number of students that attended the demonstrations.

Ninety-one towns in seventeen provinces were visited. The demonstrators gave lessons to 13,070 women in the various provinces. The cost to the Government was ₱1.65 a student. This amount is indeed very small considering that the demonstrators traveled from the most northern to the most southern part of the Philippines. The towns visited and the number of students taught in each are given in the following list:

	Province and town.	Number of women taught.
Antique:		
	San Jose de Buenavista .....	604
	Bugasong .....	262
	Culasi .....	183
	Sibalon .....	272
	Pandan .....	268
	Total .....	<u>1,589</u>
Batangas: Lipa .....		<u>28</u>
Bulacan:		
	Hagonoy .....	112
	Paombong .....	50
	Calumpit .....	160
	Total .....	<u>322</u>
Capiz:		
	Capiz .....	223
	Calivo .....	283
	Ibajay .....	202
	Total .....	<u>708</u>



Cebu:	Province and town.	Number of women taught.
	Opou .....	92
	Naga .....	58
	San Fernando .....	100
	Danao .....	68
	Bogo .....	72
	Mandawe .....	75
	Barili .....	48
	Dumanjug .....	63
	Sibonga .....	49
	Argao .....	207
	Dalaguete .....	143
	Balamban .....	294
	Tuburan .....	201
	Cebu .....	76
	Carcar .....	182
	<b>Total</b> .....	<b>1,728</b>
	<b>Iloilo: Pototan</b> .....	<b>102</b>
	<b>La Union:</b>	
	San Fernando .....	293
	San Juan .....	105
	Bacnotan .....	84
	Luna .....	116
	Balaoan .....	119
	Bangar .....	84
	Bauang .....	91
	Naguilian .....	69
	Caba .....	86
	Aringay .....	75
	Tubao .....	75
	Agoo .....	112
	Santo Tomas .....	66
	Rosario .....	62
	<b>Total</b> .....	<b>1,437</b>
	<b>Laguna:</b>	
	San Pablo .....	88
	Los Baños .....	208
	<b>Total</b> .....	<b>296</b>

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	Province and town.	Number of women taught.
<b>Mindanao:</b>		
	Zamboanga .....	244
	Jolo, Sulu .....	149
	Cotabato .....	73
	<b>Total</b> .....	<b>466</b>
<b>Misamis:</b>		
	Cagayan .....	94
	Mambajao .....	196
	<b>Total</b> .....	<b>290</b>
	Surigao .....	71
<b>Agusan:</b>		
	Cabadbaran .....	80
	Butuan .....	91
	<b>Total</b> .....	<b>171</b>
	Lanao: Dansalan .....	169
	Davao .....	187
	Mountain Province: Baguio.....	181
<b>Nueva Vizcaya:</b>		
	Bayombong .....	402
	Dupax .....	171
	Solano .....	220
	Bambang .....	146
	<b>Total</b> .....	<b>939</b>
<b>Occidental Negros:</b>		
	Silay .....	69
	Hinigaran .....	83
	Isabela .....	183
	Bacolod .....	335
	Bago .....	138
	Ma-ao .....	102
	La Granja .....	127
	Pulupandan .....	138
	<b>Total</b> .....	<b>1,175</b>

	Province and town.	Number of women taught.
<b>Oriental Negros:</b>		
	Dumaguete .....	222
	Tanjay .....	34
	Total .....	256
<b>Pampanga:</b>		
	Macabebe .....	29
	Lubao .....	47
	Arayat .....	31
	Guagua .....	45
	Angeles .....	48
	Total .....	200
<b>Pangasinan:</b>		
	Dagupan .....	125
	Alaminos .....	247
	Santa Barbara .....	134
	San Carlos .....	200
	Pozorrubio .....	172
	Total .....	878
<b>Samar:</b>		
	Catbalogan .....	366
	Calbayog .....	484
	Oquendo .....	155
	Total .....	1,005
<b>Tarlac:</b>		
	Tarlac .....	109
	Paniqui .....	159
	Gerona .....	197
	Moncada .....	64
	Victoria .....	163
	Camiling .....	206
	Concepcion .....	39
	Total .....	937
	Grand total .....	13,135

*Research.*—Due to lack of space in the laboratory and to the great demand for demonstration work in the provinces, very little time was devoted to research. Ninety-eight new recipes were prepared and found successful. These will be included in

the pamphlet, *Preservation of Philippine Foods*, when this is revised.

*Public opinion.*—The numerous resolutions and letters of thanks received from provincial and municipal officials, officers of women's clubs, and women in private life show that the women in particular and the public at large are much benefited by this special activity of the Bureau of Science.

#### GEOLOGY AND MINES

*Personnel.*—Prof. Bailey Willis, emeritus professor of Stanford University, was appointed geologist without compensation, from December 29, 1926. Prof. H. Otley Beyer was also appointed geologist without compensation during the period from December 29, 1926, to January 10, 1927. Dr. Jose M. Feliciano, acting head of the Department of Geology and Geography, University of the Philippines, was appointed geologist without compensation from April 23 to May 23.

Mr. Silverio Gayod, junior draftsman in this division, died on March 27, 1927. His work has been entrusted to Mr. Felix S. Malay, one of the laboratory helpers.

*Routine work.*—The division continued to render both to the public and to other Government entities the usual varied services consisting in consultations on geological and mining subjects, the examination and identification of rocks and minerals, the study of drilling samples for the Bureau of Public Works, and the regular work of assaying, smelting, refining, and drafting.

The petrographic studies of Philippine rocks has been continued, also the preparation of index cards for fossils, and the revised arrangement and classification of both Recent and fossil material.

*Field work.*—The field expenses of the following trips were borne by the Bureau of Science:

Geologic study of northern Luzon, by Doctor Willis, Professor Beyer, Mr. Elicaño, and Mr. Alvir, from December 29, 1926, to January 16, 1927.

Geologic study of Cebu, by Doctors Willis and Faustino and Mr. Elicaño, January 19 to 24.

Geologic study of southern Luzon, by Doctor Willis, Mr. Alvir, and Mr. Elicaño, January 24 to 27.

Geologic study of eastern Mindanao, by Doctor Willis and Mr. Elicaño, from March 28 to May 6.

Examination and survey of the Tumbaga mine, by Mr. Abad, from February 21 to March 11, and by Mr. Alvir on the following dates: March 7 to 11, April 4 to 14, and October 17 to 21.

Visit to the Masbate Mining District to obtain data for the Mineral Resources, by Mr. Abarquez, from April 1 to 24.

Collection of corals and shells near Coron, by Mr. Abad, from May 17 to 23.

Geological trip to Angat District, by Mr. Alvir, from March 20 to 22.

Visit to the manganese prospects in Tarlac, by Mr. Elicaño from June 25 to 29.

Short trips to neighboring provinces for the investigation of the Manila sand and gravel supply, by Doctor Faustino, from October 5 to date.

Visit to the gold mines of Baguio, by Mr. Alvir, from December 24, 1927, to January 2, 1928.

The following trips were undertaken at the expense of other entities:

Trip to northwestern Pangasinan, for the study of underground-water resources, by Mr. Elicaño, from March 7 to 23, paid by the Bureau of Public Works.

Trip to the chromite deposit of Zambales to guide Bureau of Lands surveyors, by Mr. Elicaño, from May 19 to June 25, paid by the Bureau of Lands. Due to bad weather the party was unable to reach the deposit.

Study of ground-water resources of Panay, by Mr. Alvir and Doctor Feliciano, from April 23 to May 30, paid by the Bureau of Public Works. This work will be continued.

Examination of gypsum claims in Mabini, Batangas, by Mr. Abad, from June 7 to 14, paid by Gloria-Castillo Gypsum Mining Co. Due to bad weather this work was not finished.

The Bureau of Public Works set aside ₱3,600 to be expended by the division in the study of underground-water resources in different parts of the Islands. On account of the work undertaken with Doctor Willis it was impossible to make a study of all the localities requested by the Bureau of Public Works. The chief of the artesian wells division, Bureau of Public Works, stated that the geological information furnished to him had effected a saving to his bureau of approximately ₱20,000 during 1927. It is expected that the Bureau of Public Works will set aside during 1928 about ₱4,000 for coöperation in geological studies.

*Research.*—We were very fortunate in having Dr. Bailey Willis with us during the early part of the year. Doctor Willis made extensive trips in the Islands in company with the regular members of the Bureau of Science staff. These trips resulted in a better understanding of the major structural problems of the Philippines. Doctor Willis has in preparation a paper on the structural geology of the Islands which he has promised for publication in the Philippine Journal of Science.

Mr. Elicaño has continued his intensive study of the geology and mineral resources of the Zambales Range, the western cordillera of Luzon. This investigation is particularly important as it is the first detailed investigation of this extensive range, which has been one of the least-known mineral districts. He has made special studies of the chromites, manganese, and white clays of this region, and also of the underground-water resources of the northwestern part of Pangasinan in which is the northern termination of the Zambales Range.

Mr. Elicaño and Mr. Abad studied the gypsum deposit in Batangas Province.

Doctor Faustino's monograph on the Recent Madreporaria of the Philippines appeared during the year. Doctor Faustino has continued his work on corals and extended it to include fossil corals.

Doctor Faustino, in cooperation with the division of inorganic chemistry, has begun the study of sand, gravel, and stone available for crushed rock in the vicinity of Manila, and will try to estimate the amount of these materials. There has been great activity in concrete construction in Manila, and the amount of material known to be available has been greatly diminished.

Mr. Alvir made a study of the geology of central Panay with special reference to the underground-water resources. Mr. Alvir has also undertaken the study of ores from the Baguio mineral district by means of polished sections. During the year Mr. Alvir worked on the preparation of the results of his studies of the geology of Angat-Novaliches region and also on the geology of Balabac Island.

*Publications.*—The following papers were published during 1927:

Philippine coal resources and their exhaustion, by Leopoldo A. Faustino.

Notes on Cebu coals, by Leopoldo A. Faustino.

The Negros earthquakes of 1925, by Leopoldo A. Faustino.

Recent Madreporaria of the Philippine Islands, by Leopoldo A. Faustino.

The Mineral Resources of the Philippine Islands for the years 1924 and 1925.

The following papers were submitted and are in process of publication:

Correlation of the tertiary formations of the Philippines with those of Europe, Asia, and America, by Leopoldo A. Faustino.

Summary of Philippine marine and fresh-water mollusks, by Leopoldo A. Faustino.

LIBRARY

*Personnel.*—There were few changes in the staff; the most important was the appointment of Mrs. Carmen M. Espinosa, librarian of the University High School, as loan librarian on January 17.

*Additions.*—Two thousand one hundred twenty-two bound volumes were added during the year, and five were withdrawn as lost, bringing the total number of bound volumes up to 61,648. On January 1 there were 40,316 unbound volumes, parts, and pamphlets, of which 5,555 were withdrawn for binding, leaving 34,761. The number of unbound volumes, parts, and pamphlets added during the year was 12,399, bringing the total number of unbound volumes, parts, and pamphlets up to 47,160. This added to 61,648 makes a total of 108,808 bound and unbound volumes, parts, and pamphlets at the close of the year.

*Exchanges.*—Twenty scientific periodicals have been added to the exchange list during the year, bringing the total number of exchange publications up to 907.

*Use of the library.*—The number of publications used in the library and those charged out was 55,896, a daily average of 154 publications. In spite of the fact that the library has not resorted to any form of library publicity, the number of visitors is steadily increasing. The number of visitors recorded was 12,593 as compared with 11,352 for 1926.

*Binding.*—The 600 volumes reported at the bindery on January 1 have been returned; 1,800 have been prepared and forwarded for binding. Of the latter number 995 have been returned, leaving 805 at the bindery at the close of the year. The number of pamphlets bound in pamphlet binders is 784.

PUBLICATIONS

*The Philippine Journal of Science.*—The three volumes of the Philippine Journal of Science for 1927 consist of the following:

	Volume 32, January to April, 1927.	Volume 33, May to August, 1927.	Volume 34, September to December, 1927.	Total.
Pages.....	569	451	491	1,511
Plates.....	50	34	73	157
Text figures.....	75	5	31	111

The following table shows the number of names on the mailing list of the Philippine Journal of Science for 1927, as compared with 1926:

	1926	1927
Paid subscriptions.....	264	268
Exchanges.....	636	651
Review subscriptions.....	33	34
Free.....	75	75
Total.....	1,008	1,028

In the following table is shown the distribution according to continents of subscribers, exchanges, and free copies of the Philippine Journal of Science. These figures show that the Journal is widely distributed to scientific institutions in all parts of the world.

	Paid subscriptions.	Exchanges.	Review subscriptions.	Free.	Total.
Philippines.....	30	13		51	94
Asia, excluding the Philippines.....	81	102	1	1	185
Europe.....	28	243	20	2	293
North America.....	102	223	13	21	359
South America.....	8	17			25
Africa.....	12	17			29
Australia and neighboring islands.....	7	36			43
Total.....	268	651	34	75	1,028

Copy for the numbers for January to June, 1928, has been sent to the printer; page proof for January and February numbers was received from the printer by the close of the year.

The following are the titles and the names of authors of the papers published in the Philippine Journal of Science during 1927:

VOLUME 32, JANUARY TO APRIL

*No. 1, January, 1927*

- ALICANTE, M. M. Nitrifying power of some Philippine soils.  
 YASUYAMA, K., and OTTO SCHÖBL. Free toxin in the blood during the course of tetanus toxæmia.  
 HERRERA-BATTEKE, PILAR. Anilides and toluides of chaulmoogric acid.  
 SANTIAGO, SIMEONA, and AUGUSTUS P. WEST. An odoriferous oil and two new linolic tetrabromides from Philippine lumbang oil.  
 DRAKE, CARL J. Tingitidæ from the Far East (Hemiptera).



OHAUS, F. Zwei neue Anomala-Arten der Philippinen (Coleoptera, Lamellicornia, Ruteliden).

MENDIOLA, NEMESIO B. Imperfect hermaphroditism in flowers of Hibiscus, removed by surgical operation.

SERRANO, FELICISIMO B. Deterioration of abacá (Manila hemp) fiber through mold action.

*No. 2, February, 1927*

REINKING, O. A., and H. W. WOLLENWEBER. Tropical Fusaria.

TAGENGREN, F. R. The Calambayungan and Larap iron-ore deposits of Mambulao, Camarines Norte Province, Philippine Islands.

*No. 3, March 1927*

SANTO, JOSÉ K. A pharmacognostical study on Datura alba Nees and Datura fastuosa Linnæus from the Philippines.

SMITH, F. L., and AUGUSTUS P. WEST. Reduction of linolenic and linolic bromides and rebromination of the free acids.

SMITH, F. L. A modified combustion method for the determination of bromine in organic compounds.

NAÑAGAS, JUAN C., and LEON C. SANTIAGO. Vital capacity and physical standards of students of the University of the Philippines.

STURTEVANT, A. H. Philippine and other Oriental Drosophilidæ.

SCHULTZE, W. Biology of the large Philippine forest scorpion.

BAKER, C. F., and C. BODEN KLOSS. Spolia mentawiensia: Hemoptera-Fulgoroidea.

HERRE, ALBERT W. A new genus and three new species of Philippine fishes.

*No. 4, April, 1927*

AGUILAR, R. H. Concrete value of Philippine sand, gravel, and crushed stone.

MANALANG, C. Effect of carbon tetrachloride, chenopodium, and thymol on the ova of expelled hookworms.

MCGREGOR, RICHARD C. New or noteworthy Philippine birds, V.

BAKER, C. F. Some Philippine and Malaysian Machaerotidæ (Cercopioidea).

JACOBI, A. Ueber einige Tomaspidinæ (Rhynchota, Homoptera) von den Philippinen.

GIRAULT, A. A. Four new chalcid flies from the Philippines.

FIDELINO, F. A., and P. A. PAÑGAN. Intrahepatic administration of drugs.

VOLUME 33, MAY TO AUGUST

*No. 1, May, 1927*

FAUSTINO, LEOPOLDO A. Philippine coal resources and their exhaustion.

MANALANG, C. Ancylostomiasis: Relation between number of ova per gram of formed stool and number of female worms harbored by the host, I.

MANALANG, C. Ancylostomiasis: Relation between number of ova per gram of formed stool and number of female worms harbored by the host, II.

EGGERS, HANS. Neue Indo-Malayische Borkenkafer (Ipidæ), II. Nachtrag.

FUNKHOUSER, W. D. New Philippine Membracidæ (Homoptera).

*No. 2, June, 1927*

- MACFARLANE, J. M. The Philippine species of *Nepenthes*. 3  
 COPELAND, E. B. Nomenclature of the abacá plant. 11  
 PARÁS, ERNESTO M. Blood-chemistry studies in leprosy, II. The alkali reserve.  
 ORETA, ADELAIDA T., and AUGUSTUS P. WEST. Salts of alpha linolic tetrabromide (sodium, potassium, zinc, barium, calcium, and strontium) from Philippine lumbang oil.  
 AGUILAR, R. H. Composition and comparative service value under Philippine conditions of some imported prepared paints.  
 HERRE, ALBERT W., and HERACLIO R. MONTALBAN. The Philippine species of *Kuhliidæ*.  
 ELLIOTT, E. A. New *Stephanidæ* from Borneo and the Philippine Islands, II.

*No. 3, July, 1927*

- YASUYAMA, K. Inquiry into the serologic side-effects of the antirabic preventive treatment.  
 MANALANG, C. Observations on the development of *ascaris* ova.  
 ALMORADIE, PEDRO R., and AUGUSTUS P. WEST. Salts of linolenic hexabromide (calcium, magnesium, strontium, and nickel) from Philippine lumbang oil.  
 SANTIAGO, SIMEONA, and AUGUSTUS P. WEST. *Chaulmoogryl* amino benzoic acids and *chaulmoogra* anilides.  
 COCKERELL, T. D. A. Hymenoptera from Lucban, Philippine Islands.  
 TYLER-TOWNSEND, CHARLES H. New Philippine Muscoidea.  
 ALEXANDER, CHARLES P. New or little-known *Tipulidæ* from the Philippines (Diptera), Part IV.  
 GRANDI, GUIDO. Hyménoptères Sycophiles récoltés aux Iles Philippines par C. F. Baker, I. Agaonini. 22<sup>me</sup> contribution à la connaissance des insectes des figuiers.

*No. 4, August, 1927*

- GARCIA, ONOFRE. A pleomorphic and gas-forming bipolar bacillus isolated from the lymph glands of slaughtered cattle.  
 JOVELLANOS, CEFERINO M., and AUGUSTUS P. WEST. Salts of alpha linolic tetrabromide (cadmium, cobalt, copper, magnesium, and manganese) from Philippine lumbang oil.  
 MARAÑON, JOAQUIN. The bitter principles of *makabuhay*, *Tinospora rumphii* Boerlage.  
 DEL MUNDO, SALVADOR. Notes on the analysis of phenol (carbolic acid).  
 FAUSTINO, LEOPOLDO A. Notes on Cebu coals.  
 ESPINOSA, JOSÉ C. Comparative strength properties of the principal Philippine commercial woods.  
 HERRE, ALBERT W., and HERACLIO R. MONTALBAN. Philippine sparoid and rudder fishes.

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*No. 1, September, 1927*

- HERRE, ALBERT W., and HERACLIO R. MONTALBAN. The Philippine butterfly fishes and their allies.

*No. 2, October, 1927*

- K. LSEER, R. A. Transmission of surra among animals of the equine species.  
 F. JUSTINO, LEOPOLDO A., and M. SADERRA MASÓ. The Negros earthquake of 1925.
- BIROSEL, D. M. Alcohol addition products of the bromo derivative of mixed ethers and bromo derivative of diphenyl-isopropyl ether.
- HERNANDO, EUGENIO. Life tables for the native resident population of the City of Manila for the year 1920.
- VALENZUELA, PATROCINIO, and FARRINGTON DANIELS. Thermal and photochemical decomposition of caryophyllene nitrosite.
- DE SANTOS, IRENE, and AUGUSTUS P. WEST. Esters of alpha linolic acid tetrabromide (methyl, ethyl, propyl, isopropyl, and allyl) from lumbang oil.
- VAN DRIEL, B. N. Note on framboesia in Sumatra.
- FERRIS, G. F. Fifth report upon Diptera pupipara from the Philippine Islands.
- HERRE, ALBERT W. *Hynniss momsa*, a new Philippine pampano.

*No. 3, November, 1927*

- COPELAND, EDWIN BINGHAM. Davalloses and related genera.
- COPELAND, EDWIN BINGHAM. The genus *Calymmodon*.
- HERRE, ALBERT W. Four new fishes from Lake Taal (Bombon).
- HERRE, ALBERT W. The Philippine band fishes.
- HERRE, ALBERT W. The fisheries of Lake Taal (Bombon), Luzon, and Lake Naujan, Mindoro.
- DRAKE, CARL J. Tingitidæ from the Far East and Madagascar (Hemiptera).
- SCHAUS, W. New species of Pyraustinæ from the Philippine Islands.
- KRÖBER, O. Die Conopiden der Philippinen.

*No. 4, December, 1927*

- ELLIOTT, E. A. New Stephanidæ from Borneo and the Philippine Islands, III.
- TYLER-TOWNSEND, CHARLES H. New Muscoidea from the Philippines and near-by territory.
- BERNHAEUER, MAX. Die Staphyliniden der Philippinen: 24. Beitrag zur indo-malayischen Staphyliniden-fauna.
- HERRE, ALBERT W. Philippine surgeon fishes and Moorish idols.

*Monographs.*—Monograph 22 of the Bureau, *Madreporaria of the Philippine Islands*, by Leopoldo A. Faustino, was issued June 25, 1927.

Monograph 23, *Gobies of the Philippines and the China Sea*, by Albert W. Herre, was issued September 19, 1927.

Monograph 21, *Distribution of Life in the Philippines*, by R. E. Dickerson et al., is in page proof.

Monograph 24, *Pomacentridæ of the Philippine Islands*, by Heraclio R. Montalban, is in page proof.

Monograph 25, Summary of Marine Mollusca, by Leopoldo A. Faustino, is partly in page proof.

Monograph 26, Catalogue of Philippine Coleoptera, by W. Schultze. Copy for this monograph, 932 folios, is in course of preparation for the printer.

The Mineral Resources of the Philippine Islands for the years 1924 and 1925 was issued October 14, 1927.

*Press bulletins.*—One press bulletin, on Chinese laundry soap, was issued July 1, 1927.

*Popular bulletins.*—Popular Bulletin 3, Fishery Resources of the Philippine Islands, by Albert W. Herre, was issued April 8, 1927.

Popular Bulletin 4, Government Coal Purchases, by F. D. Reyes and T. Dar Juan, was issued July 18, 1927.

The Twenty-fourth Annual Report of the Bureau of Science, for 1925, was issued March 16, 1927.

Respectfully submitted,

WILLIAM H. BROWN,  
*Director, Bureau of Science.*

To the Honorable  
THE SECRETARY OF AGRICULTURE  
AND NATURAL RESOURCES.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivision of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
General, inorganic, and physical chemistry:								
Metals and alloys.....	32	26	388.00	191.00	34	38	378.00	961.00
Rocks, minerals, natural pigments, and similar substances.....	19	24	170.00	199.00	5		5.50	
Clays, shales, limestones, limes, wall plasters, and slugs.....	22	10	885.00	114.00		1		10.00
Coal analyses.....	4	16	122.00	363.00	228	53	2,846.00	1,835.00
Paints and varnishes.....	91	97	2,834.00	2,746.00	143	180	4,025.00	4,566.00
Crude chemical and miscellaneous analyses.....	15	10	65.00	159.00	5	4	70.00	65.00
Standard solutions..... liters	42	29	201.67	113.97				
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	90	37	276.00	118.00	43	38	251.00	141.00
Cements.....	6,173	8,539	12,071.25	14,247.01	9,588	9,996	13,220.20	13,335.40
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	4,830	6,807	9,197.00	10,365.00	1,849	4,484	2,147.00	4,768.00
Standardization and correction of units of measure—								
Length.....	2	18	3.00	39.00		42		63.00
Capacity.....	4	45	302.00	89.00	10	26	20.00	52.00
Weight.....	32	253	152.50	674.50	5	177	55.00	1,088.00
Miscellaneous inorganic work and analyses.....	104	15	711.50	169.00	69	52	529.00	564.00
Total.....	11,460	15,961	27,373.92	30,737.48	11,991	15,113	23,781.70	27,400.40

TABLE 1.—Comparative table of routine performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivision of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Soils and fertilizers division:								
Soil analyses.....	23	17	710.00	218.00	78	77	2,562.00	2,197.00
Clays, shales, limestones, limes, wall plasters, and slags.....	7		83.00					
Commercial fertilizers.....	196	96	2,140.00	880.00	1		12.00	
Guano, copra cake, ashes, and similar materials.....	114	51	1,673.00	406.00	29		174.00	
Insecticide, fungicide, sea-water tests, and other miscellaneous analyses.....	94	47	199.00	94.00				
Fertilizer tags sold (less cost of printing).....	177,050	321,988	4,774.47	7,789.63				
Registration of fertilizers.....	6	20	300.00	1,000.00				
Total.....	177,490	322,219	9,879.47	10,387.63	108	77	2,748.00	2,197.00
Organic chemistry:								
Urine, clinical and toxicological analyses.....	585	558	2,287.08	2,152.46	212	276	1,361.00	2,168.00
Essential oils and essences.....	3	2	21.00	20.00	25	10	250.00	100.00
Petroleum and copra products and similar materials.....	687	723	4,804.34	4,611.65	44	16	711.00	190.00
Varnishes and linseed oils.....	1	1	20.00	3.00	1		20.00	
Gums, resins, and similar materials.....	10		69.00		3		50.00	
Papers, textiles, and similar materials.....	6		36.00		1		10.00	
Gastric juice, clinical examinations.....	1		30.00			1		10.00
Foods, alcohols, and beverages.....	121	227	1,320.00	1,244.00	8,445	6,680	104,561.00	79,891.00
Food preservatives and coloring matters.....	1	2	5.00	24.00	52	57	595.00	469.00
Medicines and similar articles.....	39	44	226.00	374.50	563	650	7,555.00	9,654.00

Tikitiki extract.....	bottles.....	2,189	3,723	1,552.18	2,606.10	49,380	50,004	34,566.00	35,002.80
Miscellaneous organic analyses and examinations.....		57	18	240.00	67.00	6	11	95.00	355.00
<b>Total.....</b>		<b>3,700</b>	<b>5,298</b>	<b>10,610.18</b>	<b>11,102.71</b>	<b>58,732</b>	<b>57,605</b>	<b>149,774.00</b>	<b>127,839.80</b>
<b>Mines:</b>									
Assays.....		624	197	1,566.00	709.00	3	7	14.00	28.00
Smelting and refining of gold and other precious metals.....	grains.....	85,544	24,391	696.49	632.96		97		13.00
<b>Total.....</b>		<b>86,168</b>	<b>24,588</b>	<b>2,262.49</b>	<b>1,361.96</b>	<b>3</b>	<b>104</b>	<b>14.00</b>	<b>41.00</b>
<b>Biological laboratory:</b>									
Faeces.....		691	334	2,394.36	1,134.05	51,682	54,592	597,517.00	667,573.00
Sputum.....		203	106	613.81	308.90	188	132	564.00	396.00
Blood.....		149	58	775.06	334.06	180	29	2,176.00	546.00
Cultures (diphtheria).....		11	3	65.00	15.00	863	471	4,315.00	2,355.00
Widal tests.....		93	38	319.48	124.90	44	31	132.00	93.00
Wassermann tests.....		420	193	4,218.71	1,930.00	853	953	8,530.00	9,530.00
Leprosy.....		13		39.00		932	45	2,796.00	135.00
Urines.....		425	7	1,743.05	13.50	154	61	571.00	244.00
Gonococci.....		118	51	353.00	153.00	1,419	4	4,257.00	12.00
Waters, biological.....		71	21	740.00	220.00	8,141	9,163	80,623.00	91,630.00
Histological examinations.....		11	11	106.67	103.34	9	10	90.00	100.00
Rats for plague.....						55,288	58,284	221,152.00	233,136.00
Rabies.....							8		80.00
Miscellaneous biological examinations.....		187	1,210	937.34	6,398.79	3,118	16,590	31,456.00	101,548.00
<b>Total.....</b>		<b>2,392</b>	<b>2,032</b>	<b>12,305.48</b>	<b>10,735.54</b>	<b>122,871</b>	<b>140,373</b>	<b>954,179.00</b>	<b>1,107,378.00</b>
<b>Serum section of the biological laboratory:</b>									
Vaccine virus.....	units.....	3,093,415	2,903,453	71,944.48	61,687.70				
Autogenous vaccines.....	ampules.....	416	779	405.98	718.20	30	10	30.00	10.00
Miscellaneous sera and vaccines.....	cc., and units.....	5,175,396	4,188,648	268,614.62	223,067.05	4,125,301	2,078,312	826,419.00	421,024.00
<b>Total.....</b>		<b>8,269,227</b>	<b>7,092,880</b>	<b>280,965.08</b>	<b>285,472.95</b>	<b>4,125,331</b>	<b>2,078,322</b>	<b>826,449.00</b>	<b>421,034.00</b>

TABLE 1.—Comparative table of routine performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivision of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Miscellaneous:								
Photographic work.....	5,089	4,916	1,283.23	1,579.12	608	582	301.20	192.50
Natural-history specimens.....	53	52	376.50	420.50				
Shop work.....	1		6.00					
Aquarium tickets, post cards, etc.....				3,946.40				
Supplies and equipment.....	6,319	6,617	1,934.07	3,009.30				
Sales of publications.....			3,839.45	5,134.97				
Refunded, work not done, etc. (deducted).....			(127.34)	(261.86)				
Fines of employees and forfeitures of salaries; credit adjustment of prior year expense.....								
Power, steam, etc.....								
Total.....	11,462	11,585	33,752.27	41,281.72	608	582	301.20	192.50
Grand total.....	8,561,899	7,474,563	377,154.31	391,079.99	4,319,644	2,292,176	1,957,246.90	1,686,082.70



TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Bureau of Agriculture:								
Waters, chemical.						15		201.00
Standard solutions.		4		20.00				
Miscellaneous inorganic work and analyses.					40		200.00	
Soil analyses.					77	77	2,527.00	2,197.00
Commercial fertilizers.					1		12.00	
Guano, copra cake, ashes, and similar materials.					27		158.00	
Gums, resins, and similar materials.					3		50.00	
Foods, alcohols, and beverages.					44	34	672.00	417.00
Miscellaneous sera and vaccines, ampules, cc., and units.	30,000	4,000	60.00	8.00				
Photographic work.		104		39.80				
Supplies and equipment.	65	5	66.69	15.00				
Total.	30,065	4,113	126.69	82.80	192	126	3,619.00	2,815.00
Bureau of Audits:								
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.					8	3	36.00	75.00
Miscellaneous organic analyses and examinations.								
Total.					8	3	36.00	75.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Bureau of Commerce and Industry:								
Blood.....						1		3.00
Wassermann tests.....		2		20.00				
Photographic work.....	21	10	4.50	2.00				
Total.....	21	12	4.50	22.00		1		3.00
Bureau of Customs:								
Standardization and correction of units of weight.....						4		30.00
Miscellaneous inorganic work and analyses.....						2		16.00
Essential oils and essences.....					25	2	250.00	20.00
Petroleum and copra products and similar materials.....						4	100.00	
Foods, alcohols, and beverages.....						4	55.00	5.00
Assays.....						7		28.00
Supplies and equipment.....		9		0.45				
Medicines and similar articles.....					235	57	1,492.00	365.00
Waters, biological.....						3	30.00	
Photographic work.....	16		3.20					
Total.....	16	9	3.20	0.45	271	73	1,927.00	464.00



TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Bureau of Lands:								
Sputum.....		1		3.00	1		3.00	
Supplies and equipment.....	25	40	37.50	30.50				
Total.....	25	41	37.50	33.50	1		3.00	
Bureau of Non-Christian Tribes:								
Supplies and equipment.....		1		3.00				
Bureau of Posts:								
Metals and alloys.....					5	14	25.00	110.00
Bureau of Printing:								
Metals and alloys.....					4	3	65.00	50.00
Assays.....					1		8.00	
Smelting and refining of gold and other precious metals.....						97		13.00
Total.....					5	100	73.00	63.00
Bureau of Prisons:								
Feces.....					1,934		9,668.00	
Widal tests.....					4	4	12.00	12.00
Wassermann tests.....					115	314	1,150.00	3,140.00
Gonococci.....					7		21.00	
Waters, biological.....					4	6	40.00	60.00



## THE BUREAU OF SCIENCE

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Bureau of Supply—Continued.								
Standard solution..... liters.....								
Cements.....	3		15.00					
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	986	2,032	1,336.20	2,694.40	7,493	8,502	10,036.20	11,316.20
Standardization and correction of measures of capacity.....		5		25.00	7	1	35.00	5.00
Miscellaneous inorganic work and analyses.....					10		20.00	
Petroleum and copra products and similar materials.....					13	11	260.00	178.00
Foods, alcohols, and beverages.....	7	6	98.00	94.00	20	12	330.00	162.00
Medicines and similar articles.....	2	2	30.00	24.00		2		20.00
Papers, textiles, and similar materials.....					17	7	220.00	70.00
Tikitiki extract.....	236	1,118	165.20	782.60	1		10.00	
Waters, biological.....					2	5	20.00	50.00
Miscellaneous biological examinations.....					8	4	400.00	200.00
Vaccine virus.....	50		5.00					
Miscellaneous sera and vaccines..... ampules, c.c., and units.....	251,902	135,624	977.00	781.20				
Photographic work.....	2	494	4.93	100.00				
Supplies and equipment.....	1,586	206	621.00	220.50				
Total.....	254,779	139,511	3,284.13	4,984.70	7,637	8,612	12,632.20	13,149.20

<b>Executive Bureau:</b>						
Book varnish.....		2		10.00		
<b>Philippine Constabulary:</b>						
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....			18		11	106.00 53.00
Medicines and similar articles.....	22		12	110.00	18	100.00 90.00
Urines, clinical and toxicological analyses.....			1		8	75.00
Miscellaneous organic work and examinations.....						280.00
Feces.....					1	5.00
Sputum.....					1	3.00
Blood.....			9		4	675.00 300.00
Gonococci.....			4		1	12.00
Rabies.....						10.00
Vaccine virus.....	3.150	2.260				
Miscellaneous sera and vaccines..... ampules, c.c., and units.....	159.816	22.718	2.277.60	1.422.00		
Supplies and equipment.....	180	500	9.00	15.00		
<b>Total.....</b>	<b>163,146</b>	<b>25,240</b>	<b>2,318.10</b>	<b>1,569.00</b>	<b>44</b>	<b>968.00 741.00</b>
<b>Philippine Health Service:</b>						
Waters, chemical.....			52		27	1,710.00 875.00
Urines, clinical and toxicological analyses.....			211		274	1,286.00 2,018.00
Foods, alcohols, and beverages.....			8,382		6,641	103,675.00 79,419.00
Food preservatives and coloring matters.....			50		57	575.00 469.00
Medicines and similar articles.....			11		14	123.00 370.00
Feces.....			32,691		40,878	502,434.00 599,121.00
Sputum.....			136		72	408.00 216.00
Blood.....			138		22	577.00 98.00
Cultures (diphtheria).....			818		471	4,090.00 2,365.00
Widal tests.....			20		27	60.00 81.00
Wassermann tests.....			711		596	7,110.00 5,955.00
Leprosy.....			33		45	99.00 135.00
Urines, microscopical.....			25		2	125.00 8.00
Gonococci.....			6		4	18.00 12.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Waters, biological.....					5,183	7,948	51,275.00	79,480.00
Histological examinations.....					7	8	70.00	80.00
Rats for plague.....					54,088	57,271	216,332.00	229,084.00
Rabies.....						5		50.00
Miscellaneous biological examinations.....					3,011	3,212	30,147.00	32,110.00
Vaccine virus.....	3,448,950	2,841,200	68,936.00	59,648.00				
Autogenous vaccine..... ampules.....		10		10.00				
Miscellaneous sera and vaccines..... ampules, c.c., and units.....	2,229,327	2,114,825	172,493.32	193,643.20	4,124,640	2,078,192	826,256.00	421,000.00
Photographic work.....	392	640	206.18	406.61				
Supplies and equipment.....	492	62	87.42	14.80				
Total.....	5,679,161	4,956,727	241,722.92	253,712.61	4,230,208	2,195,775	1,746,370.00	1,452,936.00
Philippine General Hospital:								
Waters, chemical.....					2		70.00	
Crude chemical and miscellaneous analyses.....					1		20.00	
Petroleum and copra products and similar materials.....					3	4	65.00	28.00
Gastric juice, clinical examinations.....						1		10.00
Foods, alcohols, and beverages.....	8	1	36.00	12.00	3	2	39.00	30.00
Food preservatives and coloring matters.....					2		20.00	
Medicines and similar articles.....						5		106.00
Vaccine virus.....		7		0.70				



Miscellaneous sera and vaccines.....ampoules, c.c., and units.....	1,261.951	1,172.271	4,334.90	4,399.40	608	582	301.20	192.50
Photographic work.....		8		8.00				
Supplies and equipment.....					1,000	1,250	700.00	875.00
Tikicki extract.....bottles.....								
Total.....	1,261.954	1,172.287	4,370.90	4,420.10	1,619	1,844	1,215.20	1,240.50
<b>City of Manila:</b>								
Standardization and correction of units of meas- ure—								
Length.....		5		7.50				
Weight.....		7		34.00				
Cements.....	3		25.25					
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	265	413	340.00	551.00		2		150.00
Toxicological analyses.....								
Foods, alcohols, and beverages.....	1		25.00					
Medicines and similar articles.....	20		60.00					
Miscellaneous organic analyses and examina- tions.....					6		95.00	20.00
Rabies.....						2		
Supplies and equipment.....	1,330	480	69.00	24.00				
Total.....	1,669	905	519.25	616.50	6	4	95.00	170.00
<b>Metropolitan Water District:</b>								
Cements.....	305		408.00					
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	1,697	1,991	2,226.00	2,470.00				
Standard solution.....liters.....	28	16	131.67	59.13				
Guano, copra cake, ashes, and similar materials.....		2		16.00				

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Metropolitan Water District—Continued.								
Waters, biological.....		168	61.68	70.67	1,265	1,201	12,650.00	12,010.00
Supplies and equipment.....		2,143	3,327.35	2,615.80	1,265	1,201	12,650.00	12,010.00
Total.....								
Board of Pharmaceutical Examiners and Inspectors:								
Medicines and similar articles.....					277	437	5,530.00	8,524.00
Provinces and municipalities:								
Waters, chemical.....	16	19	550.00	595.00				
Cements.....	1		3.75					
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	2		16.00					
Standardization and correction of units of measure—								
Length.....		1		1.50				
Weight.....		15		18.00				
Medicines and similar articles.....	2	3	13.00	27.50				
Miscellaneous organic analyses and examinations	4		65.00					
Blood.....	1		75.00					
Miscellaneous sera and vaccines		1		0.40				
Waters, biological.....	9	3	90.00	30.00				

Photographic work.....	1			10.00
Supplies and equipment.....	8	14	19.70	31.57
Total.....	43	57	892.45	713.97
<b>United States Army and Navy:</b>				
Metals and alloys.....	1	2	20.00	11.00
Coal analyses.....	1	2	35.00	59.00
Waters, chemical.....		5		45.00
Crude chemical and miscellaneous analyses.....		2		60.00
Cements.....		5		25.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	7		8.00	
Standardization and correction of measures of weight.....		134		139.00
Petroleum and copra products and similar materials.....	2	5	20.00	62.00
Foods, alcohols, and beverages.....	9	6	177.00	12.00
Vaccine virus.....	53,130	25,370	2,044.50	1,232.00
Miscellaneous sera and vaccines..... ampules c.c., and units.....	285,737	63,113	4,632.40	2,998.00
Supplies and equipment.....	94	96	4.70	82.69
Total.....	338,981	88,740	6,941.60	4,725.69
<b>Office of the Governor-General:</b>				
Photographic work.....	4	2	9.86	4.23
Supplies and equipment.....	1	4	5.00	13.00
Total.....	5	6	14.86	17.33
<b>University of the Philippines:</b>				
Cements.....	141	430	180.60	596.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	136	556	456.00	691.00
Crude chemical and miscellaneous analyses.....		3		43.00

## THE BUREAU OF SCIENCE

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
University of the Philippines—Continued.								
Ferrea.....					652	541	3,260.00	2,705.00
Waters, biological.....		1		10.00				
Vaccine virus.....	600	600	6.00	6.00				
Miscellaneous sera and vaccines..... ampules, c.c., and units.....	12,060	26,350	55.30	153.00				
Photographic work.....	729	242	197.86	160.64				
Tikitiki extract.....	12		8.40					
Miscellaneous.....				320.00				
Supplies and equipment.....	33	16	33.85	80.00				
Total.....	13,711	28,198	938.01	2,060.14	652	541	3,260.00	2,705.00
Public Welfare Commissioner:								
Waters, biological.....						2		20.00
Miscellaneous sera and vaccines..... ampules, c.c., and units.....	3,000	6,006	6.00	15.00	661	120	163.00	24.00
Supplies and equipment.....	6		14.00					
Tikitiki extract.....					48,380	48,580	33,866.00	34,006.00
Total.....	3,006	6,006	20.00	15.00	49,041	48,702	34,029.00	34,050.00
Philippine Library and Museum:								
Supplies and equipment.....	4		24.77					

Miscellaneous:									
31	22	368.00	155.00	7	10	120.00	146.00		
Metals and alloys.....									
19	24	170.00	199.00	5		5.50			
Rocks, minerals, natural pigments, and similar substances.....									
7	10	88.00	114.00						
21	33	850.00	1,091.00	199	27	1,838.00	925.00		
4	8	122.00	171.00	12	22	240.00	552.00		
17	37	514.00	986.00		4		120.00		
15	5	65.00	56.00	3	3	40.00	30.00		
14	6	70.00	19.84						
Crude chemical and miscellaneous analyses.....									
Standard solution..... liters									
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....									
82	26	229.00	86.00	5		50.00			
53	61	209.00	265.25	1,324	788	1,588.80	960.00		
Cements.....									
280	221	558.00	425.00	8		21.00			
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....									
Standardization and correction of units of measure—									
2	12	3.00	30.00						
Length.....									
4	45	302.00	89.00						
Capacity.....									
32	97	152.50	483.50	5	99	55.00	983.00		
Weight.....									
104	15	711.50	169.00	14	39	44.00	370.00		
Miscellaneous inorganic work and analyses.....									
23	17	710.00	218.00						
Soil analyses.....									
196	96	2,140.00	880.00						
114	49	1,673.00	390.00						
Commercial fertilizers.....									
Guano, copra cake, ashes, and similar materials.....									
94	47	199.00	94.00						
177,050	321,988	4,774.47	7,789.63						
Fertilizer tags sold (less cost of printing).....									
6	20	300.00	1,000.00						
Registration of fertilizers.....									
585	558	2,287.08	2,152.46						
Urine, clinical and toxicological analyses.....									
3	2	21.00	20.00						
Essential oils and essences.....									
678	712	4,686.34	4,455.65	17		216.00			
Petroleum and copra products and similar materials.....									

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1927, as compared with the fiscal year 1926, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1926	1927	1926	1927	1926	1927	1926	1927
Miscellaneous—Continued.								
Varnishes and linseed oils.....	1	1	20.00	3.00	1		20.00	
Gums, resins, and similar materials.....	10		69.00					
Papers, textiles, and similar materials.....	6		36.00					
Gastric juice, clinical examinations.....	1		30.00					
Foods, alcohols, and beverages.....	106	218	1,052.00	1,196.00				
Food preservatives and coloring matters.....	1	2	5.00	24.00				
Medicines and similar articles.....	17	19	153.00	237.00				
Tiktiki extract.....	1,941	2,605	1,378.58	1,823.50		174		121.80
Miscellaneous organic analyses and examinations.....	53	18	175.00	67.00				
Assays.....	624	197	1,566.00	709.00				
Smelting and refining of gold and other precious metals..... grams.....	85,544	24,391	696.49	652.96				
Feces.....	435	334	1,362.66	1,134.05		59		177.00
Sputum.....	105	105	305.81	305.90		59		177.00
Blood.....	38	58	196.72	334.06				
Cultures (diphtheria).....	2	8	10.00	15.00				
Widal tests.....	28	38	90.14	124.90				
Wassermann tests.....	285	191	2,851.72	1,910.00		44		440.00
Urines.....	4	7	10.50	13.50		59		236.00
Gonococci.....	66	51	198.00	153.00				
Waters, biological.....	41	17	403.00	180.00				
Histological examinations.....	11	11	106.67	103.34				

Miscellaneous biological examinations	63	14	566.67	389.00	
Vaccine virus	5,725	4,276	493.48	316.00	
Autogenous vaccines		779		718.20	
Miscellaneous sera and vaccines					
ampules				14,851.65	
c.c., and units				822.99	
Photographic work	917,468	636,326	16,707.44	420.50	
Natural-history specimens	3,832	3,874	727.73		
Shop work	53	52	376.50		
1			6.00		
Aquarium tickets, post cards, etc.				3,626.40	
Supplies and equipment	2,285	5,195	692.01	2,316.12	
Sales of publications			3,839.45	5,134.97	
Refunded, work not done, etc. (deducted)			(127.34)	(261.86)	
Fines on employees and forfeitures of salaries:					
Credit adjustment of prior year expense					
Power, steam, etc.			60.75	484.53	
26,252.27			26,252.27	26,968.76	
Total	1,197,680	1,002,396	81,636.48	86,113.80	1,600
Examinations and sales of the Cebu Biological Laboratory:					1,382
Miscellaneous biological examination	297	353	1,508.36	1,810.22	2,872
Miscellaneous sera and vaccines					2,774
ampules					
c.c., and units	256		1,198.48	1,414.80	30
Total	553	353	2,706.84	3,225.02	2,902
Examinations and sales of the Iloilo Biological Laboratory:					
Miscellaneous biological examinations	1,006	843	4,520.23	4,199.57	5,670
Miscellaneous sera and vaccines					10,559
ampules					
c.c., and units	160		6,145.16	2,775.40	
Total	1,166	843	10,665.39	6,974.97	5,670
Grand total	8,561,899	7,474,563	377,154.31	391,079.99	4,319,644
					2,252,176
					1,957,246.90
					1,686,082.70

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1927, as compared with the fiscal years 1925 and 1926.

## EXPENDITURES.

Item.	Fiscal year—		
	1925	1926	1927
	Pesos.	Pesos.	Pesos.
<b>Salaries and wages, etc.:</b>			
Salaries and wages, including accrued leave.....	351,497.17	363,599.64	375,005.81
Traveling expenses of personnel.....	11,069.16	11,362.11	10,999.84
Total.....	362,566.33	374,961.75	386,005.65
<b>Apparatus, supplies, etc.:</b>			
Consumption of supplies and materials.....	145,756.80	171,400.24	171,817.25
Apparatus and equipment, including books.....	20,192.48	12,600.00	12,600.00
Total.....	165,949.28	184,000.24	184,417.25
<b>Miscellaneous:</b>			
Postal, telegraph, telephone, and cable service....	8,381.16	6,000.00	8,825.73
Freight, express, and delivery service.....	3,515.30	3,500.00	2,270.70
Printing and binding reports, documents, and publications.....	34,900.00	34,900.00	34,900.00
Illumination and power service.....	1,764.44	2,086.69	2,500.00
Miscellaneous service.....	13,597.16	10,978.51	10,202.04
Maintenance and repair of equipment.....	1,872.95	5,042.19	5,000.00
For the acquisition and transportation of certain species of fish desired for cultivation.....	2,000.00	1,623.99	2,000.00
Uncollectible debts.....	55.31		
Deterioration of supplies and sales stock.....		476.65	
Total.....	66,086.32	64,608.03	65,698.47
<b>Distribution of tikitiki extract, antityphoid vaccine, and antidyenteric serum:</b>			
Salaries and wages, including accrued leave.....	4,555.38	2,909.53	2,709.10
Consumption of supplies and materials.....	33,054.74	23,774.80	17,493.05
Other service.....	1,388.29	741.65	196.48
Total.....	38,998.41	27,425.98	20,398.63
<b>Special fund:</b>			
Developing Home Canning and Food Preservation Industry, Acts 3231 and 3308:			
Salaries and wages, including accrued leave.....	121.29	8,246.99	13,093.16
Traveling expenses of personnel.....		3,276.86	6,260.63
Freight, express, and delivery service.....		179.67	645.35
Postal, telegraph, telephone, and cable service.....		131.91	397.84
Illumination and power service.....			10.00
Miscellaneous service.....		188.19	176.11
Consumption of supplies and materials.....	9.30	1,553.44	1,166.52
Printing and binding reports, documents, and publications.....		911.45	605.60
Maintenance and repair.....			31.64
Purchase of equipment.....		233.81	429.06
Total.....	130.59	14,722.32	22,815.91



TABLE 3.—Comparative statement showing expenditures and income during the fiscal year, as compared with the fiscal years 1925 and 1926—Ctd.

EXPENDITURES—Continued.

Item.	Fiscal year—		
	1925	1926	1927
	Pesos.	Pesos.	Pesos.
Reorganization of Division of Fisheries, Act 3307:			
Salaries and wages, including accrued leave.....			24,072.87
Traveling expenses of personnel.....			2,697.66
Freight, express, and delivery service.....			467.71
Postal, telegraph, telephone, and cable service.....			16.67
Miscellaneous service.....			405.67
Consumption of supplies and materials.....			14,929.48
Purchase of equipment.....			630.13
Total.....			48,220.19
Grand total.....	633,730.93	665,718.32	722,556.10

INCOME.

Receipts from operation.....	385,102.68	373,570.71	387,576.16
Sales of supplies.....	31.06	17.34	1,161.34
Sales of fixed assets.....	1,954.87	1,916.73	917.12
Other income.....	1,609.15	1,649.53	1,425.37
Total.....	388,697.76	377,154.31	391,079.99
Appropriation account:			
Appropriation.....	622,220.00	650,996.00	656,520.00
Allotment by the Emergency Board.....	13,938.27		
Balance brought forward for the purchase of equipment.....	17,659.10		
Special Fund, Acts 3231 (balance) and 3308.....	15,000.00	44,869.41	30,147.09
Special Fund, Act 3307.....		110,000.00	110,000.00
Total.....	668,817.37	805,865.41	766,667.09



ABSTRACTS FROM THE TWENTY-FIFTH ANNUAL  
REPORT OF THE BUREAU OF SCIENCE  
FOR THE YEAR 1926

ROUTINE

The expenditures and income of the Bureau of Science for the year 1926 are shown in Table 3 of the Twenty-sixth Annual Report, for the year 1927. Tables 1 and 2 of that report show the amount of routine work accomplished in 1926 as compared with that done in 1927.

RESEARCH

Among the accomplishments during the year along research lines are the following:

Biology.

Studies of yaws, including pathogenesis, immunity, transmission, etiology, globulin precipitation reaction, protein manifestations of skin lesions, and superinfection.

Serological analysis of lepers' sera.

Study of experimental pneumonia in monkeys.

Contribution to the serologic grouping of *Bacillus dysenteriae* based upon the quality of the antigen and normal agglutinins.

Free toxin in the blood during the course of tetanus toxæmia.

Botany.

Histological study of the bark of *Alstonia scholaris*.

Pharmacognostical study of *Datura alba* and *Datura fastuosa*.

General zoölogy.

Study of the biology of the large Philippine forest scorpion.

Classification of new or noteworthy Philippine birds.

Completion of a catalogue of Philippine Coleoptera.

Fisheries.

Monograph of the gobies of the Philippines.

Monograph of the Acanthuridæ.

Monograph of the Pomacentridæ.

Monographs of the chætodonts, Kuhliidæ, and Sparidæ of the Philippines.

A summary of the Philippine catfishes, order Nematognothi.

Description of miscellaneous new fishes.

General, inorganic, and physical chemistry.

Concrete value of Philippine sand, gravel, and crushed stone.

General, inorganic, and physical chemistry—Continued.

Composition and comparative service value under Philippine conditions of some imported prepared paints.

Government coal purchases under specifications.

Soils and fertilizers.

Nature and availability of the plant-food constituents of Philippine guano.

The nitrifying power of some Philippine soils.

Organic chemistry.

Preparation of various esters of chaulmoogric acid.

Preparation of various salts of linolenic hexabromide from lumbang oil.

Isolation of an essential oil and two new linolic tetrabromides from Philippine lumbang oil.

Preparation of isomeric bromo derivatives of linolenic and linolic acids from lumbang oil.

The deodorization of coconut oil.

Study of illicit beverages.

Mineral cordage oils.

Geology and mines.

A catalogue of Philippine marine mollusks.

Geological reconnaissance in Palawan.

Geologic reconnaissance of the northern part of Zambales Mountains.

Study of the artesian waters in northwestern Pangasinan.

Preparation of a geologic map of the Philippines.

Stratigraphic study of coal measures of the Philippine Islands.

Metallogenetic epochs of the Philippine Islands.

#### PUBLICATIONS

*The Philippine Journal of Science.*—The Philippine Journal of Science was published monthly during 1926, in three volumes for the year. Each volume consists of four numbers and is separately paged and indexed.

The following table shows the number of pages, plates, and text figures contained in Volumes 29, 30, and 31:

	Volume 29, January to April, 1926.	Volume 30, May to August, 1926.	Volume 31, September to December, 1926.	Total.
Pages .....	563	509	547	1,619
Plates .....	21	23	32	82
Text figures .....	21	7	17	45

Copy for the numbers for January to May, 1927, has been sent to the printer. The January number is in page proof. The galley proof for January, February, and the greater part of March was received from the printer before the close of the year.

The following list gives the names of authors and the titles of the papers published in the Philippine Journal of Science during 1926:

VOLUME 29, JANUARY TO APRIL

*Nos. 1-2, January-February, 1926*

SILER, J. F., MILTON W. HALL, and A. PARKER HITCHENS. Dengue: Its history, epidemiology, mechanism of transmission, etiology, clinical manifestations, immunity, and prevention.

*No. 3, March, 1926*

SCHÖBL, OTTO, and JOSÉ RAMIREZ. Serological analysis of lepers' sera.  
SUMULONG, MANUEL D. Effect of castration upon pulling power and endurance in guinea pigs.

MERRILL, ELMER, D. The flora of Banguay Island.

HAUPT, H. Beitrag zur Kenntnis der Hemipteren-Fauna der Philippinen.

*No. 4, April, 1926*

MORISHIMA, KAN-ICHIRO. Experimental inquiry into the constancy of types of *Bacillus dysenteriae*.

FELICIANO, R. T. Illicit beverages.

MERRILL, ELMER D. Additions to our knowledge of the Philippine flora, II.

HERRE, ALBERT W. C. T. Two new fishes from Lake Lanao.

ZWIERSYCKI, J. Notes on the morphology and tectonics of the north coast of New Guinea.

ELLIOTT, E. A. New Stephanidæ from Borneo and the Philippine Islands.

TYLER-TOWNSEND, CHARLES H. New muscoid flies of the Oriental, Australian, and African faunas.

ROEWER, C. Fr. Opiliones vom Mount Maquilang auf Luzon, Philippinen.

SACK, P. Syrphiden (Diptera) von den Philippinen und Malaya.

VOLUME 30, MAY TO AUGUST

*No. 1, May, 1926*

SCHÖBL, OTTO, and RITA VILLAAMIL. Contribution to the serologic grouping of *Bacillus dysenteriae* based upon the quality of antigen and normal agglutinins.

PINEDA, ELOY V., and ELISA ROXAS-PINEDA. Studies on the serology of leprosy, I. The Wassermann reaction in leprosy.

WADE, H. W. Studies on the serology of leprosy, II. Nitric acid precipitation (Bruck, modified).

TIRONA, MARIANO. Nature and availability of the plant-food constituents of Philippine guano.

MERRILL, ELMER, D. Additions to our knowledge of the Bornean flora, II.

AURIVILLIUS, CHR. Revision of the Philippine species of the Gleneini (Coleoptera, Longicornia).

MCATEE, W. L., and J. R. MALLOCH. Philippine and Malayan Ploiariinæ (Hemiptera, Reduviidæ).

*No. 2, June, 1926*

- MERRILL, ELMER D. Hugh Cuming's letters to Sir William J. Hooker.  
 JULIANO, JOSÉ B. Origin, development, and nature of the stony layer of the coconut (*Cocos nucifera* Linnæus).  
 BROOKE, WALTER L. The deodorization of coconut oil.  
 BROOKE, WALTER L. Mineral cordage oils.  
 PARÁS, ERNESTO M. Blood-chemistry studies in leprosy, I. Non-protein nitrogenous substances, sugar, and chloride.  
 HANDSCHIN, EDUARD. Collembola from the Philippines and New Caledonia.  
 HERMS, WILLIAM B. *Diocalandra taitensis* (Guerin) and other coconut pests of Fanning and Washington Islands.

*No. 3, July, 1926*

- ARGÜELLES, M. V. The Kahn test in leprosy.  
 ADOLPH, WILLIAM H. Analyses of Chinese food materials.  
 PINEDA, ELOY V., and ELISA ROXAS-PINEDA. Studies on the serology of leprosy, III. The Kahn precipitation reaction in leprosy.  
 BROOKE, WALTER L. A note on the problem of painting ipil wood.  
 SANTOS, F. O., and S. SANTOS. The vitamin B content of some Philippine fruits and vegetables, II.  
 COPELAND, EDWIN BINGHAM. Filices aliquot novae orientales.  
 SAISAWA, KAZO, and BUNSHIRO TANABE. Notes on healthy carriers of dysentery bacilli.  
 BAKER, C. F. Nomenclatorial notes on the Jassoidea, V.  
 MARSHALL, GUY A. K. New Curculionidæ from the Malay Archipelago (Coleoptera).  
 D'ORCHYMONT, A. Notes on Philippine Hydrophilidæ.  
 GEBIEN, HANS. Die Tenebrioniden (Coleoptera) des indo-malayaischen Gebietes, unter Berücksichtigung der benachbarten Faunen, IX.

*No. 4, August, 1926*

- MERRILL, ELMER D. Additions to our knowledge of the Philippine flora, III.  
 LOPEZ-RIZAL, LEONCIO, PERFECTO GUTIERREZ, and LORENZO FERNANDEZ. A field experiment in the control of yaws.  
 NAVARRO, REGINO J. A serological estimate of the efficacy of neosalvarsan in the treatment of yaws in a field dispensary.  
 LACY, GEORGE RUFUS, and ANDREW WATSON SELLARDS. Investigation of immunity in yaws.  
 SELLARDS, ANDREW WATSON, GEORGE RUFUS LACY, and OTTO SCHÖBL. Superinfection in yaws.  
 SCHÖBL, OTTO, ANDREW WATSON SELLARDS, and GEORGE RUFUS LACY. Some protean manifestations of the skin lesions of yaws.  
 SCHÖBL, OTTO, and JOSÉ RAMÍREZ. The globulin precipitation reaction in yaws. Its independence of the Wassermann reaction and its behavior during the course and treatment of the disease.  
 LOPEZ-RIZAL, LEONCIO, and ANDREW WATSON SELLARDS. A clinical modification of yaws observed in patients living in mountainous districts.

## VOLUME 31, SEPTEMBER TO DECEMBER

*No. 1 September, 1926*

SCHÖBL, OTTO, and ANDREW WATSON SELLARDS. Experimental pneumonia in monkeys.

KLEINE, R. Die Lyciden der Philippinen-Inseln.

*No. 2, October, 1926*

RODRIGUEZ, JOSÉ N. Studies on early leprosy in children of lepers.

SUMULONG, MANUEL D. Congenital absence of both hind legs in an adult pig.

HERRERA-BATTEKE, P. P., and AUGUSTUS P. WEST. Esters of chaulmoogric acid (capryl, allyl, phenyl, ortho cresol, meta cresol, para cresol).

VIBAR, TORIBIO. The relation of temperature and moisture to diseased and disease-free corn.

HERRE, ALBERT W. Four rare Philippine fishes.

SKVORTZOW, B. W. New Flagellata from north Manchuria, China.

FISHER, W. S. Fauna Samarensis: Coleoptera, Buprestidæ.

BERNHAEUER, MAX. Die Staphyliniden der Philippinen: 21. Beitrag zur indo-malayischen Staphyliniden-Fauna.

*No. 3, November, 1926*

SMITH, 2D, FREDERICK L., and AUGUSTUS P. WEST. Notes on Meulen's catalytic method for the determination of nitrogen in organic compounds.

BROTHERUS, V. F. Contributions to the bryological flora of the Philippines, VI.

SCHEERER, OTTO. Batán texts with notes.

OCHS, GEORG. Additional remarks on Philippine Gyrinidæ.

ANDREWES, H. E. A catalogue of Philippine Carabidæ.

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), Part I.

HERRE, ALBERT W. A summary of the Philippine catfishes, order Nematognathi.

SANTOS, JOSÉ K. Histological study of the bark of *Alstonia scholaris* R. Brown from the Philippines.

*No. 4, December, 1926*

YASUYAMA, K. Some factors influencing, in vivo, the result of the globulin precipitation test.

IMPERIAL, GERARDO A., and AUGUSTUS P. WEST. Salts of linolenic hexabromide from lumbang oil.

BAKER, CHARLES FULLER. Braconidæ-Cheloninæ of the Philippines, Malaya, and Australia. I. Chelonini (except *Chelonus*).

MALLOCH, J. R. Notes on Oriental Diptera, with description of new species.

KARNY, H. H. Philippine cricket-locusts (Gryllacridæ).

HERRE, ALBERT W. Four new Philippine fishes.

The following table shows the number of names on the mailing list of the Philippine Journal of Science during the last two years:

	1925	1926
Paid subscriptions.....	255	264
Exchanges.....	617	636
Review subscriptions.....	34	33
Free.....	57	75
Totals.....	963	1,008

*Special publications.*—Publication No. 18, Enumeration of Philippine Flowering Plants, Vol. 4, by Elmer D. Merrill, was issued July 26.

Monograph 20, Dengue: Its history, epidemiology, mechanism of transmission, etiology, clinical manifestations, immunity, and prevention, by J. F. Siler, Milton W. Hall, and A. Parker Hitchens, was issued May 24.

Monograph 21, A Study of Island Life, by R. E. Dickerson et al., is in galley proof.

Monograph 22, Recent Madreporaria of the Philippine Islands, by Leopoldo A. Faustino, is in page proof.

Copy was sent to the printer for Monograph 23, Gobies of the Philippines and the China Sea, by Albert W. Herre; for Monograph 24, Pomacentridæ of the Philippine Islands, by Heraclio R. Montalban; for Mineral Resources of the Philippine Islands for 1924 and 1925; and for Annual Report of the Bureau of Science for 1925.

*Popular bulletins.*—The Bureau of Science has from time to time issued small press bulletins of a popular nature, but the time seemed to have arrived when the Bureau should issue more extensive popular publications which would make the work of the Bureau more available to the general public. Accordingly, a series of bulletins known as popular bulletins was inaugurated. Popular Bulletin 1, Preservation of Philippine Foods, and Popular Bulletin 2, A Discussion and Bibliography of Philippine Flowering Plants, were issued during 1926. Popular Bulletin 3, Fishery Resources of the Philippine Islands, and Popular Bulletin 4, Government Coal Purchases under Specifications, are in press.

*Press bulletins.*—Press Bulletin No. 111, Restoral of abacá and coconut plantations, was issued November 9.



## PERSONNEL

The Director attended the International Botanical Congress at Ithaca, New York, in August, and the Third Pan-Pacific Science Congress held in Tokyo, Japan, in October and November. Messrs. V. Elicaño, A. W. Herre, and A. D. Alvir attended the Pan-Pacific Science Congress. Mr. Elicaño was Acting Director from July 1 to October 12, and Mr. A. S. Argüelles was Acting Director from October 13 to November 30, 1926.

In the division of botany Dr. C. J. Humphrey, who was appointed plant pathologist during the early part of 1925, reported for duty early in 1926 and assumed charge of the mycological work of the Bureau of Science and of the combined laboratory of plant pathology of the Bureaus of Science and Agriculture. In the division of organic chemistry Mr. Walter L. Brooke resigned effective January 14, 1926. Dr. H. I. Cole was appointed in his place effective September 20, 1926. Messrs. Pedro Sengson and Salvador Sevilla, chemists, resigned effective September 30 and October 17, 1926, respectively.

Dr. M. Basaca, after spending two years as a pensionado in the United States, resumed his duties in the division of biology and serum laboratory.

The division of organic chemistry continued its work of preparing simple recipes for the preservation of Philippine foods and of popularizing home canning with very gratifying results. In 1925 the Philippine Legislature appropriated ₱15,000 for this work and in 1926 appropriated an additional ₱30,000 and created a new division with a chief, assistant chief, inspectors, several senior and junior demonstrators, etc. Miss Maria Y. Orosa was appointed chief of the division.

## IMPROVEMENTS

Early in the year it was feared that there might be a cholera epidemic in the Philippines. To avoid this the Philippine Health Service started an extensive vaccination campaign and requested the Bureau of Science to prepare larger amounts of vaccines than could have been produced with the facilities available. In order to meet this emergency two laboratory rooms were added to the vaccine laboratory at Alabang. At the beginning of the year the bodega at Alabang was in a very bad state of repairs due largely to attacks of termites. The

lower part of the structure was changed from wood to concrete, the upper part was repaired, and the whole structure was enlarged. These changes greatly improved the storage facilities.

A small pond for breeding carp was constructed on the Bureau of Science grounds between the power plant and the inorganic-chemistry laboratory. A shed for breeding rats was also constructed in the rear part of the grounds.

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# TWENTY-SEVENTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

WILLIAM H. BROWN

DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1928



MANILA  
BUREAU OF PRINTING  
1929



# TWENTY-SEVENTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE,

MANILA, *February 9, 1929.*

SIR: I have the honor to submit the following report of the Bureau of Science covering the fiscal and calendar year 1928. The first part of the report deals with the Bureau as a whole, while in the latter part the work of the various divisions is given more in detail.

## EXPENDITURES, INCOME, AND FREE WORK

The expenditures for the year 1928 were ₱714,310.21 as against ₱722,556.10 for the year 1927 or a decrease of ₱8,245.89. The cash income amounted to ₱388,269.92 as compared with ₱391,079.99 for the previous year or a decrease of ₱2,810.07. The income for 1928 was larger than for any previous year except for 1927. The decrease in the income for 1928 is less than the value of items for which charges were formerly made but which were put on the free list during the year.

The free work done for other Government entities would have had a cash value of ₱1,815,249.72 according to the Bureau of Science schedule of charges. The cash income and the value of free work amounted to ₱2,203,519.64. Subtracting from this the total expenditures of the Bureau there is left a balance of ₱1,489,209.43 which represents the actual profit to the Government of operating the Bureau of Science. The actual cost to the Government is the amount expended, ₱714,310.21 minus the total income, ₱388,269.92, which leaves ₱326,040.29; for which the Bureau did ₱1,815,249.72 of free work, for Government entities or ₱5.57 worth of free work for each peso expended. The free work mentioned above includes only the actual tests and examinations made and supplies furnished to other Government entities and does not take account of the free examinations made for the public or the fact that a considerable

proportion of the funds of the Bureau of Science are expended in ways that are of direct value to the people of the Philippine Islands and for which no charges can be calculated. Among such items are the expenditures for the development of home canning and food preservation, for the development of the fisheries industries, for free laboratory medical examinations, for the prevention of rabies, for the identification of minerals, plants, and animals; and for consultations in regard to various industries. Neither does it take into account the large amount of research, which is of advantage to the public, including such activities as geological and soil surveys; the study of plant diseases; the study of the medicinal constituents of Philippine plants; the cause, cure, and prevention of human diseases; and the commercial uses of various Philippine products.

Tables showing in detail the income and expenses of the Bureau and the work performed are given at the end of this report. Table 1 shows the amount of routine work performed and supplies manufactured and disposed of during the fiscal year 1928 as compared with that for the fiscal year 1927 by number or quantity and by value, arranged by subdivisions of the Bureau of Science. Table 2 gives similar data arranged according to the entities for which the work was performed. Table 3 is a comparative statement showing expenditures and income during the fiscal year as compared with the fiscal years 1926 and 1927.

#### ROUTINE

The amount of routine done by the Bureau has been steadily and rapidly increasing for several years. This is due to a considerable extent to the increased appreciation of the work of the Bureau of Science by other Government entities and by the public. The amount of routine work done at present not only exceeds that of any past period but, I believe, it is done in a more accurate and satisfactory manner than at any previous time since the establishment of the Bureau. The great amount of routine work performed is shown in detail in Tables 1 and 2 at the end of this report. The Bureau of Science does work and manufactures supplies, mostly free of cost, for practically all Insular Government entities. Brief mention is made below of some of the larger items for various entities.

*Philippine Health Service.*—The Bureau of Science manufactures vaccines and serums in large quantities for the Philippine Health Service. The Bureau of Science sold to the Philippine Health Service 1,184,690 doses of vaccines against cholera,



typhoid, cholera and typhoid, and dysentery, and 3,350,000 doses of smallpox vaccine, and furnished free of cost 2,548,790 units of vaccine against cholera, typhoid, cholera and typhoid, and dysentery. In addition considerable amounts of other products were either sold or furnished free to the Philippine Health Service. Although there were no epidemics during the year, the Philippine Health Service took larger amounts of vaccines and serums than in the previous year.

The Bureau of Science serves as a laboratory for the Philippine Health Service. During the year there were examined free for the Health Service 38,000 samples of fæces, 8,879 samples of foods, alcohols, and beverages, 5,200 samples of water, and 50,924 rats for plague. In all, free examinations for the Philippine Health Service were made on 108,802 specimens.

The enforcement of the pure-food law is in the hands of the Philippine Health Service, and all analyses and examinations made in connection with the enforcement of this law are conducted by the Bureau of Science for the Philippine Health Service.

*Public Welfare Commissioner.*—The Office of the Public Welfare Commissioner was furnished free with 51,893 bottles of tikitiki extract for the cure of beriberi. These had a sales value of ₱36,325.

*Bureau of Quarantine Service.*—The samples collected by the Bureau of Quarantine Service are sent to the Bureau of Science for analysis. More than 10,600 free examinations for that service were made during 1928.

*Board of Pharmaceutical Examiners and Inspectors.*—The Bureau of Science serves as a laboratory for the Board of Pharmaceutical Examiners and Inspectors and makes all analyses for them in connection with the enforcement of the drug law.

*Bureau of Supply.*—The Bureau of Supply buys many articles on specifications, and these articles are tested by the Bureau of Science. During 1928 more than 13,759 such examinations were made without charge for the Bureau of Supply.

In addition to making examinations for the Bureau of Supply the Bureau of Science spent a great deal of time on the formulation of specifications to be used by the Bureau of Supply in the purchase of materials. During the year the chief work along this line was the preparation of very extensive and complete specifications for paints which were adopted by the Government Committee on Standardization of Supplies. These specifications have already saved the Government a great deal of

money. Specifications were also prepared for linotype and monotype metals, and much work has been done on specifications for papers, galvanized iron, and other materials. Ink specifications adopted in 1927 have given very good results.

*Bureau of Public Works.*—The Bureau of Science examines free of charge all samples of cement, concrete, and artesian-well water for the insular projects of the Bureau of Public Works. During 1928 about 18,000 such free examinations were made. Also a large number of samples was submitted by the Bureau of Public Works for analysis or test for provincial or municipal projects.

#### RESEARCH

The important research done by the Army Medical Research Board, and that in connection with the Rockefeller Foundation, and the Manila Railroad are mentioned under the heading of Coöperation.

The Bureau of Science has been actuated, as in the past, by the belief that the most lasting benefits are obtained not from routine work, however important this may be, but by the establishment of new principles and improved practices which result from investigation. With this idea in mind, as much time and money as possible has been devoted to research. The greatly increased appreciation of the routine work of the Bureau by both Government entities and the public greatly increased the demand on the time of our technical staff for the performance of routine work. The great increase in routine work also required extensive space and an increase in equipment. In spite of the demand of routine, emphasis was laid on research and the accomplishments along this line were not small. The most outstanding accomplishments along research lines are the following:

##### Medical biology.

The experiments on yaws and syphilis added greatly to the knowledge of the cause and treatment of these diseases. A vaccine has been developed which not only gives monkeys life-long immunity to yaws but also immunizes them against syphilis. There are indications that it may be practical to improve this vaccine and immunize man against both yaws and syphilis, and thus greatly minimize the incidence of these diseases. Also it is indicated that it may be possible to treat cases of syphilis with the vaccine and prevent the occurrence of the late distressing nervous manifestations. This line of work, which is a continuation of the work on the etiology, clinical manifestations, and immunity of yaws, is one of the greatest contributions ever made by the Bureau of Science to medicine.

**Medical biology—Continued.**

A method has been devised for the purification and concentration under tropical conditions of serums against tetanus, diphtheria, and dysentery. This improvement will greatly reduce the discomforts of patients and increase the popularity of these serums.

**Botany.**

The total alkaloidal content of *Datura fastuosa* and *Datura alba* was determined.

The active principle of *Artabotrys suaveolens*, which is an alkaloid, was isolated and its chemical composition determined.

Morphological and pharmacological studies of the leaves and stems of macabuhay (*Tynospora rumphii* and *Tynospora reticulata*) were completed. These plants are the most highly prized of the Philippine medicinal plants.

Physiological and microchemical studies of the bark of *Artabotrys suaveolens* were also undertaken. The alkaloidal constituent of this bark was isolated and identified. This alkaloid is the active principle of the bark, and is a powerful poison with therapeutic value.

The active principle of *Kaempferia galanga* was found to be an aromatic oil which is a carminative. It stupefies and paralyzes fish without killing them unless they are exposed to it for a considerable length of time. Filipinos use the rhizomes of this plant as a stimulant and carminative.

Work has been started on the alkaloids of Philippine anonaceous plants and the alkaloidal constituents of four have been determined.

Pharmacognostical studies of the barks of various species of cinnamon have been undertaken and almost completed. These studies will enable those dealing in cinnamon bark to determine what species they are handling and to detect adulterations.

**Plant pathology and mycology.**

A study was completed on the cause and control of a very severe die-back disease of cacao. This disease is so serious that it prevents the profitable cultivation of cacao in many parts of the Philippines. However, it can be controlled by proper cultivation, and eradicated by pruning and spraying.

In coöperation with the Bureau of Agriculture, considerable progress has been made on the study of the stem-rot disease of rice, which is the most serious disease of this plant in the Philippines. Considerable progress has been made in studying and determining the fungi that are responsible for the decay both of standing trees and lumber.

**Fisheries.**

Considerable progress has been made in monographing several families of fishes.

Studies have also been conducted on the Crustacea of the Philippines.

In coöperation with the Bureau of Forestry studies have been made on the marine woodborers at the mouth of Pasig River.

**Organic chemistry.**

A considerable number of new compounds were made from the acids of chaulmoogra oil in the hopes of finding one which would be more efficacious than chaulmoogra oil in the treatment of leprosy.

Coconut oil which was absolutely water-white and acid free was made from clean copra. The copra cake was then made into a pure white, fine grained, agreeable-tasting flour suitable for human consumption. This flour has proved to be particularly good for the making of cakes. This work may lead to the adoption of higher standards for coconut oil and more profitable use of copra cake.

The chemical composition of Philippine bagasse was determined. A number of pure starches were prepared from Philippine tubers. The vitamin content of a number of Philippine fruits and vegetables was determined.

The microchemical composition and food value of a large number of wild food plants were determined.

**General, inorganic, and physical chemistry.**

A great deal of progress has been made in the preparation of standard specifications for the use of the Bureau of Supply and other Government entities. Particularly important has been the preparation of very complete standards for paints.

The amount of paper pulp that can be obtained from a given area of cogon land was determined. Rice straw was found to be more suitable than cogon for paper pulp.

High-grade vitrified products such as sewer pipes, bricks, and porcelain have been prepared from Philippine clays.

A laboratory method for determining the wearing quality of paint has been perfected.

A refined method for determining the alkalinity of Philippine limes has been developed.

It was found that practically all artesian-well waters of Manila and vicinity contain appreciable amounts of radioactive material.

Considerable progress has been made in the study of the mechanical properties of Philippine woods, particular attention having been paid to the nail- and spike-holding power of various woods, including those treated with preservatives. The results will be useful to those employing railroad ties and also to those using wood for building purposes.

**Soils and fertilizers.**

Field work on a soil survey of Albay Province has been completed, and considerable work has been done on the soils of Sorsogon and Camarines Sur Provinces.

**Geology and mines.**

Considerable progress has been made on an extensive study of the geology and mineral resources of Zambales Range, which is one of the least-known mineral districts. Results have also been obtained from studies on systematic paleontology and stratification, coral reefs, and coal resources.

## COÖPERATION

*United States Army Medical Department Research Board.*—As in the past the United States Army Medical Department Research Board occupied quarters in the Bureau of Science. Coöperation with the board has been a great help to the Bureau of Science and the results of the board's work are of value not only to the Bureau but to the Philippines as a whole. The Bureau of Science has placed its facilities at the disposal of the board and the appreciation of the board, both verbal and written, has been very gratifying. During the year, there was a complete change of personnel. Col. Edward B. Vedder, Maj. Paul A. Schule, and Maj. Raymond A. Kelsner, returned to the Army Medical School in Washington, D. C. Their places were taken by Maj. J. S. Simmons, as president of the board, and Capt. Joe H. St. John and Capt. F. H. K. Reynolds as members. The board does no routine work, its activities are confined to research.

Field work was carried on in connection with surveys for malaria carriers among the Filipino population of Corregidor and for *Anopheles* mosquitoes breeding there and elsewhere. For the first time it was ascertained that *Anopheles minimus*, which is the only known carrier of malaria in the Philippines, breeds in considerable numbers on Corregidor Island. The source of infection having thus been discovered it may be possible to prevent further contraction of malaria by troops living at Corregidor.

Colonel Vedder made a study of the lepers segregated in the Philippines during the past twenty years and conducted experiments to see whether mosquitoes transmit leprosy from a leper to a healthy person. The results have been published in the Philippine Journal of Science. Colonel Vedder also completed his investigative work to determine a satisfactory standard for beriberi-preventing rice. The results have been published in the Philippine Journal of Science.

Work on dengue was continued by Major Schule whose experiments showed that dengue was not transmitted by the interrupted feeding of *Aedes* mosquitoes on infected persons followed by feeding on non-immune volunteers, but could be transmitted if the interval between feeding on a case and on an uninfected person is eight days. This is slightly less time than was previously determined by Colonel Siler and others. Major Schule also attempted by cultural and histological methods to

identify the dengue virus, and to infect Filipino monkeys, but with negative results. Since the arrival of the new members of the board, work on dengue has been continued.

Major Kelsner completed his work on an improved vaccine for immunizing against rinderpest and the results were published in the Philippine Journal of Science. As mentioned in my last report, the vaccine developed by Major Kelsner can be used as soon as prepared instead of having to be aged like the old vaccine, is more active than the old vaccine, and has excellent keeping qualities, whereas the time during which the old vaccine was potent was both very short and variable. The new type of vaccine is now used by the Bureau of Agriculture and a one injection method of immunizing has been developed.

Experiments on the chemotherapy of equine epizootic lymphangitis were conducted by major Kelsner. His best results were obtained with mercuric iodide.

Many chemical agents have been tried by Captain Reynolds for the treatment of surra, but so far the results have not been successful. Major Reynolds is conducting experiments to determine the method of transmission and prevention of equine dhoobie itch.

The board has as a whole made bacteriological and serological examinations to determine the incidence of *Bacillus melitensis* and *Bacillus abortus* infection in man and lower animals in the Philippines.

The following papers were published or accepted for publication during the year:

- The treatment of periodic ophthalmia with mercuric iodide, by F. A. Kelsner.
- Mercuric iodide in the treatment of equine epizootic lymphangitis, by R. A. Kelsner.
- Dengue fever; transmission by *Aedes ægypti*, by Paul A. Schule.
- An investigation to determine a satisfactory standard for beriberi-preventing rices, by E. B. Vedder and R. T. Feliciano.
- A discussion of the etiology of leprosy with special reference to the possibility of the transference of leprosy by insects and the experimental inoculation of three men, by E. B. Vedder.
- The prevalence and distribution of malaria on Corregidor Island, P. I. Report of a survey made July 1928, by J. S. Simmons.
- Pulmonary infection of man by a nematode of the genus *Cyathostoma*, by J. H. St. John, J. S. Simmons, and Leon L. Gardner.

*Rockefeller Foundation.*—Dr. Earl B. McKinley, who was stationed by the Rockefeller Foundation in the Bureau of Science, left about the middle of the year to become director of the

School of Tropical Medicine of Columbia University at San Juan, Porto Rico. Before leaving he worked on experimental encephalitis, the presence of *Spirochæta icterohæmorrhagia* in rats caught in and around Manila, and rinderpest; and finished several articles. His largest work was the completion of a treatise on filterable virus diseases of man, mammals, birds, insects, fishes, and plants. This treatise will be published as a double number of the Philippine Journal of Science and reprinted as a monograph.

*Manila Railroad.*—As during the past three years, the work in coöperation with the Manila Railroad Company has been conducted by Dr. T. Dar Juan, who has been stationed in the Bureau of Science. The Manila Railroad pays the salary of Doctor Dar Juan, bears a part of the expenses, and furnishes him with an assistant. The investigative work is primarily along lines which are of interest to the railroad but also of great value to the Government. In addition to research activities Doctor Dar Juan supervises the control analyses of coal, cement, lubricants, and other materials.

Particular attention has been paid to the study of the behaviour of various oils, pigments, and thinners on exposure so as to determine which paints are most serviceable for various purposes. In order to try various paints and at the same time to see how paints made in large quantities approximate the requirements of paint specifications, 450 kilograms of paints were prepared under technical supervision in the Bureau of Science. The results of this work have been of value not only in the preparation of paint specifications for the Manila Railroad, but have been combined with further work, with the result that the Committee on Standardization of Supplies for the Philippine Government has been able to adopt very complete specifications for paints for Government use. These specifications, together with discussions of the relative values of various paint materials and methods of painting will be issued as a popular bulletin by the Bureau of Science. In this way the results of this work will be available not only to Government officials but to the public as well. The research along this line has already saved the Manila Railroad and the Philippine Government considerable sums of money and is an excellent example of the value of coöperative effort.

Extensive field tests on the suitability of various grades of coal for railway locomotive consumption have been conducted during the year. From the technical and scientific view, the

results of such tests have been found of value in that they establish a relation between laboratory analyses and the results obtained under actual working conditions. From the practical standpoint, the value of the field tests conducted is even more tangible and apparent. As a result of these tests, for example, it has been possible to determine and select the kind of fuel that will render the most efficient service at the least cost. A working basis on which coal purchases are made has been developed and contracts for the purchase of coal are now awarded in accordance with results obtained in actual service. It is conservatively estimated that on this account an economy of thousands of pesos has resulted in favor of the Manila Railroad. Exact figures are on record at the office of the company.

Shipments of some 82,840 tons of coal valued at ₱1,367,800 were sampled and analyzed for the quality control of all deliveries. Penalties amounting to ₱12,236 were imposed upon those deliveries in which quality was below the guaranteed standard.

Side by side with the field steaming tests of fuels, a study of the lubrication requirements of the engines and locomotives of the Manila Railroad was undertaken. The object of the study was to find out exactly, under working conditions, what kind and grade of lubricant was needed in every case; and to determine whether the cost of lubrication, which constitutes a large item in the operating expense of the company, could be reduced. As a partial result of the work conducted along this line, tentative specifications for lubricants have been prepared and drafted for the use of the Manila Railroad.

Samples of water from various supply stations were analyzed to determine their quality for boiler use. As a result of this study, a formula for boiler compound was evolved at the request of the mechanical superintendent to meet the particular needs of the Manila Railroad. After an extended period of trial, during the course of which time excellent results were obtained, the formula was finally adopted for the official use of the company and large quantities of this compound are prepared for the use of the railroad. It is believed that operating expenses have actually been cut down due to reduced formation of boiler scale and decreased corrosion and pitting.

The Bureau of Science receives many requests for methods of treating water to make it suitable for boilers. Formulas developed in coöperation with the Manila Railroad have been furnished to various inquirers with very good results.



*Metropolitan Water District.*—As in past years the Metropolitan Water District has supplied a chemist particularly for the chemical examination of the water of Manila. This chemist makes several determinations daily of the chlorine content of the city water, while a bacteriologist of the Bureau of Science examines the water several times each day for bacterial content. The results of these examinations are highly satisfactory and indicate that the city water as it comes from the tap is safe for drinking and other domestic purposes.

#### WORK DONE BY THE BUREAU OF SCIENCE FOR THE PUBLIC

The work of the Bureau of Science for the public covers a wide field and directly or indirectly touches almost every phase of human activity in the Philippines. Most of the activities of the Bureau are of great importance to the public but are carried on so unobtrusively that the public hears or sees nothing of them. The preceding pages are occupied largely by a consideration of the finances of the Bureau of Science, the relation of the Bureau to other Government entities, and the research of the Bureau. In this section the activities are briefly reviewed in reference to their direct relation to public welfare.

The health of the public is protected against epidemic diseases by vaccines manufactured by the Bureau of Science. Seven million two hundred thousand doses of these vaccines were dispensed in 1928. Among the most important of these were vaccines against smallpox, cholera, typhoid, and dysentery.

Smallpox, which used to be a tremendous scourge and caused terrible epidemics, is now little feared owing to the use of vaccine. The efficiency of this vaccine is due to a considerable extent to improvements introduced in its manufacture by the Bureau of Science. The last cholera epidemic was ended with the use of Bureau of Science vaccine against cholera. So long as this vaccination is continued there should be no further epidemics. Vaccine has also been a great agency in the control of typhoid. More recently the Bureau of Science perfected an antidysenteric vaccine suitable for local conditions and which has no painful reaction. In the Philippines there is generally an outbreak of dysentery at the beginning of every rainy season. The absence of such an outbreak in 1928 was probably connected with the use by the Philippine Health Service of the antidysenteric vaccine manufactured by the Bureau of Science.

The Bureau of Science helps the health conditions in the Islands in many other ways. Important among these is the examination of foods submitted by various agencies, including the Philippine Health Service and the Bureau of Customs. Such substances are examined to see that they meet the requirements of the Pure Food and Drugs Act. Particularly important is the examination of imported canned goods such as salmon and sardines. Some of the local products examined include ice cream, coconut and other vegetable oils, meats, lard, milk, soft drinks, alcoholic beverages, bread, confectionery, fruits, vegetables, fish, sugar, molasses, soaps, cheese, dyes, flour, and cereals. During the year 1928 over fourteen thousand examinations were made on food substances and soft drinks. Bacteriologic examinations are also made on the food handlers in Manila. Waters all over the Philippines are examined both bacteriologically and chemically and no waterworks project is started until the Bureau of Science certifies that the water is suitable for human consumption. About eight thousand examinations of water were made in 1928.

The Bureau of Science also assists the Quarantine Service in keeping out epidemic diseases. In 1928 fifty-two thousand rats were examined for plague as a protection against the introduction of this disease into the Islands.

Better known is the antirabic treatment against rabies. Each treatment consists of twenty-five injections which are furnished free. More than two thousand five hundred such treatments were given during the year 1928. This antirabic treatment is also used by the City Veterinarian of Manila to vaccinate dogs.

The Bureau of Science assists the Bureau of Health, the Quarantine Service, and other Government entities as well as private doctors in making diagnoses by examining free of charge specimens, such as faeces, blood, sputum, and urine, submitted to the Bureau with the prescription of a doctor. Over sixty thousand such examinations were made in 1928. For the protection of the public the Pure Food and Drugs Act of the Islands requires that the containers of drugs and biologic products be properly labeled, not mislabeled, and that the labels state accurately the constituents of the drug. Under this law, drugs are collected by the Board of Medical and Pharmaceutical Examiners and Inspectors and analyzed by the Bureau of Science; if found to be mislabeled, they cannot be sold.

The strength of cement and other structural materials that go into the construction of buildings, and the strength of the

resulting concrete are very important from the standpoint of public safety. The Bureau of Science is required to test all cement used in Government structures and all cement used in buildings in the City of Manila, also the resulting concrete in these structures. Twenty-seven thousand such tests were made in 1928.

The Bureau of Internal Revenue is in charge of the supervision of weights and measures used to weigh and measure articles sold in the Philippine Islands, but the Bureau of Science carries on the examination and certification of standard weights and measures.

The Bureau assists in the development and in the promotion of the mining industry by geologic survey work, investigating economic mineral deposits, assaying ore and bullion, testing ores for milling purposes, identifying minerals, and examining mines and prospects for private parties with the view of assisting in their development. Among the mineral deposits discovered is an extensive deposit of chromium in Zambales. Chromium is used in hardening steel such as that used in the armor of battle-ships, projectiles, safe vaults, and other materials requiring toughness and hardness. All the chromium used in the United States is imported and so the location of a very extensive deposit in the Philippines may prove to be of great value to the American steel industries. Sites for artesian wells are located for the Bureau of Public Works.

The Bureau works for the farmers by examining soils and fertilizers. All fertilizers sold are required to be registered in the Bureau of Science, and the Bureau inspects fertilizers to see that the farmer gets the composition guaranteed by the manufacturer.

The Bureau also aids the farmer by investigating the cause, prevention, and remedies of plant diseases and by giving information and advice on these subjects.

People interested in fisheries consult the Bureau on their problems, and the Bureau recommends to the Secretary of the Department of Agriculture and Natural Resources the formulation of rules and regulations for the protection of fish and the fishing industries.

A popular activity of the Bureau is the demonstration of methods of canning and preserving fruits and vegetables. These demonstrations are given by the Bureau of Science demonstrators throughout the Archipelago. The recipes used were developed in the Bureau, and their demonstration to housewives has

resulted in extensive use of homemade preserves. This activity has also resulted in the establishment of commercial canneries. During the year, demonstrations were given in 47 towns in 11 provinces.

The demonstrators, in addition to doing demonstration work in provincial towns, have also collected Filipino recipes for cooking, 292 such recipes having been tried in the laboratory. The best of these, together with foreign recipes suitable or modified to be suitable for the Philippines, will be printed in a cook book and will be used by the demonstrators for the instruction of the public.

The Bureau of Science is open to the public for consultations on all matters pertaining to science, and the Bureau makes examinations for the public of almost all conceivable kinds of articles. These examinations include medical specimens, cotton goods, paper, leather goods, galvanized iron, mineral oils, food products, paints, and practically anything that requires testing.

Consultations and advice are given free to manufacturers of and merchants dealing in soaps, oils, paints, dairy products, soft drinks, ice, artesian water, etc.

The researches conducted by the Bureau of Science have aided the development of industries in the Philippines and the promotion of sanitation and the development of medicine.

Researches conducted by the Bureau of Science have resulted in the establishment of numerous industries and the improvement of a great many more, while the possibilities of still other industries have been pointed out. These include glass, paper, vitrified brick, medicinal remedies, paint oils including lumbang, and numerous others.

Original work done by the Bureau of Science along medical lines has been very important. An enumeration of all of it would require much space, but one example may be mentioned here. For many years beriberi was a cause of much infant mortality, until scientists working in the Bureau brought forward tikitiki extract as a remedy. Tikitiki extract is now made by a number of firms and also by the Bureau of Science. The Bureau's product is distributed free by the Public Welfare Commission through their puericulture centers. During 1928, The Bureau of Science furnished the Public Welfare Commission without cost 51,893 bottles of tikitiki extract and sold 3,420 bottles.

## PUBLICATIONS AND LIBRARY

The Philippine Journal of Science, embodying the results of the research work of the Bureau, was issued in three volumes in 1928 with an aggregate of 1,417 pages, 183 plates, and 51 text figures. The contents of the three volumes are given later in this report under the heading, Publications.

The Philippine Journal of Science is sent to 945 paid subscribers and exchanges, and 102 copies are distributed free for review, to associate editors, and other parties. The total mailing list is 1,047. This is distributed as follows: Philippines, 94; remainder of Asia, 191; Europe, 301; North America, 351; South America, 27; Africa, 31; Australia and neighboring islands, 46. These figures show that the Journal is widely distributed to scientific institutions in all parts of the world.

Three monographs were issued during the year and one is in press.

The library has continued to grow in size and usefulness and has maintained its high standard of excellence. During the year, 1,595 bound volumes and 8,605 unbound volumes, parts, and pamphlets were added, making a total of 112,483 bound and unbound volumes, parts, and pamphlets at the close of the year. The library receives 2,234 scientific serials of which 454 are paid subscriptions, 699 exchanges, and 1,081 free. The number of publications used and charged out was 58,158 or a daily average of 159 publications. The number of visitors recorded in the library was 14,101.

## MUSEUM DISPLAY

The Bureau of Science is visited by a great many people who desire to know something of the scientific work of the Bureau. Excursions of school children accompanied by teachers from Manila and neighboring provinces frequently visit the Bureau of Science, so that during the course of the year many thousands of people pass through the Bureau. In order to demonstrate the work of the Bureau and to give instruction to these people the Bureau has installed a series of cases in the corridors on the first floor in which there are displayed collections of birds, fishes, insects, shells, corals, sponges, and other animals, as well as plants and plant diseases. The cases also contain exhibits illustrating the work of the Bureau and products manufactured by the Bureau. This exhibition has proved very popular and has attracted an increased number of visitors.

## AQUARIUM

As in past years, the Bureau of Science continued to operate the Aquarium in the bastion of the Real Gate of the Walled City where a considerable variety of interesting and curious fishes and other marine animals are displayed for the benefit of the public and tourists. During the year there were 16,937 paid admissions; 4,196 free admissions to elementary students, officers and sailors of the Japanese Navy, and others; and 1,140 half-fee admissions to high-school students.

## IMPROVEMENTS

The number of people coming to the Bureau for examination, consultation, etc., had increased so greatly that the facilities for handling them were wholly inadequate. To remedy this condition the Chief Clerk's office was remodeled and large counters placed on both sides of the main entrance. This change has given much better facilities for dealing with the public and also more space in the Chief Clerk's office.

An experimental shed has been constructed in the rear of the Bureau of Science grounds in Manila for the breeding of rats and for experimentation on the vitamin content of Philippine fruits, and vegetables.

## PERSONNEL

The great increase in the demand for work by other Government entities and by private individuals and the enlargement of the activities of the Bureau has necessitated an increase of 22 in the number of personnel. The total number of employees on the pay roll as of December 31, 1928, was 345. Of these 128 composed the technical staff, 34 were clerical, while 183 were laborers, including janitors, carpenters, gardeners, watchmen, helpers, etc.

## REPORT BY DIVISIONS

## BIOLOGY AND SERUM LABORATORY

*Personnel.*—Doctors Mallari and Layug were promoted from junior to assistant bacteriologists. Doctor Bañuelos was transferred to the Philippine Health Service and Doctor Pasco was appointed junior bacteriologist.

*Coöperation.*—Dr. E. B. McKinley, representative of the Rockefeller Foundation, left Manila and no one has been assigned to the Bureau of Science to take his place. While in the Bureau, Doctor McKinley finished several short papers and a very extensive review of filterable virus diseases, which will be published in the Philippine Journal of Science.

Lieut.-Col. B. Tanabe, Imperial Japanese Army, completed his assignment to the Bureau of Science for the purpose of studying tropical medicine and left Manila in May, 1928. Upon Lieutenant-Colonel Tanabe's return to Japan, Surg. Lieut. I. Miyao of the Japanese Navy was assigned to the Bureau of Science for the study of tropical diseases. He arrived in May, 1928, and has collaborated with the chief of the division on the serology and immunology of experimental yaws and syphilis.

As in previous years Doctors Schöbl and Basaca assisted in the instruction given at the School of Hygiene and Sanitation, University of the Philippines.

Each year, the City Veterinarian of Manila vaccinates all licensed dogs in Manila against rabies. The division of biology and serum laboratory supplies free the vaccine used for this purpose.

*Routine.*—The routine examinations were less than in 1927. The decrease was particularly noticeable in faeces, water, rats for plague, ice creams, soft drinks, etc. This decrease is probably connected with the fact that there were no scares of epidemic diseases. Particularly noticeable was the fact that there was no dysentery outbreak at the beginning of the rainy season, whereas such an outbreak has previously been an annual occurrence. The improvement is probably connected with the extensive use by the Philippine Health Service of the anti-dysenteric vaccine recently perfected and manufactured by the Bureau of Science. Though the number of routine examinations has decreased, the manufacture of vaccines and serums has increased. The Philippine Health Service was furnished about half a million more doses of vaccine virus than in 1927, and also with an additional half million doses of bacterial vaccines. This latter increase is largely due to the more extended use of antidysenteric vaccine.

During the year the Bureau of Science inaugurated a free and direct laboratory service for physicians for clinical diagnoses. It has been the policy of the Bureau of Science to make laboratory clinical examinations for private parties only on the request of a licensed physician. After the introduction of the free service all such examinations were made without charge. This service has resulted in a greatly increased use of the Bureau by private physicians. The improvement consisted not so much in the inauguration of a free as of a direct free service. Previously physicians could obtain free service from the Bureau of Science only by sending specimens through the Philippine Health

Service. Both the Philippine Health Service and the Bureau of Science came to regard this system as unnecessarily inconvenient and time-consuming, and by mutual consent it was agreed that the Bureau of Science give the free service to licensed physicians. The direct free diagnostic service greatly increased the use of the Bureau by physicians and has really proved very valuable. There are many people who can pay a doctor but cannot afford the additional expense of a laboratory fee and doctors treat many people who cannot afford to pay even a doctor's fee. It is evident that a large proportion of the population falls into these two classes and this portion of the population must do without laboratory service, unless it can be furnished free. The primary object of the inauguration of the free service was to reach these classes of people and to encourage generally the use of laboratory diagnoses. The free laboratory service in Manila is intended to be only a start, as it is hoped that it will be possible to establish laboratories at strategic points throughout the Islands and inaugurate a mail service so that physicians in any part of the Islands can have laboratory diagnostic service. Money for this purpose was voted by the Senate in the last session of the Legislature.

A free service has also been inaugurated for the examination of drinking water, swimming pools, etc. Requests for such service need not be signed by licensed physicians. During the year, dairies, soda-water and ice-cream manufactures, as well as manufacturers of various foods and beverages were given free sanitary examinations.

The following table shows the amount of routine work accomplished by the division:

*Summary of routine work of the Biological Laboratory during 1928.*

	Samples or units.	Value.
<b>Cash work.</b>		<i>Pesos.</i>
Examinations made in Manila during 1928.....	1,794	7,889.74
Vaccines and serums sold from central office.....	4,640,877	298,332.64
Cebu laboratory examinations and sales.....	475	2,850.86
Iloilo laboratory examinations and sales.....	865	5,174.03
<b>Total.....</b>	<b>4,644,011</b>	<b>313,746.77</b>
<b>Free work.</b>		
Examinations in Manila.....	121,573	1,078,024.00
Vaccines and serums.....	2,558,992	517,504.00
Cebu laboratory examinations.....	3,796	14,606.00
Iloilo laboratory examinations.....	9,090	64,985.00
<b>Total.....</b>	<b>2,693,451</b>	<b>1,675,119.00</b>



In the above table the work is expressed both in terms of units and in value in pesos according to the Bureau of Science schedule of charges. These figures show that the actual cash income from the operation of the division of biology and serum laboratory was over ₱300,000, that more than 4,500,000 units of vaccines and serums were sold, and that the Bureau of Science furnished free to other Government entities more than 2,500,000 units of vaccines and serums and more than 130,000 free examinations. The total value of free examinations, vaccines, and serums furnished to other Government entities was in excess of ₱1,650,000.

The Bureau of Science has on hand a sufficient stock of its principal biologic products to meet any emergency that is likely to occur. At present there are on hand 1,409,000 doses of cholera vaccine, 1,494,150 doses of typhoid and paratyphoid vaccine, 190,000 doses of smallpox vaccine, 140,000 doses of dysenteric vaccine, 240 liters of antidysenteric serum, 995 doses of antitetanic serum, 78 liters of normal horse serum, 10 liters of antirabic vaccine, besides smaller amounts of other biologic products.

*Field work.*—The field work of the division of biology and serum laboratory consists largely of examinations of waters, and the examination of lepers during collecting trips and at treatment stations. The Government has recently adopted the policy of not approving the installation of a municipal water system until the water at the source has been examined by the Bureau of Science to see that it is suitable for human consumption. In order to make a satisfactory examination of the bacteria present it is necessary to examine the water at the site. As there is at present a great and increasing activity in the construction of municipal waterworks in the Philippines, the Bureau of Science receives many requests for the examination of water supplies. Numerous trips for the purpose of examination were made during the year.

*Research.*—In the past there has been much difficulty in purifying and concentrating serums in the tropics. During the year, great progress was made on a method of purifying and concentrating serums against tetanus, diphtheria, and dysentery so that the volume of material to be injected will be smaller, and the after effects of serum injection will be greatly minimized. The Bureau plans to put these improved serums on the market. They will save patients a great deal of discomfort, and should become increasingly popular.

The most important line of investigation was that undertaken by Doctor Schöbl and his collaborators on the two trepanematous infections, yaws and syphilis. The first part of this work was reported in my last annual report as follows:

The most noteworthy accomplishment of the year was the work on yaws by Doctor Schöbl. The experiments on the etiology of the various clinical manifestations and on immunity in many of its phases were continued and gave a very comprehensive picture of the etiology, clinical manifestations, and immunity of the disease. The results are embodied in a paper now in press on Experimental Yaws in Philippine Monkeys. This paper is one of the most outstanding ever produced by the Bureau of Science and will be a classic in medical literature.

The work mentioned above has been published and has received very favorable comment. The continuation of this work is even more important and has thrown a great deal of light on the cause and treatment of syphilitic infections. Still more striking is the fact that a vaccine has been developed which not only gives monkeys life-long immunity to yaws but also immunizes them against syphilis. Though work on man has not been started, there are indications that some day it may be possible to reduce the number of victims of these diseases by preventive vaccination, and also to prevent a patient infected with syphilis from developing the very distressing symptoms which so often characterize the late stages of this disease.

*Publications.*—The following papers were published during the year:

Note on local terminology of certain manifestations of yaws, by Otto Schöbl.

Note on bacteriological diagnosis of bacillary dysentery, by Otto Schöbl and Rita Villamil.

Experimental yaws in Philippine monkeys and a critical consideration of our knowledge concerning framboesis tropica in the light of recent experimental evidence, by Otto Schöbl.

Viability of *Treponema pertenu* outside of the body and its significance in the transmission of yaws, by K. Yasuyama.

Notes on the serological relationship of the choleralike vibrios isolated from human beings and from waters in Manila, by Onofre García.

Fermentation as affecting the quality of abaca, by Trinidad Bañuelos and P. L. Sherman.

The effect of the administration of alcohol upon the result of the Wassermann test in yaws monkeys, by B. Tanabe.

The following papers were submitted for publication and are in press:

Note on the duration of immunity to yaws in Philippine monkeys, by B. Tanabe.

Serologic studies in experimental yaws, by Otto Schöbl.

Experiments concerning the yaws antigen which produces positive Wassermann reaction when injected in suitable experimental animals, by Otto Schöbl and B. Tanabe.

Is the Wassermann reaction provoked in Philippine monkeys by yaws vaccination specific? by I. Miyao.

Following the subcutaneous immunization with yaws vaccine is the skin tissue proper responsible for the production of Wassermann reagin or do other tissues also participate? by I. Miyao.

The relation with regard to Treponema antigen of the Wassermann and Kahn reactions, by O. Garcia.

Summary of serologic studies in experimental yaws, by Otto Schöbl.

#### BOTANY

*Personnel.*—The Bureau was very fortunate in securing the services of Dr. Eduardo Quisumbing as systematic botanist. After receiving his doctor's degree in the University of Chicago, Dr. Quisumbing taught for some years in the College of Agriculture and then studied systematic botany for two years under Dr. E. D. Merrill, dean of the College of Agriculture of the University of California, formerly Director and botanist in the Bureau of Science. Dr. Quisumbing was appointed botanist in the Bureau July 6.

*Routine work.*—The Bureau of Science has continued the identification of plants submitted by the Bureaus of Commerce and Industry, Agriculture, and Forestry, the Philippine Health Service, and by various divisions of the Bureau of Science. It has also identified many plants for private individuals to whom much information concerning the economic value or curative properties of various Philippine plants has been given. The exchange of botanical specimens with institutions abroad was maintained regularly and specimens were received from the Malay Peninsula, Amboina, Burma, India, Java, and the United States.

*Field work.*—Botanical explorations were carried on in Camarines Sur, Catanduanes Islands, and Laguna Province. More than 9,000 specimens were collected.

*Research.*—Work on medicinal plants was continued. Records of the local medicinal uses of 149 species which were not heretofore reputed to have medicinal properties were obtained. Seventeen of these have poisonous properties. The total alkaloids of *Datura fastuosa* and *Datura alba* were determined. Also the alkaloidal constituent of *Artabotrys suaveolens* was determined. Morphological and pharmacological studies were made of the leaves and stems of *Tinospora rumphii* and *Tinos-*

*pora reticulata* (macabuhay). These plants are regarded by Filipinos as having valuable medicinal properties and are, in fact, the most highly prized Philippine medicinal plants. A chemical study of these plants was completed last year. Histological and microchemical studies of the bark of *Artabotrys suaveolens* were also completed. A determination was made of the alkaloidal constituent that is the active principle of the bark of *Artabotrys suaveolens*. This alkaloid is a powerful poison and has therapeutic value. A study of the chemical constituents of *Kampferia galanga* is nearly completed. The active principle is an aromatic oil that is a carminative. It stupefies and paralyzes fish without killing them unless they are exposed to it for a considerable length of time. The Filipinos use the rhizomes of this plant as a stimulant and carminative. The alkaloids of some anonaceous plants have also been studied, so far the work on the alkaloidal constituents of four have been completed. In the Philippines there is at least one cinnamon which seems to be equivalent in value to the commercial species, and in fact is often sold as Chinese cinnamon. Other species are used as adulterants of this species and also of *Cinnamomum ceylanicum*. Owing to this fact pharmacognostical studies of the various species of cinamon have been undertaken and are almost completed. This will enable merchants to determine what kinds of barks they are handling.

The Bureaus of Science and Forestry are coöperating in the preparation of an extensive work on the economic trees of the Philippines. This will be issued in four volumes, the first of which is largely completed, while much work has been done on the others.

*Publications.*—The following research papers were completed and published in the Philippine Journal of Science:

Total alkaloids of *Datura fastuosa* Linnæus and *Datura alba* Nees from the Philippines, by J. M. Marañon.

A cytological study of *Cocos nucifera*, Linnæus, by J. K. Santos.

Stem and leaf structure of *Tinospora rumphii* Boerlage and *Tinospora reticulata* Miers, by J. K. Santos.

New Philippine plants, by E. Quisumbing and E. D. Merrill.

The following papers were presented for publication:

An alkaloidal constituent of *Artabotrys suaveolens*, by J. M. Marañon.

Histological and microchemical studies of the bark of *Artabotrys suaveolens*, by J. K. Santos.

#### PLANT PATHOLOGY AND MYCOLOGY

*Personnel.*—Mr. José M. Mendoza was assigned to this division as assistant mycologist January 1. Miss Simeona Leus

was appointed junior mycologist February 9. Miss Mercedes Z. Quijano was appointed laboratory helper May 17. Mr. F. B. Serrano, of the Bureau of Agriculture, resigned July 21, 1928, to undertake plant pathology work for an agricultural corporation. Mr. F. M. Clara, of the Bureau of Agriculture, left for the United States September 1 as a pensionado to specialize in plant pathology.

As in the past the work in this division was done by the staff of the Bureau of Science and men detailed from the Bureau of Agriculture. Under the coöperative agreement the laboratory has been known as the phytopathological laboratory of the Bureaus of Science and Agriculture.

*Research.*—The greatest progress in plant pathology was in the control of a severe die-back disease of cacao. This disease is characterized by the death of the terminal portion of branches, and a general unhealthy appearance in badly infected plants, and by a practical absence of fruits. The disease first attacks the tender twigs and leaves, then works back to the larger branches and finally to the main trunk, killing as it goes. This disease is caused by a fungus of the genus *Colletotrichum*. The disease is wide spread and its presence is responsible for the fact that the cultivation of cacao is not profitable in many localities in the Philippines. It has been found that the die-back disease of cacao can be controlled, at least partially, by the proper selection of the soil, proper spacing of the plants to insure sufficient sunlight, and subsequent cultivation to keep down other competing vegetation. When the disease first appears it can be eradicated rapidly and cheaply by cutting away the diseased twigs and branches, painting the stubs with asphaltum, and then burning the branches that were removed. Where heavy infection occurs and the disease has become thoroughly established, burning should be followed by several applications of a suitable spray. Proper pruning and spraying will eradicate the disease even when the plantation is heavily infected.

Investigation on rice has been confined to the stem rot disease, *Sclerotium oryzae*, which appears to be the most serious disease of rice in the Philippines. Since the causative fungus persists in the soil for long periods of time, the disease is very difficult to eradicate. It would seem that efforts toward controlling the disease in infected fields must be confined largely to the selection of varieties or strains of rice that are resistant to the disease. This year's investigations have centered around this point.

However, studies of the effect of fertilization and the density of planting on the disease are under way.

Considerable progress has been made in the study of wood-destroying fungi that are responsible for the decay both of standing trees and of lumber. This type of work is very tedious and exacting, but the results will be of great value to the lumber industry.

*Publications.*—The following papers were published during the year:

A Phytophthora disease of santol seedlings, by F. M. Clara.

Bacterial fruitlet brown-rot of pineapple in the Philippines, by F. B. Serrano.

#### GENERAL ZOOLOGY

*Personnel.*—Mr. G. Taguibao, junior preparator, resigned March 19. The position of entomologist has been vacant since the resignation of Mr. W. Schultze, in 1927.

*Coöperation.*—Various small collections of insects have been sent to specialists in the United States, who contribute papers to the Philippine Journal of Science. Some papers on entomology based on the Baker collection have been received for publication. A field trip to Romblon Province was made in part with the aid of Mr. W. Parsons.

*Routine work.*—Work in entomology has been at a standstill. The regular taxodermic work on private orders has taken considerable time. Mounted birds for the exhibition series have been labeled and arranged in the hall cases.

*Field work.*—Field work has been done in Romblon, Bulacan, and Laguna Provinces, resulting in collections of birds, plants, and insects. Parties were in the field during parts or the whole of each month. The chief of the division joined some of these parties for brief periods, but was forced to be in Manila most of the time to help on the Bureau publications.

*Research.*—Due to lack of personnel and pressure of routine no research was done.

*Publications.*—Several papers on ornithology are in progress, but none was completed.

#### FISHERIES

*Personnel.*—Dr. Albert W. Herre, former chief of the division, retired from the service June 25, and accepted an appointment as Curator of the Stanford University Museum. Mr. Florencio Talavera, pensionado of the Bureau, arrived from the United States and was added to the scientific staff of the division of fisheries August 2 as specialist on Crustacea and Mol-

lusca. The other members of the division continue as during last year.

*Routine work.*—The varied activities conducted during the year by the members of the staff included the following:

Consultations and correspondence pertaining to fish culture, fish preservation, and fishing methods; recording and identification of fishes, crustaceans, reptiles, and batrachians collected or submitted; care of the fish museum containing 1,400 species of fish; and the management of the aquarium which was overhauled and put in good condition.

*Field work.*—On January 3, Mr. Montilla made a trip to Ilocos Norte to examine possible sites for the cultivation of bañgos and to obtain information about the condition of carp planted the previous year in Lake Paoay; from there he proceeded to Bontoc and Apayao to see if it would be advisable to introduce additional species of fish in lakes and rivers of that region. During the early part of February, Mr. Montalban was in Santa Cruz and Paete, Laguna Province, to collect specimens of carp from Laguna de Bay and to locate sites suitable for the culture of carp and gurami. In March, he went to Camarines Sur and Albay where he observed the quantities and sizes of carp caught from Lake Buhi and Lake Bato, and conferred with the municipal authorities on the problem of the introduction of carp and gurami. During the same month, Mr. Martin went on a collection and observation trip with a Japanese muro-ami fishing outfit operating from Manila to the Cuyo Islands; and Mr. Lopez accompanied by Mr. Canlas made a trip to Tayabas and Polillo Island to collect fish specimens. March 24, Mr. Montalban was sent to Canton and Formosa for the purpose of securing carp fry and learning the methods of cultivating this fish. As a result of this trip, much valuable information was obtained, throwing light on the problems involved in the successful pond culture of carp. The period from April 16 to May 12 was spent by Mr. Martin in the study of the methods and problems of bañgos culture in regions around Manila Bay. June 9, Mr. Lopez went with a Japanese muro-ami fishing outfit, operating from Cebu, to collect fish specimens at Dipolog, Dapitan, Iligan Reef, and in the neighborhood of Bohol. About the same time, Mr. Martin planted gurami in Laguna de Bay. Mr. Deroy went to Calapan early in August to collect live fishes for the Bureau of Science Aquarium. August 14, Mr. Montilla looked into the possibilities of fish culture in the Pampanga Agricultural School, at Magalang. Mr.

Lopez spent about three weeks during August and September collecting specimens at Busuanga and Linapacan Islands. The Japanese fishing outfits operating from Manila very kindly furnished him transportation gratis. During the first half of September, Mr. Martin made a survey of the fisheries of Laguna de Bay. During October, Mr. Montalban visited the Muñoz Agricultural School for the purpose of selecting a site for a fish farm, and from there he proceeded to La Union and Pangasinan to collect fish specimens and to survey the fisheries of Lingayen Gulf. December 1, Mr. Martin made a trip to Camarines Sur to investigate the fisheries of Lake Bato and Lake Buhi, to collect fish specimens, and to obtain information about the attitude of the people towards carp as a food fish. December 5, Mr. Montilla surveyed the ipon fisheries of the Ilocano regions, and on the 8th, Mr. Lopez went to Cebu and Bantayan Island to collect Venus flower baskets, shells, and corals. Later in the month, Mr. Deroy revisited Calapan to obtain live fishes for the Bureau of Science Aquarium.

*Publications and research.*—Mr. Montalban and Mr. Martin completed two papers during the year: one on the systematic treatment of the family Sillaginidae and the other on Japanese fishing methods used by Japanese fishermen in Philippine waters, and have under preparation a monographic review on the family Sciaenidae. Mr. Montalban has continued the monographing of the sea bass group or family Serranidae. Mr. Talavera in collaboration with the experiment of Mr. Luis Reyes, of the Bureau of Forestry, has conducted studies on marine wood borers at the mouth of the Pasig River, and has studied the collection of crustaceans of the Bureau of Science. Papers published during the year are as follows:

Three new Philippine fishes, by A. W. Herre.

The Philippine gars or needle fishes, by A. W. Herre.

The Philippine siganids, by A. W. Herre and H. R. Montalban.

The goatfishes, or Mullidæ, of the Philippines, by A. W. Herre and H. R. Montalban.

A monograph of the Pomacentridæ of the Philippine Islands, by H. R. Montalban.

#### GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

*Personnel.*—Mr. Aurelio Cruz was transferred to the division of organic chemistry and his place filled June 20 by the appointment of Mr. Ceferino Jovellanos. Mr. Gil Opiana resigned October 21, and we have not been able to fill his place as no suitable candidate has been available.



*Coöperation.*—Extensive experiments have been undertaken in coöperation with the Manila Railroad Company on the standardization of paints, lubricants, coals for boiler purposes, and boiler-water treatments. The results are given in some detail in the general part of this report.

Coöperation has been extended to other Government entities, particularly to the Bureau of Supply, through the Government Committee on the Standardization of Supplies. The results obtained from the coöperation with the Manila Railroad Company on the standardization of paints have been enlarged and combined with other specifications to form a rather lengthy and complete set of specifications for paints and paint materials for the insular and provincial governments. These specifications have already saved the Government considerable sums of money in the purchase of paints and give promise of being a source of greater saving and satisfaction. In order that these specifications might be available in a useful form, not only for various insular and provincial government entities, but for the public as well, they have been combined with an introduction discussing the value of various paint materials for different purposes and also methods of painting, and the whole is being printed as a popular bulletin.

Specifications for ink which were prepared for the Government Committee on Standardization of Supplies and which were adopted by that committee continue to give good results as shown by actual service and laboratory tests.

At the request of the Bureau of Supply and the Manila Railroad Company, considerable work has been done on standards for gasoline. As a result of actual service tests information has been gathered on the relative merits and costs of the different brands of gasoline available in the local market. Particular attention has been paid to the correlation of actual service with the results of simple laboratory tests. This work has already given promising results. There are many difficulties to be overcome; for example, it has been found that between two brands of gasoline, one may give better results for short trips with many stops as in the City of Manila, while the other may be superior for long provincial trips with few stops.

Coöperation has also been furnished to the Bureau of Supply and the Bureau of Commerce and Industry in the matter of correlating the results of distillation and burning tests of kerosene with actual efficiency for illumination.

Considerable progress has been made in the formulation of tentative specifications for the purchase of paper by the Bureau of Supply for various Government entities. This work when completed will be of considerable benefit to the Government in coördinating the kinds of papers used for similar purposes thereby diminishing the number of kinds to be kept in stock, and also giving standards of value, so that money may be spent to the best advantage.

At the request of the Bureau of Supply, standard specifications have been drawn up for linoype and monotype alloys for the Bureau of Printing.

*Routine.*—This division is called upon to do much routine work and this work will tend to increase rather than decrease, particularly as a large part of it is necessitated by Government regulations. Another factor tending to increase the routine work of this division is the increasing use by the Government of specifications in the purchase of supplies. A great deal of time has been spent not only in formulating specifications but also in checking up materials to see that they meet the specifications. Such examinations are often long and laborious, particularly when they deal with the composition of such complex substances as paints.

According to regulations, all cement used by the Government must be tested before it can be employed in construction. Likewise, samples of all concrete used in Government construction must be tested. A city ordinance of Manila requires the testing of all cement and the resulting concrete used in concrete construction, both private and Government. During the year 27,000 samples of cement and concrete were tested. The value of free work done for the Government in testing cement amounted to ₱18,498.40.

A prerequisite for the construction of water supplies for municipalities is that the water pass standard chemical and bacteriological tests. Many samples of water were submitted for chemical test by the Bureau of Public Works and the Philippine Health Service.

The work on fuel testing is heavy as the result of Executive Order No. 3, issued January 27, 1922, by virtue of which all coal purchased by the Government and corporations financed by it must be tested by the Bureau of Science. For two Government institutions alone our fuel testing laboratory has sampled and tested during the year 94,459 long tons valued at

₱1,603,700. The total penalties imposed on deliveries made below the standard amounted to ₱16,219.

The work on standardization of weights and measures is carried out in accordance with Section 10 of Act No. 1519 of the Philippine Legislature. This act provides that the Bureau of Science shall be the official depository of the fundamental weights and measures for the Philippine Islands and that all comparisons of the secondary standards used by provinces and municipalities with the fundamental ones shall be made by the Bureau, upon the request of the Collector of Internal Revenue.

In the following table is given in detail the nature of the routine work done during the year under review.

TABLE—Showing routine work accomplishment during the year 1928.

Nature of samples received.	Samples.	Determinations.
<b>Water laboratory.</b>		
Waters.....	377	3,707
Cements (chemical analysis).....	172	688
Rocks, ores, and minerals.....	81	71
Electrolytes and standard solutions.....	48	69
Chemicals.....	8	11
Boiler scale.....	4	34
Miscellaneous chemicals.....	6	32
<b>Total.....</b>	<b>646</b>	<b>4,612</b>
<b>Paints and alloys laboratory.</b>		
Paints and oils.....	86	532
Metals and alloys.....	61	177
Inks, varnishes, and miscellaneous products.....	169	900
<b>Total.....</b>	<b>316</b>	<b>1,609</b>
<b>Weights and measures.</b>		
Measures of length.....	12	12
Measures of capacity.....	139	139
Weights.....	185	185
Gasoline trucks and pumps.....	26	104
Scales and other weighing devices.....		
Miscellaneous.....	35	140
<b>Total.....</b>	<b>397</b>	<b>580</b>
<b>Cement laboratory.</b>		
Cement (physical test).....	17,447	22,681
Concrete specimens.....	9,244	9,244
Reinforcing steel, cables, and plates.....	107	321
Ropes.....	104	208
Cloth and other fabric.....	105	630
Sand, gravel, broken stones.....	100	500
Lime and limestones.....	20	40
Asphalt.....	4	20
Miscellaneous.....	11	33
<b>Total.....</b>	<b>27,142</b>	<b>33,677</b>

TABLE—Showing routine work accomplishment during the year 1928—Ctd.

Nature of samples received.	Samples.	Determinations.
<b>Fuel laboratory.</b>		
Coal, Manila Railroad.....	* 138	828
	82,839	
Coal, Bureau of Supply.....	* 11,620	* 21,582
Coal, private.....	13	78
Fuel oil.....	7	10
Miscellaneous.....		
<b>Total.....</b>	<b>207</b>	<b>1,210</b>
<b>Grand total.....</b>	<b>28,708</b>	<b>40,688</b>

\* Long tons.

*Research.*—A large part of the investigation conducted by this division has been practical in nature and has been either along the line of the preparation of standard specifications for the Bureau of Supply and other Government entities as discussed under the section on coöperation, or on the behaviour of the different brands of commercial products. The latter type of investigation is valuable to the Government but must necessarily be of confidential character and is, therefore, not suitable for publication. In addition to these types of work, researches looking toward the utilization of Philippine raw materials have been conducted.

Investigations on the possibility of utilizing cogon and rice straw as raw materials for paper have been completed. The results show the amount of paper pulp that can be obtained from a given area of cogon land and the percentage of cellulose present in cogon of different ages. Rice straw proved to be a better source of raw material than cogon and would seem to offer greater commercial possibility. It is available in larger quantities and in more accessible areas than cogon, and is strictly a waste by-product.

In the Philippines there seems to be great scarcity of clays suitable for vitrified products such as vitrified sewer pipes, vitrified bricks, and porcelain. However, an investigation conducted during the year shows that certain of the Philippine clays are promising materials for pipes and bricks, and others for porcelain.

Considerable work has been done on a laboratory method of testing the wearing qualities of protective paints within short periods of time. The results so far obtained are very promis-

ing in that short laboratory tests agree remarkably well with long exposure tests. If this work turns out as it promises, it will afford an easy and quick method of determining the relative protective merits of different paints.

A refined method of determining the alkalinity of commercial limes was developed.

The study of the radioactive properties of artesian-well waters in Manila and vicinity has been continued. Practically all such waters were found to contain appreciable amounts of radioactive materials.

The Bureaus of Forestry and Science have long been interested in determining the various mechanical properties of Philippine woods as this information is of great value, particularly to architects and engineers in determining what kinds of woods they should use and in what sizes to obtain proper strength in finished buildings. The Bureau of Forestry has coöperated in this work by supplying large quantities of timbers. In addition the Bureau of Science has bought large amounts of various woods, particularly the more expensive ones. This work was continued during the year and a large number of tests made. Special attention has been paid to the nail and spike holding power of various woods, including those treated with preservatives. The results will be useful to those employing railroad ties and also to those using woods for building purposes.

*Publications.*—The following papers were published during the year:

Strength properties in relation to specific gravity of Philippine woods, by J. C. Espinosa.

The lime industry of the Philippine Islands, by F. D. Reyes.

The following papers were submitted for publication and are in press:

Cogon and rice straw as raw material for paper manufacture, by F. D. Reyes and Aurelio O. Cruz.

Alkalinity determination of commercial lime, by Ceferino M. Jovellanos. An inexpensive method of improving the appearance of buntal fibers and articles made of such materials, by Salvador del Mundo.

Popular bulletin on paints and paint specifications, by T. Dar Juan.

#### SOILS AND FERTILIZERS

*Personnel.*—There was no change in the personnel of this division during the year.

*Routine work.*—The routine work of the division has been increasing due to a greater demand for fertilizers especially in

the sugar regions of the Islands and to some extent to the increasing use of fertilizer in the rice region of central Luzon. Many farmers have come to realize the importance of an adequate knowledge of soil conditions with reference to productive capacity of the lands. In spite of the shortage in personnel a considerable volume of work was accomplished due to the interest taken and the spirit of coöperation among the members of the division.

*Coöperation.*—This division is frequently called upon to render technical advice to local fertilizer manufacturers. The exploitation of guano has grown with the growth of the local fertilizer industry. This division has helped foster the use of guano by indicating the method of exploitation and of utilization by proper mixing with chemical ingredients. It is frequently called upon to do umpire work and to appraise local fertilizer materials. Controversies on the merits of one class of fertilizer over another are referred to this laboratory for settlement.

During the latter part of the year, Dr. Manuel L. Roxas, acting for the Philippine Sugar Association, arranged for close coöperative work on soil investigations of the principal sugar regions in Luzon. It is believed that the carrying out of this coöperative work will be of service to the sugar industry and enhance the accomplishments of the two coöperating institutions. The tentative outline of the activities to be undertaken include  $P_H$  value determinations; biological studies; chemical and physical studies; soil survey; profile studies, nature of subsoil, depth of surface soil, etc.; percolation coefficient; productive capacity; general agronomic studies.

The Bureau of Agriculture continues to send samples of soils and fertilizers. The Bureau of Education, as represented by the various agricultural schools, also sends soil samples for analysis and consults the division on the soil problems encountered. The division has been called upon to study certain irrigated areas and analyze irrigation waters in relation to soil fertility of the locality. Agricultural companies and private parties have frequently consulted the division with regard to the adaptability of crops for certain kinds of soils.

*Field work.*—Due to more adequate funds for travel, more field work was done during the year than in previous years. Considerable time was spent in a reconnaissance soil survey of Albay Province. Preliminary work along this line has also been started in Sorsogon and Camarines Sur Provinces. This work when completed should be of help in the development of

the abacá and coconut industries for which the region is especially adapted.

A trip to Lubao, Pampanga, was undertaken in compliance with a request of the Municipal Board of that municipality to look into the possibility of increasing the rice production in the region.

*Research.*—The largest item in research undertaken during the year was a soil reconnaissance survey of the Bicol region. Field work in Albay Province has been completed and the report is in progress of preparation, and considerable work has been done in Sorsogon and Camarines Sur Provinces.

Many of the soils of the Philippines are deficient in carbohydrates which serve as sources of energy for nitrogen-fixing bacteria, so that the process of fixation of atmospheric nitrogen in the soil is not as rapid as would be desirable. Experiments are under way to see whether or not this deficiency in carbohydrates can be supplied by cane-sugar bagasse and molasses, as both of these substances, particularly bagasse, are waste products from the manufacture of sugar.

Considerable progress has been made in a method of determining the lime requirements of the soil by the number of nitrogen-fixing bacteria present.

A study has been made of the effect in certain cases of using alkaline waters for irrigating a region of limestone formation and it has been found that under such circumstances irrigation may be very detrimental to the soil as it increases the alkalinity to such a point that many crops, particularly rice, cannot be grown.

In the Philippines fertilizers have been used with great success in the growth of sugar cane, but little progress has been made in the use of fertilizers for other crops. However, a beginning has been made in the case of rice, and in order to aid the farmers in the use of the right kind of fertilizers field studies are under way to determine what types of fertilizers will be most suited to various rice soils.

Another practical line of research from which results are expected is the study of the growth of abacá in various types of soils, specially in the Bicol region.

*Publications.*—The abo-abo soil of Occidental Negros, by M. M. Alicante, was published in the Philippine Journal of Science.

The occurrence of nitrification in acid soils, a paper by M. M. Alicante, has been submitted for publication.

## ORGANIC CHEMISTRY

*Personnel.*—Miss Irene de Santos was appointed assistant in research organic chemistry and Miss Fé Anido, assistant in drug analysis. Mr. Aurelio Cruz was placed in charge of the analysis of coconut oil and copra products. During the year Mr. Ramon Feliciano and Mr. D. M. Birosel resigned to accept other positions.

*Routine work.*—A large part of the routine work of this division is in connection with the enforcement of the Pure Food and Drug Act. Under the provisions of this act samples of imported foods and drugs are collected by the Bureau of Customs and tested by the Bureau of Science to see that they conform to the provisions of the act. Various foods including canned goods, cakes, lard, milk, soft drinks, bread, confectionery, cheese, flour, cereals, etc., are also collected by the Philippine Health Service from stores, markets, and vendors, and examined by the Bureau of Science to see that they are suitable for human consumption. Likewise, drugs are collected by the Board of Medical and Pharmaceutical Examiners and Inspectors and sent to the Bureau of Science for examination to see that the containers of the drugs are properly labeled, not mislabeled, and that the labels state accurately the constituents of the drugs. The sale of all foods and drugs that fail to meet the requirements of the Pure Food and Drug Act is prohibited, thus this work is a great protection for the public. In such testing, the division is called upon to examine many complex substances, particularly drugs, and a high degree of skill is required.

A great deal of routine analytical work was done for private parties and the division was consulted frequently for advice on foods, drugs, and other industrial organic products. The coconut oil shipped from the Philippines is tested by the Bureau of Science, and the shipments are financed by the banks on the bases of the reports of the Bureau.

The following table gives an idea of the various kinds of samples analyzed:

Drug analyses.	Samples.
Miscellaneous alkaloid analysis.....	180
Ointments .....	22
Ampules .....	20
Alcohol .....	88
Pills .....	46
General examinations.....	109
Tikitiki analysis (complete).....	7
Liniments .....	3



Drug analyses—Continued.

Unknown drugs (complete).....	20
Stomach contents (routine).....	2
Toxicological examinations (complete).....	10
Soaps .....	10
	<hr/>
	517
	<hr/> <hr/>

Lubricating oils, etc.

Gasoline .....	11
Kerosene .....	2
Lubricating oils .....	50
Fuel oils.....	19
Asphalt .....	5
Miscellaneous petroleum products .....	9
Floor wax .....	10
Miscellaneous (soap, explosives, wood preservatives, tar) .....	23
	<hr/>
	129
	<hr/> <hr/>

Copra products, etc.

Coconut oil .....	572
Copra .....	4
Copra cake .....	2
Miscellaneous oils, tallow, etc.....	14
	<hr/>
	592
	<hr/> <hr/>

Food analyses.

Meat and its products, including salmon, sardines, hams, sausages, shrimps, lard, etc.....	3,889
Grain products, including rice, flour, bread, etc.....	3,368
Beverages, alcoholic and nonalcoholic.....	1,030
Sugar and molasses.....	476
Milk and its products, including fresh and canned milk, ice cream, butter, cheese, etc.....	395
Miscellaneous, including foods, condiments, coloring matters, and preservatives.....	445
	<hr/>
Total .....	9,603
	<hr/> <hr/>

*The manufacture of tikitiki extract.*—During the year 55,313 bottles of tikitiki extract with a sale value of ₣38,719 were prepared. Of these, 3,420 bottles with a sale value of ₣2,394 were sold, and 51,893 bottles with a sale value of ₣36,325 were furnished to the Office of the Public Welfare Commissioner for free distribution through puericulture centers. As stated in previous annual reports, the tikitiki plant in which tikitiki ex-

tract is manufactured is wholly inadequate both from the standpoint of increased production and of efficiency in operation.

*Research.*—A number of chemical researches were completed. At present the mixed ethyl esters obtained from the acids of chaulmoogra oil are used in the treatment of leprosy. As this treatment is usually a rather slow process it is possible that some new remedy may give quicker results. During the year several researches on new chaulmoogra preparations were completed.

Researches were conducted and are now nearly completed on the analysis and properties of refined lumbang oil, coconut oil, and Philippine chaulmoogra oil (*Hydnocarpus alcalae*). Absolutely water-white and acid free coconut oil was made from clean copra. The copra cake was then made into a pure white, fine-grained, agreeably tasting flour well suited for human consumption. It has proved to be particularly good for the making of cakes. This work may lead to higher standards for coconut oil and more profitable methods of utilizing copra cake.

The composition of various kinds of Philippine coffees was determined, and it was found that these coffees compare favorably with foreign coffees.

Bagasse from Philippine sugar cane was investigated and the composition determined. It was believed that bagasse might be suitable for the rayon industry, but the results obtained were not promising. However, Philippine bagasse seems to be suitable for low-grade paper.

A number of starches were prepared from Philippine tubers. Some Philippine plants have starches which might be used as substitutes for the starch preparations now found on the market. The published photomicrographs of these Philippine starches will serve as a help in identifying starches of unknown origin.

The vitamin content of a number of Philippine vegetables and fruits was determined. A number of experiments were carried out to ascertain standards for commercial tikitiki, and the potency of commercial preparations.

Research on medicinal plants has been continued and some interesting glucosides and alkaloids have been found. Such investigations lead primarily to the utilization of Philippine plants for medicinal purposes and contribute toward the preparation of a Philippine pharmacopœia.

There are many plants and plant products used as food in certain localities that are not generally used by the people throughout the Islands. The composition and food value of a

large number of these unusual plants were determined during the past year.

*Publications.*—During the year 1928 the following researches were published:

Chaulmoogryl derivatives of lactates and salicylates, by S. Santiago and A. P. West.

Esters of alpha linolenic acid hexabromide (isobutyl, amyl, n-propyl and isopropyl) from lumbang oil, by M. L. A. Vicente and A. P. West. Composition and nutritive value of Philippine food fishes, by A. Valenzuela.

Composition of Philippine pineapples, by A. H. Wells, F. Agcaolli, H. Taguibao, and A. Valenzuela.

An investigation to determine a satisfactory standard for Beriberi Preventing Rices, by E. B. Vedder and R. T. Feliciano.

Total alkaloids of *Datura fastuosa* Linnaeus and *Datura alba* Nees from the Philippines, by Joaquin Marañon.

The following papers were submitted for publication:

Chaulmoogryl substituted phenols and chaulmoogryl hydroxy ethyl benzoate, by I. de Santos and A. P. West.

Chaulmoogryl amino phenols and chaulmoogryl benzylamine, by I. de Santos and A. P. West.

Photomicrographs of Philippine starches, by Ray N. Allen.

Composition of Philippine bagasse, by A. Valenzuela and A. P. West. A biological study of the vitamin contents of Philippine foods I, by A. J. Hermano.

Composition of Philippine coffee, by A. Valenzuela.

An alkaloidal constituent of *Artabotrys suaveolens* Blume, by Joaquin Marañon.

An aid in bending glass tubing in the laboratory, by Ray N. Allen.

#### FOOD PRESERVATION

*Personnel.*—Miss Maria Y. Orosa, chief of the division, was sent abroad to study labor-saving machinery and general methods of canning and food preservation. Miss Presentacion Atienza was made assistant chief of the division October 15, and has acted as chief of the division during the absence of Miss Orosa. August 16, Miss Adela Platon was appointed senior demonstrator, and Miss Angelina Fajardo, junior demonstrator. Four demonstrators resigned during the year; Miss Matilde Rivera May 13, Miss Roberta Dioquino June 1, Miss Josefina Javier April 1, and Miss Carolina Gonzales November 16.

*Coöperation.*—Assistance was furnished the De Santos Fruit Packing Company, a commercial manufacturer of canned and preserved native fruits and vegetables; also the Napiza Sisters of Sta. Cruz, Laguna, and Miss Juana Yaneza of Pagsanjan,

Laguna, who are preserving native fruits and pickles for sale. Twelve former students in the provinces intend to establish their own commercial factories in the near future. Special conferences were given these students regarding preserving jars, cans, sterilizers, sealing machines, and other utensils used in food preservation work.

Lectures and special demonstrations have been given to domestic science and home economics teachers in primary and intermediate grades of the public schools. It is very interesting to note that food preservation is now taught both in public and private schools.

This division has participated in nearly all the provincial carnivals where numerous food preservation contests have been held among housekeepers. These contests have aroused the interest of the Filipino people in canning their own fruits and vegetables instead of buying from grocery stores, which encourages the substitution of home products for imported canned goods.

*Routine work.*—The food preservation room in the Bureau of Science is often crowded with women who are very desirous to learn scientific methods of food preservation. On Saturdays, the laboratory is crowded with visitors and excursionists from the provinces, for whom special lectures and demonstrations are given.

*Field work.*—The demonstrators of this division spent most of their time in the provinces. After an arrangement has been made with the officials of a province a senior and a junior are usually sent together to the chief towns of the province. The length of stay in each place depends upon the coöperation given by the officials and the number of students attending the demonstration. The following table shows the forty-seven towns in eleven provinces that were visited during the year:

Bataan.	Davao—Continued.
Balanga.	Daliaon.
Limay.	Tugbok.
Orion.	Iloilo: Arevalo.
Basilan: Isabela.	Leyte.
Cagayan.	Tacloban.
Tuguegarao.	Tanawan.
Aparri.	Dagami.
Alcala.	Burawen.
Cotabato: Cotabato.	Dulag.
Davao.	Abuyog.
Davao.	Malitbog.
Kinking.	Maasin.

Leyte—Continued.

Bato.  
Hilongos.  
Baybay.  
Ormoc.  
Palompon.  
Barrugo.  
Carigara.  
Sogod.  
Palo.

Ilocos Norte.

Laoag.  
Batac.  
Currimao.  
Paoay.

Ilocos Norte—Continued.

Badoc.  
Dingras.  
Solsona.  
Piddig.  
Sarrat.

Mindoro: San Jose.

Negros Oriental.

Guihuluṅgan.

Siaton.

Bacong.

Zamboanguita.

Palawan.

Culion Leper Colony.

Balala.

*Research.*—The demonstrators when in the field not only did demonstration work but also collected native recipes for cooking. Two hundred ninety-two such recipes have been collected and tried in the laboratory. The best of these recipes together with foreign recipes suitable or modified to be suitable for the Philippines will be included in a cook book and used by the demonstrators for the instruction of the public.

GEOLOGY AND MINES

*Personnel.* There was no change in the personnel of the division during the year.

*Coöperation.*—The Bureau of Public Works again set aside the amount of ₱3,600 to cover the field expenses incurred by the Bureau of Science in the investigation of underground-water resources of certain localities. Although, due to lack of time and personnel, it has been impossible to study all the regions requested by the Bureau of Public Works; this coöperation reduced the number of failures in well drillings to two during 1928.

The Gloria-Castillo Gypsum Mining Company requested an examination of its gypsum and clay-paint claims in Mabini, Batangas. Mr. Elicaño inspected the claims and as a result of the examination advised the company to drop all gypsum and clay-paint mining. It was found, however, that some of the clay deposits intended for paint were suitable for vitrifiable materials, and, on the completion of tests now being conducted by the inorganic division on samples from the claims, the company may undertake the manufacture of vitrified wares. The company paid the field expenses for the study of its properties and the geology of the surrounding region.

At the request of one of the interested parties Messrs. Elicaño and Abarquez made an examination of reported and much advertised high-grade gold and copper deposits in Baguio. A timely visit prevented the expenditure of more money in worthless prospects.

A high-grade gold prospect reported from San Jose, Nueva Ecija, also caused considerable excitement among prospective mining investors, who came to the Bureau for advice. Mr. Alvir examined the prospect and did not find any high-grade lode in the claim.

Mr. Holt leased the lead and zinc mines of the Marinduque Mining Company and requested an examination of the property. Mr. Alvir conducted the examination and through his report, Mr. Holt was able to interest some capitalists in the United States, who are willing to develop and operate the mine.

*Routine work.*—The members of the staff continued to render varied services both to the public and to other Government entities. These services were the usual consultations on geological and mining subjects, the examination and identification of rocks, minerals, and fossils, the study of drilling samples for the Bureau of Public Works, and the regular work of assaying, smelting, refining, and drafting. The routine work in the assay laboratory covered 153 requests representing 346 samples. The drafting consisted of 283 drawings, 256 tracings, 101 blue-prints, and 462 jobs of miscellaneous drafting work.

*Field work.*—The following field trips were made by the staff of the division for the purposes mentioned below:

**Mr. V. Elicaño.**

Examination of gypsum and clay-paint deposits in Mabini, Batangas, and the geology of the surrounding region, January 18 to February 11, and February 15 to 19.

Examination of gold and copper prospects in Baguio, March 19 to April 15. Mr. Abarquez accompanied Mr. Elicaño.

Geologic reconnaissance of Zambales Mountains and survey of the Chromite Reservation, April 14 to July 4. All field expenses in connection with the survey of the Chromite Reservation were paid by the Bureau of Lands.

Underground-water resources in the neighborhood of Aparri, Cagayan, November 20 to December 13. Expenses paid by the Bureau of Public Works.

**Dr. L. A. Faustino.**

Investigation of the activities of Mayon Volcano, January 20 to 27; June 26 to July 3; July 21 to 27.

Study of coral reefs in southern Tayabas, March 21 to 28.

Dr. L. A. Faustino—Continued.

Underground-water resources for the Ilocos coastal plain, April 3 to May 8. Expenses paid by the Bureau of Public Works.

Underground-water resources of Cebu, October 16 to 29. Expenses paid by the Bureau of Public Works.

Mr. A. D. Alvir.

Baguio Mineral District, December 24, 1927, to January 2, 1928. Examination of lead and zinc mines in Marinduque, March 16 to 23.

Examination of gold prospects in San Jose, Nueva Ecija, November 6 to 8.

Underground-water resources in Pateros, Rizal, October 15.

Mr. L. F. Abad.

Underground-water resources of northeastern Leyte, April 14 to May 28. Expenses paid by the Bureau of Public Works.

*Research.*—Mr. Elicaño continued his intensive study of the geology and mineral resources of the Zambales Range, and it is hoped that the work will be completed during 1929. This investigation is very important; it is the first detailed survey of this extensive range which is one of the least-known mineral districts.

Dr. Faustino has worked on systematic paleontology and stratigraphy, coral reefs, and coal resources.

*Publications.*—Monograph 25, Summary of Philippine Marine and Fresh-water Mollusks, by Dr. Faustino, was issued October 30, 1928.

Correlation of the Tertiary Formations of the Philippines with those of Europe, Asia and America, by Dr. Faustino; Philippine Journal of Science, February, 1928.

#### LIBRARY

*Personnel.*—Few changes in the personnel have occurred during the year. During the absence of Mr. Perez on leave in the United States, March 24 to August 2, Mr. Basilio Hernandez, reference librarian, was acting librarian.

*Publicity.*—As usual the quarterly list of additions to the library has been issued and sent to most of the researchers using the library. During the year almost seven hundred circular letters have been sent to our patrons calling attention to articles of interest and value to them. It is very encouraging to state that most of the persons who received these letters either came to the library or sent for the publications to which their attention had been called. A list of current agricultural periodicals and allied serials has been compiled, mimeographed, and sent

to patrons who would likely make use of such a list. This is the second list compiled, the first being a list of medical periodicals and allied serials mentioned in the report for 1927. The above lists were well received by the public as shown by a number of letters received. We expect to continue preparing similar lists and also a union list of serials available in all the Government libraries in the city. The latter list will require a great deal of time and care.

*Use of the library.*—As the resources of the library become better known, scientific workers in particular and the reading public in general make increasing use of the library facilities. The following table shows the greater use of the library during 1928 as compared with 1927:

	1927	1928
Publications used in the library.....	44,279	45,645
Publications loaned.....	11,617	12,518
Total publications used.....	55,896	58,158
Visitors.....	12,593	14,101
Bibliographies compiled.....	18	23
Inquiries answered which required some search in addition to the type-written bibliographies made.....	91	192
Cuts loaned.....	33	123

*Growth of the library.*—During the year, 1,595 bound volumes were added and six were withdrawn, bringing the total number of bound volumes to 63,237. On January 1, there were 47,160 unbound volumes, parts, and pamphlets from which 6,419 were withdrawn for binding, leaving 40,641. The number of unbound volumes, parts, and pamphlets added during the year is 8,605, bringing the total number of unbound volumes, parts, and pamphlets to 49,246.

*Binding.*—The 805 volumes reported at the bindery January 1 have been returned; and 2,100 volumes have been prepared and forwarded to the Bureau of Printing for binding. Of the latter number 1,236 have been returned, leaving 1,669 at the bindery at the close of the year. During the year 942 pamphlets were bound in pamphlet binders. Three hundred eighty-two incomplete volumes were bound in magazine binders ordered from the Bureau of Printing.

*Inventory.*—An inventory of the library was started in June by two representatives from the Insular Auditor's office and two



from this library and was finished at the end of the year. It is very pleasing to note that after twenty-five years of the library's existence only 71 books were found missing, and it is believed that half of these have been only temporarily misplaced and will be found.

PUBLICATIONS

*Personnel.*—Mrs. Anna B. Banyea, copy editor, resigned May 20, 1928. Miss Winifred Kelly was appointed temporarily as chief editorial clerk, September 4, 1928. Miss Dorothy Boozer was appointed as copy editor, November 20, 1928.

*The Philippine Journal of Science.*—The Philippine Journal of Science was published monthly, in three volumes for the year. Each volume consists of four numbers and is separately paged and indexed.

The following table shows the number of pages, plates, and text figures contained in Volumes 35, 36, and 37:

	Volume 35, January to April, 1928.	Volume 36, May to August, 1928.	Volume 37, September to Decem- ber, 1928.	Total.
Pages.....	502	499	416	1,417
Plates.....	69	57	57	183
Text figures.....	21	15	15	51

The following table shows the number of names on the mailing list of the Philippine Journal of Science for 1928, as compared with 1927:

	1927	1928
Paid subscriptions.....	268	278
Exchanges.....	651	667
Review subscriptions.....	34	34
Free.....	75	68
Total.....	1,028	1,047

In the following table is shown the distribution according to continents of subscribers, exchanges, reviews, and free copies of the Philippine Journal of Science. These figures show that the Journal is widely distributed to scientific institutions in all parts of the world.

	Paid sub- scriptions.	Exchanges.	Review Subscrip- tions.	Free.	Total.
Philippines.....	36	14		44	94
Asia, excluding the Philippines.....	36	103	1	1	191
Europe.....	30	249	20	2	301
North America.....	99	224	18	21	357
South America.....	8	19			27
Africa.....	11	20			31
Australia and neighboring islands.....	8	38			46
Total.....	278	667	34	68	1,047

Copy for the numbers for January to July, 1929, has been sent to the printer; page proof for the January and February numbers and galley proof for the March and April numbers were received from the printer by the close of the year.

The following are the titles and the names of authors of the papers published in the Philippine Journal of Science during 1928:

VOLUME 35, JANUARY TO APRIL

*No. 1, January, 1928*

- MERRILL, ELMER D. Nomenclatural notes on Philippine plants.  
 MANALANG, C. Trichuriasis: Relation between the number of ova per gram of formed stool and the number of female worms harbored by the host.  
 MANALANG, C. Ascariasis: Relation between the number of ova per gram of formed stool and the number of female worms harbored by the host.  
 HERRE, ALBERT W. Three new Philippine fishes.  
 SKVORTZOW, B. W. Diatoms from Khingán, North Manchuria, China.  
 WILLIAMS, FRANCIS X. The natural history of a Philippine nipa house, with descriptions of new wasps.

*No. 2, February, 1928*

- FAUSTINO, LEOPOLDO A. Correlation of the Tertiary formations of the Philippines with those of Europe, Asia, and America.  
 SCHÖBL, OTTO. Note on local terminology of certain manifestations of yaws.  
 SCHÖBL, OTTO, and RITA VILLAAMIL. Note on bacteriological diagnosis of bacillary dysentery.  
 HERRE, ALBERT W., and HERACLIO R. MONTALBAN. The Philippine siganids.  
 SANTOS, JOSÉ K. Stem and leaf structure of *Tinospora rumphii* Boerlage and *Tinospora reticulata* Miers.

*No. 3, March, 1928*

- SCHÖBL, OTTO. Experimental yaws in Philippine monkeys and a critical consideration of our knowledge concerning framboesia tropica in the light of recent experimental evidence.

**YASUYAMA, KODO.** Viability of *Treponema pertenu* outside of the body and its significance in the transmission of yaws.

*No. 4, April, 1928*

**VEDDER, EDWARD B.,** and **R. T. FELICIANO.** An investigation to determine a satisfactory standard for beriberi-preventing rices.

**ALICANTE, M. M.** The abo-abo soil of Occidental Negros.

**SANTIAGO, SIMEONA,** and **AUGUSTUS P. WEST.** Chaulmoogryl derivatives of lactates and salicylates.

**CLARA, FELICIANO M.** A *Phytophthora* disease of santol seedlings.

**ESSIG, E. O.** Charles Fuller Baker.

**ELLIOTT, E. A.** New *Stephanidæ* from Borneo and the Philippine Islands, IV.

**ALEXANDER, CHARLES P.** New or little-known *Tipulidæ* from eastern Asia (*Diptera*), II.

VOLUME 36, MAY TO AUGUST

*No. 1, May, 1928*

**BOYNTON, WILLIAM HUTCHINS.** Rinderpest, with special reference to its control by a new method of prophylactic treatment.

**TUBANGUI, MARCOS A.** Larval trematodes from Philippine snails.

**ESPINOSA, JOSÉ C.** Strength properties in relation to specific gravity of Philippine woods.

**VICENTE, MARIA LUISA A.,** and **AUGUSTUS P. WEST.** Esters of alpha linolenic acid hexabromide (isobutyl, amyl, n-propyl, and isopropyl) from Philippine lumbang oil.

**ELLIOTT, E. A.** New *Stephanidæ* from Borneo and the Philippine Islands, V.

**HERRE, ALBERT W.,** and **HERACLIO R. MONTALBAN.** The goatfishes, or *Mullidæ*, of the Philippines.

*No. 2, June, 1928*

**REYES, F. D.** The lime industry of the Philippine Islands.

**WELLS, A. H., F. AGCAOILI, H. TAGUIBAO,** and **A. VALENZUELA.** Composition of Philippine pineapples.

**GARCIA, ONOFRE.** Notes on the serological relationship of the choleralike vibrios isolated from human beings and from waters in Manila.

**KIENHOLZ, RAYMOND.** Environmental factors of Philippine beaches, with particular reference to the beach at Puerto Galera, Mindoro.

**HERRE, ALBERT W.** The Philippine gars or needlefishes.

**VALENZUELA, ABELARDO.** Composition and nutritive value of Philippine food fishes.

**ROXAS, HILARIO A.** Philippine littoral *Echinoida*.

*No. 3, July, 1928*

**SERRANO, F. B.** Bacterial fruitlet brown-rot of pineapple in the Philippines.

**AURIVILLIUS, CHR.** Revision of the Philippine species of the *Clytini* (*Coleoptera*, *Longicornia*).

**TAKAHASHI, RYOICHI.** *Coccidæ* of Formosa.

**TUBANGUI, MARCOS A.** Trematode parasites of Philippine vertebrates.

*No. 4, August, 1928*

- KELSER, R. A., STANTON YOUNGBERG, and TEODULO TOPACIO. An improved vaccine for immunization against rinderpest.
- RODIER, E. A. A single-injection method of immunization against rinderpest.
- SCHEERER, OTTO. Isneg texts with notes.
- GIRAULT, A. A. Some new Philippine chalcid flies.
- ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), III.

VOLUME 37, SEPTEMBER TO DECEMBER

*No. 1, September, 1928*

- SHERMAN, P. L. Abacá-soil conditions in two districts of the Philippine Islands and their relation to fiber production.
- SHERMAN, P. L., and HARTLEY EMBREY SHERMAN. The tensile strength of abacá fibers in relation to their acidity.
- BAÑUELOS, TRINIDAD, and P. L. SHERMAN. Fermentation as affecting the quality of Philippine abacá.
- KELSER, R. A. Mercuric iodide in the treatment of equine epizootic lymphangitis.
- HASSELMANN, C. M., and MARGARETE HASSELMANN-KAHLERT. Notes on plasmogone (plasmochin).
- MANALANG, C. Notes on malaria transmission.

*No. 2, October, 1928*

- QUISUMBING, EDUARDO, and ELMER D. MERRILL. New Philippine plants.

*No. 3, November, 1928*

- VEDDER, EDWARD B. A discussion of the etiology of leprosy, with especial reference to the possibility of the transference of leprosy by insects, and the experimental inoculation of three men.
- TANABE, B. The effect of the administration of alcohol upon the result of the Wassermann test in yaws monkeys.
- MARAÑON, JOAQUIN M. Total alkaloids of *Datura fastuosa* Linnæus and *Datura alba* Nees from the Philippines.
- HODGE, EDWIN T. An asphaltite from the Philippine Islands.
- FRISON, THEODORE H. The bumblebees of the Philippine Islands (Bremidae: Hymenoptera).
- SIVICKIS, P. B., and JOSÉ S. DOMANTAY. The morphology of a holothurian, *Stichopus chloronotus* Brandt.
- SILVICKIS, P. B. New Philippine shipworms.

*No. 4, December, 1928*

- COPELAND, EDWIN BINGHAM. *Leptochilus* and genera confused with it.
- SANTOS, JOSÉ K. A cytological study of *Cocos nucifera* Linnæus.

*Monographs.*—Monograph 21, *Distribution of Life in the Philippines*, by Roy E. Dickerson et al., was issued October 23, 1928.

Monograph 24, *Pomacentridæ of the Philippine Islands*, by Heraclio R. Montalban, was issued February 27, 1928.

Monograph 25, Summary of Philippine Marine and Fresh-water Mollusks, by Leopoldo A. Faustino, was issued September 18, 1928.

Monograph 26, A check-list of Philippine Fishes, by Albert W. Herre, was sent to the printer.

The Twenty-sixth Annual Report of the Bureau, for 1927, was sent to the printer.

*Press bulletins.*—No press bulletin was issued during 1928.

*Popular bulletins.*—Popular Bulletin 5, Philippine Standard Specifications for Paint and Paint Materials, by T. Dar Juan, was sent to the printer.

*Miscellaneous work.*—Two hundred printing jobs, including labels for various divisions of the Bureau, forms, envelopes, etc., for most of which it was necessary to read proof, passed through the publications division.

Respectfully submitted,

WILLIAM H. BROWN,  
*Director, Bureau of Science.*

To the Honorable,  
The SECRETARY OF AGRICULTURE  
AND NATURAL RESOURCES.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivisions of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
General, inorganic and physical chemistry:								
Metals and alloys.....	26	22	191.00	275.00	38	29	361.00	382.00
Rocks, minerals, natural pigments and similar substances.....	24	42	199.00	342.00		7		85.00
Clays, shales, limestones, limes, wall plasters and slugs.....	10	27	114.00	290.00	1	2	10.00	20.00
Coal analyses.....	35	29	1,150.00	1,000.00	53	47	1,885.00	1,645.00
Oil analyses.....		2		48.00		38		505.00
Paints and varnishes.....	16	12	863.00	286.00	22	34	552.00	662.00
Water.....	97	97	2,746.00	2,506.00	180	249	4,566.00	4,312.00
Crude chemical and miscellaneous analysis.....	10	56	169.00	1,083.00	4	4	65.00	71.00
Standard solutions..... liters.....	29	17	113.97	82.00				
Physical tests of wire, twine, fibers, textiles, papers and similar articles.....	37	102	118.00	509.00	38	54	141.00	186.00
Cements.....	8,589	3,515	14,247.01	5,530.95	9,996	14,111	13,335.40	18,498.40
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	6,807	5,974	10,365.00	8,358.00	4,484	3,752	4,768.00	4,187.00

Standardization and correction of units of measure—									
Length.....	18	21	39.00	31.50	42	23	68.00	34.50	
Capacity.....	45	65	39.00	169.00	26	25	52.00	50.00	
Weight.....	253	129	674.50	392.00	177	6	1,088.00	126.00	
Miscellaneous inorganic work and analyses.....	15	33	169.00	309.00	52	58	564.00	1,263.00	
Total.....	15,961	10,143	30,737.48	21,211.45	15,113	18,489	27,400.40	32,026.90	
Soils and fertilizers:									
Soil analyses.....	17	13	218.00	417.00	77	63	2,197.00	1,967.00	
Commercial fertilizers.....	96	89	880.00	805.00					
Guano, copra cake, ashes, and similar materials.....	51	37	406.00	258.00		88		384.00	
Insecticide, fungicide, sea-water tests, and other miscellaneous analyses.....	47	77	94.00	216.00		8		46.00	
Fertilizer tags sold (less cost of printing).....	321,968	264,091	7,739.63	6,406.64					
Registration of fertilizers.....	20	15	1,000.00	750.00					
Total.....	322,219	264,322	10,337.63	8,852.64	77	109	2,197.00	2,347.00	
Organic chemistry:									
Urine, clinical and toxicological analyses.....	558	3	2,152.46	115.00	276	26	2,168.00	1,305.00	
Essential oils and essences.....	2	3	20.00	30.00	10		100.00		
Petroleum and copra products and similar materials.....	723	709	4,611.65	5,102.75	16	27	190.00	535.00	
Varnishes and linseed oils.....	1	1	3.00	5.00		8		132.00	
Gums, resins, and similar materials.....		2		10.00					
Papers, textiles, and similar materials.....									
Gastric juice, clinical examination.....					1		10.00		
Foods, alcohols, and beverages.....	227	519	1,244.00	2,742.50	6,680	9,048	79,891.00	111,961.00	
Food preservatives and coloring matters.....	2	5	24.00	26.00	57	31	469.00	310.00	
Medicine and similar articles.....	44	19	374.50	182.00	550	527	9,654.00	8,893.00	
Tikiki extract.....	3,723	3,420	2,606.10	2,394.00	50,004	51,893	85,002.80	36,325.10	
Miscellaneous organic analyses and examinations.....	18	9	67.00	186.00	11	12	355.00	110.00	
Total.....	5,298	4,690	11,102.71	10,743.25	57,605	61,572	127,839.80	159,571.10	

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivisions of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pases.		Samples or units.		Pases.	
	1927	1928	1927	1928	1927	1928	1927	1928
Mines:								
Assays.....	197	180	709.00	755.00	7	23	28.00	110.00
Smelting and refining of gold and other precious metals.....	24,391	13,523	652.96	606.98	97	118	13.00	16.42
Drafting.....	2	2	1.50	1.50				
Total.....	24,588	13,705	1,361.96	1,368.48	104	141	41.00	126.42
Biological laboratory:								
Feces.....	334	75	1,134.05	291.70	54,592	49,614	667,573.00	710,410.00
Sputum.....	106	33	308.90	99.00	132	936	396.00	2,808.00
Blood.....	58	13	334.06	68.67	29	780	546.00	7,117.00
Culture (diphtheria).....	3	4	15.00	20.00	471	1,610	2,355.00	8,050.00
Widal tests.....	88	14	124.90	46.38	31	146	98.00	488.00
Wassermann tests.....	193	59	1,930.00	595.00	953	2,071	9,580.00	20,710.00
Leprosy.....	1	1	3.00	3.00	45	22	135.00	66.00
Urines.....	7	225	13.50	837.77	61	4,739	244.00	23,482.00
Gonococci.....	51	6	153.00	18.00	4	262	12.00	786.00
Waters, biological.....	21	15	220.00	150.00	9,163	6,437	91,680.00	64,365.00
Histological examinations.....	11	1	103.34	10.00	10	47	100.00	470.00
Rats for plague.....					58,284	61,601	233,136.00	206,404.00
Rabies.....	1	1	10.00	10.00	8	10	80.00	100.00



Ice creams, milk, soft drinks, etc.....	14	7	389.00	165.00	3,097	8,298	81,995.00	32,818.00
Cebu Biological Laboratory.....	353	475	1,810.22	1,570.12	2,884	8,796	10,267.50	14,606.00
Iloilo Biological Laboratory.....	343	866	4,199.57	8,505.10	10,609	9,090	59,285.50	64,985.00
<b>Total.....</b>	<b>2,032</b>	<b>1,794</b>	<b>10,795.54</b>	<b>7,389.74</b>	<b>140,873</b>	<b>184,459</b>	<b>1,107,378.00</b>	<b>1,157,615.00</b>
<b>Serum section of the biological laboratory:</b>								
Vaccine virus..... units.....	2,908,453	3,403,651	61,687.70	72,978.80				
Autogenous vaccine..... ampules.....	779	1,020	718.20	954.02	10	60	10.00	60.00
Miscellaneous serums and vaccines..... doses.....	* 991,848	1,236,206	223,067.05	224,399.82	2,078,312	2,558,982	421,024.00	517,444.00
<b>Total.....</b>	<b>3,896,080</b>	<b>4,640,877</b>	<b>285,472.95</b>	<b>298,332.64</b>	<b>2,078,322</b>	<b>2,558,992</b>	<b>421,034.00</b>	<b>517,504.00</b>
<b>Miscellaneous:</b>								
Photographic work.....	4,916	3,539	1,579.12	1,250.30	582	586	192.50	175.60
Natural history specimens.....	52	67	420.50	496.50				
Shop works.....		1		15.00				
Aquarium tickets, post cards, etc.....			8,946.40	3,607.30				
Supplies and equipment.....	6,617	10,532	8,009.30	4,086.09				
Sales of publications.....			5,134.97	3,184.93				
Refunded, work not done, etc (deducted).....			(261.86)	(66.10)				
Fines of employes and forfeitures of salaries; credit adjustment of prior year expense.....			484.53	447.90				
Power, steam, etc.....			26,968.76	27,324.80				
<b>Total.....</b>	<b>11,585</b>	<b>14,139</b>	<b>41,281.72</b>	<b>40,376.72</b>	<b>582</b>	<b>586</b>	<b>192.50</b>	<b>175.60</b>
<b>Grand total.....</b>	<b>4,277,768</b>	<b>4,949,670</b>	<b>391,079.99</b>	<b>388,269.92</b>	<b>2,292,176</b>	<b>2,774,248</b>	<b>1,686,082.70</b>	<b>1,869,369.02</b>

\* This figure is different from that in last year's report; the units of antitetanic serum have been converted into doses.

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Bureau of Agriculture:								
Waters, chemical.....					15	4	201.00	100.00
Standard solutions.....	4	6	20.00	18.00				
Clay, shales, limestones, limes, wall plasters and slags.....								
Soil analyses.....						1		10.00
Guano, copra cake, ashes, and similar materials.....					77	60	2,197.00	1,890.00
Foods, alcohols, and beverages.....						38		334.00
Miscellaneous serums and vaccines.....doses	4	31	8.00	62.00	34	147	417.00	1,867.00
Photographic work.....	104	114	39.80	26.80		2		4.00
Supplies and equipment.....	5	76	15.00	4.15				
Total.....	117	227	82.80	110.95	126	252	2,815.00	4,205.00
Bureau of Audits:								
Physical tests of wire, twine, fibers, textiles, papers and similar articles.....						14		14.00
Petroleum and copra products and similar materials.....						8		264.00
Miscellaneous organic analyses and examinations.....					3		75.00	
Total.....					3	22	75.00	278.00

Bureau of Coast Surveys:						
Waters, chemical.....						148.00
Miscellaneous inorganic work and analyses.....						5.00
Varnishes and linseed oils.....						25.00
<b>Total.....</b>					<b>37</b>	<b>178.00</b>
Bureau of Commerce and Industry:						
Petroleum and copra products and similar materials.....						44.00
Blood.....				1		8.00
Wassermann tests.....	2	20.00				
Photographic work.....	10	106	2.00	21.50		
<b>Total.....</b>	<b>12</b>	<b>106</b>	<b>22.00</b>	<b>21.50</b>	<b>1</b>	<b>44.00</b>
Bureau of Customs:						
Paints and varnishes.....						3.00
Waters, chemical.....					1	4.00
Varnishes and linseed oils.....					1	5.00
Miscellaneous organic analyses and examinations.....						20.00
Standardization and correction of units of weight.....					4	30.00
Miscellaneous inorganic work and analyses.....				2		16.00
Essential oils and essences.....				2		20.00
Petroleum and copra products, and similar materials.....					5	95.00
Foods, alcohols and beverages.....				1		115.00
Assays.....				7		28.00
Supplies and equipment.....						20.00
Medicines and similar articles.....	9	4	0.45	0.30		
Waters, biological.....				57		365.00
Photographic work.....					56	560.00
<b>Total.....</b>	<b>9</b>	<b>54</b>	<b>0.45</b>	<b>10.60</b>	<b>78</b>	<b>1,387.00</b>

## THE BUREAU OF SCIENCE

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage.—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Bureau of Education:								
Soil analyses.....								
Water, biological.....						3		77.00
Photographic work.....	25	58	16.75	10.90	1		10.00	
Supplies and equipment.....	10	16	71.00	50.67				
Total.....	35	69	87.75	61.57	1			
Bureau of Forestry:								
Photographic work.....		114		22.54			10.00	77.00
Total.....		114		22.54				
Bureau of Internal Revenue:								
Standardization and correction of units of measure—								
Length.....								
Capacity.....					42	14	68.00	21.00
Weight.....					26		52.00	
Petroleum and copra products.....					74		75.00	
Essential oils and essences.....						1		4.00
Medicines and similar articles.....					8		80.00	
Photographic work.....	24		16.00			9		180.00
Total.....	24		16.00		150	24	270.00	155.00



TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pecos.		Samples or units.		Pecos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Bureau of Prisons:								
Foods, alcohols and beverages.....						5		175.00
Widal tests.....						4		6.00
Wassermann tests.....						314		3,140.00
Waters, biological.....						5		50.00
Histological examinations.....						2		20.00
Miscellaneous biological examinations.....						8		11.00
Vaccine virus.....	7,000	9,800	235.00	158.00				
Miscellaneous serums and vaccines..... doses.....	919	669	305.00	386.50				
Autogenous vaccine.....								
Total.....	7,919	10,469	540.00	494.50	326	420	3,232.00	3,752.00
Bureau of Public Works:								
Paints and varnishes.....								
Waters, chemical.....	36	30	1,120.00	810.00		4		191.00
Cements.....	6,008	3,025	10,665.86	4,763.20	192	104	3,920.00	2,600.00
Compression, tensile or transverse strength of concrete, stone, mortar rope, iron and steel etc.....					711	106	1,059.20	127.20
Waters, biological.....	3,621	4,107	6,203.00	5,787.00	4,483	3,730	4,763.00	4,098.00
Supplies and equipment.....	1		3.00			1		10.00

Insecticide, fungicide, sea-water tests, and other miscellaneous analyses.....	18		65.00			3		22.00
Petroleum and copra products and similar materials.....						1		12.00
<b>Total.....</b>	<b>9,666</b>	<b>7,175</b>	<b>17,991.86</b>	<b>11,425.20</b>	<b>5,826</b>	<b>3,949</b>	<b>9,142.20</b>	<b>7,055.20</b>
<b>Bureau of Quarantine Service:</b>								
Feces.....					18,113	9,928	65,565.00	49,615.00
Wassermann tests.....						2		20.00
Waters, biological.....					1,018	677	4,052.00	2,708.00
Rats for plague.....								
Vaccine virus.....	22,800	15,000	228.00	150.00				
Miscellaneous serums and vaccines.....	1,500	228	300.00	78.00				
Supplies and equipment.....		15		.75				
<b>Total.....</b>	<b>24,300</b>	<b>15,243</b>	<b>528.00</b>	<b>228.75</b>	<b>14,126</b>	<b>10,603</b>	<b>69,617.00</b>	<b>52,353.00</b>
<b>Bureau of Supply:</b>								
Metal and alloys.....	2	4	24.00	50.00	11	6	55.00	49.00
Rocks, minerals, natural pigments and similar substances.....						4		65.00
Clays, shales, limestones, limes, wall plaster and slags.....				10.00	1	1	10.00	10.00
Coal analyses.....					26	21	910.00	735.00
Paints and varnishes.....	8		192.00			13		205.00
Waters, chemical.....					2	1	50.00	25.00
Crude chemical and miscellaneous analyses.....						1	35.00	
Physical tests of wire, twine, fibers, textiles, papers and similar articles.....	11	45	32.00	815.00	27	22	88.00	67.00
Cements.....	2,082	435	2,694.40	586.00	8,502	13,584	11,816.20	17,974.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	5		25.00		1		5.00	

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Bureau of Supply—Continued.								
Standardization and correction of units of measure—								
Length.....						9		18.50
Capacity.....						25		50.00
Weight.....						1		1.00
Miscellaneous inorganic work and analyses.....					11	50	178.00	1,209.00
Petroleum and copra products and similar materials.....	6	8	94.00	89.00	12	8	162.00	74.00
Foods, alcohols and beverages.....	2	5	24.00	75.00	2	2	20.00	24.00
Medicines and similar articles.....					7		70.00	
Tikitiki extract.....	1,118	757	782.60	529.90				
Waters, biological.....					5	4	50.00	40.00
Insecticide, fungicide, sea-water tests and other miscellaneous analyses.....						5		24.00
Varnishes and linseed oils.....						5		88.00
Miscellaneous biological examinations.....					4	2	200.00	100.00
Miscellaneous serums and vaccines..... doses.....	759	320	781.20	281.00				
Photographic work.....	494		100.00					
Supplies and equipment.....	206	184	220.50	457.00				
Total.....	4,646	1,759	4,984.70	2,842.90	8,612	19,759	18,149.20	20,753.50



<b>Executive Bureau:</b>									
Toxicological analyses.....								1	75.00
Foods, alcohols and beverages.....								1	60.00
Medicines and similar articles.....								1	5.00
Photographic work.....	22		4.93						
Supplies and equipment.....	2		10.00						
<b>Total</b> .....	<b>2</b>	<b>22</b>	<b>10.00</b>	<b>4.93</b>				<b>3</b>	<b>140.00</b>
<b>Philippine Constabulary:</b>									
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel.....								3	15.00
Physical tests of wire, twine, fibers, textiles, papers and similar articles.....						11		10	58.00
Medicines and similar articles.....	22		110.00			18		1	90.00
Toxicological analyses.....						8		9	280.00
Miscellaneous organic work and examinations.....						1			5.00
Feces.....						1			8.00
Sputums.....						4		9	300.00
Blood.....						1			10.00
Rabies.....									
Vaccine virus.....	2,200	4,700	22.00	47.00					
Miscellaneous serums and vaccines.....dozes.....	6,734	788	1,422.00	186.00					
Supplies and equipment.....	300	360	15.00	18.00					
<b>Total</b> .....	<b>9,256</b>	<b>5,798</b>	<b>1,569.00</b>	<b>251.00</b>		<b>44</b>		<b>32</b>	<b>741.00</b>
<b>Philippine Health Service:</b>									
Waters, chemical.....						27		92	875.00
Urines, clinical and toxicological analyses.....						274		18	2,018.00
Foods, alcohols and beverages.....						6,641		8,879	79,419.00
Food preservatives and coloring matters.....						57		81	469.00
Medicines and similar articles.....						14		14	870.00
Physical tests of wires, twine, fibres, textiles, papers and similar articles.....								2	2.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.				
	Samples or units.		Pesos.		Samples or units.		Pesos.		
	1927	1928	1927	1928	1927	1928	1927	1928	
Philippine Health Service—Continued.									
Petroleum and copra products and similar materials.....						2			34.00
Varnishes and linseed oils.....						1			14.00
Feces.....					40,878	38,045	599,121.00		653,775.00
Sputum.....					72	116	216.00		348.00
Blood.....					22	7	98.00		177.00
Culture (diphtheria).....					471	1,595	2,855.00		7,975.00
Widal tests.....					27	16	81.00		48.00
Wassermann tests.....					595	526	5,950.00		5,260.00
Leprosy.....					45	19	135.00		57.00
Urine, microscopic.....					2	213	8.00		852.00
Gonococci.....					4		12.00		
Waters, biological.....					7,948	5,111	79,480.00		51,105.00
Histological examinations.....					8	8	80.00		80.00
Rats for plague.....					57,271	50,324	229,084.00		203,696.00
Rabies.....					5	2	50.00		20.00
Miscellaneous biological examinations.....					3,212	3,186	32,110.00		31,885.00
Vaccine virus.....	2,841,200	3,350,000	59,648.00	71,000.00					
Autogenous vaccine.....	10	20	10.00	20.00					
Miscellaneous serums and vaccines..... doses.....	954,986	1,184,690	199,643.20	198,819.50	2,078,192	2,556,840	421,000.00		517,008.00

Photographic work.....	640	313	406.61	157.08			
Supplies and equipment.....	62	202	14.80	80.00			
<b>Total.....</b>	<b>8,796,888</b>	<b>4,535,225</b>	<b>253,712.61</b>	<b>270,026.58</b>	<b>2,195,775</b>	<b>2,665,642</b>	<b>1,452,986.00</b>
<b>Philippine General Hospital:</b>							
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel.....						4	20.00
Petroleum and copra products and similar materials.....							
Gastric juices, clinical examinations.....					4	1	28.00
Foods, alcohols and beverages.....	1		12.00		1		10.00
Medicines and similar articles.....					2	5	30.00
Vaccine virus.....	7	10	0.70	1.00	5		105.00
Miscellaneous serums and vaccines..... doses.....	3,441	2,559	4,399.40	3,554.90			
Photographic work.....					582		192.50
Supplies and equipment.....	8		8.00				
Tilitiki extract..... bottles.....					1,250	1,150	875.00
<b>Total.....</b>	<b>3,457</b>	<b>2,579</b>	<b>4,420.10</b>	<b>3,555.90</b>	<b>1,844</b>	<b>1,696</b>	<b>1,240.50</b>
<b>City of Manila:</b>							
<b>Standardization and correction of units of measure—</b>							
Length.....	5		7.50				
Weight.....	7		34.00				
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel etc.....							
Toxicological analyses.....	413	295	551.00	382.00	2	3	150.00
Foods, alcohols and beverages.....						2	20.00
Medicines and similar articles.....						3	60.00
Miscellaneous organic analyses and examinations.....		1		10.00		9	90.00

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TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
City of Manila—Continued.								
Rabies.....								
Supplies and equipment.....	480	842	24.00	47.24	2	4	20.00	40.00
Total.....	905	1,138	616.50	489.24	4	21	170.00	435.00
Metropolitan Water District.....								
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel etc.....	1,991	1,181	2,470.00	1,553.00				
Standard solution.....liters	16		59.13					
Guano, copra cake, ashes and similar materials.	2		16.00					
Waters, biological.....					1,201	1,126	12,010.00	11,260.00
Supplies and equipment.....	168	222	70.67	72.09				
Total.....	2,177	1,403	2,615.80	1,625.09	1,201	1,126	12,010.00	11,260.00
Board of Pharmaceutical Examiners and Inspectors: Medicines and similar articles.....					487	385	8,524.00	7,760.00
Provinces and municipalities: Rocks, minerals, natural pigments and similar substances.....		1		16.00				
Waters chemical.....	19	6	595.00	160.00				

Standardization and correction of units of measures—						
Length.....	1	11	1.50	16.50		
Capacity.....		18		36.00		
Weight.....	15	51	18.00	128.00		
Medicines and similar articles.....	3	3	27.50	15.00		
Tikiki extract.....		500		350.00		
Miscellaneous serums and vaccines.....	1		.40			
Waters, biological.....	3	2	30.00	20.00		
Photographic work.....	1		10.00			
Supplies and equipment.....	14		31.57			
<b>Total.....</b>	<b>57</b>	<b>592</b>	<b>713.97</b>	<b>741.50</b>		
United States Army and Navy:						
Metals and alloys.....	2		11.00			
Coal analyses.....	2	9	59.00	300.00		
Waters, chemical.....	5	14	45.00	324.00		
Crude chemical and miscellaneous analyses.....	2	38	0.00	1,005.00		
Cements.....	5	1	25.00	19.00		
Waters, biological.....		1		10.00		10.00
Paints and varnishes.....		2		60.00		
Standardization and correction of measures of weight.....	134		139.00			
Miscellaneous inorganic work and analyses.....		14		44.00		
Medicines and similar articles.....		1		10.00		
Petroleum and copra products and similar materials.....	5	19	62.00	364.00		
Foods, alcohols and beverages.....	6	11	12.00	79.00		
Vaccine virus.....	25,370	22,130	1,232.00	1,351.00		
Miscellaneous serums and vaccines..... doses.....	13,163	38,140	2,998.00	7,628.00		
Supplies and equipment.....	96	91	82.69	6.93		
<b>Total.....</b>	<b>38,790</b>	<b>60,471</b>	<b>4,725.69</b>	<b>11,200.93</b>		<b>10.00</b>

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Office of the Governor-General:								
Photographic work.....	2		4.33					
Supplies and equipment.....	4	2	13.00	1.00				
Total.....	6	2	17.33	1.00				
University of the Philippines:								
Cements.....	480	40	596.50	48.00				
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel etc.....	556	240	691.00	269.00				
Crude chemical and miscellaneous analyses.....	3		43.00					
Medicines and similar articles.....							1	5.00
Faces.....					541		591	2,705.00
Waters, biological.....	1		10.00					
Waters, chemical.....							7	65.00
Vaccine virus.....	600		6.00					
Miscellaneous serums and vaccines..... doses.....	376	560	153.00	138.00				
Photographic work.....	242	99	160.64	147.60				
Natural-history specimens.....		1		100.00				
Miscellaneous.....								
Supplies and equipment.....	16	2	80.00	10.00				
Total.....	2,224	942	2,060.14	712.60	541	599	2,705.00	3,028.00



TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Miscellaneous—Continued.								
Commercial fertilizers.....	96	89	880.00	805.00				
Guano, copra cake, ashes and similar materials.....	49	37	390.00	258.00				
Insecticide, fungicide, sea-water tests, and other miscellaneous analyses.....	47	64	94.00	151.00				
Fertilizer tags sold (less cost of printing).....	321,988	264,091	7,789.63	6,406.64				
Registration of fertilizers.....	20	15	1,000.00	750.00				
Urines, clinical and toxicological analyses.....	558	3	2,152.46	115.00				
Essential oils and essences.....	2	3	20.00	30.00				
Petroleum and copra products and similar materials.....	712	682	4,455.65	4,649.75				
Varnishes and linseed oils.....	1		3.00					
Gums, resins and similar materials.....		1		5.00				
Paper, textiles and similar materials.....		2		10.00				
Foods, alcohols and beverages.....	218	503	1,196.00	2,588.50				
Food preservatives and coloring matters.....	2	5	24.00	26.00				
Medicines and similar articles.....	19	15	237.00	157.00				
Tiktiki extract.....bottles.....	2,605	2,163	1,823.50	1,514.10	174	433	121.80	303.10
Miscellaneous organic analyses and examinations.....	18	8	67.00	126.00				
Assays.....	197	180	709.00	755.00				
Smelting and refining of gold and other precious metals.....grams.....	24,391	13,523	652.96	606.98				



Drafting.....				1 50									
Faeces.....	384	75	1,134.05	291.70	59	1,055	177.00					4,065.00	
Sputum.....	105	33	305.90	99.00	59	820	177.00					2,460.00	
Blood.....	58	13	334.06	68.67		763						6,190.00	
Culture (diphtheria).....	3	4	15.00	20.00		15						75.00	
Widal tests.....	38	14	124.90	46.38		128						884.00	
Wassermann tests.....	191	59	1,910.00	595.00	44	1,198	440.00					11,980.00	
Leprosy.....		1		8.00		3						9.00	
Urines.....	7	225	13.50	837.77	59	4,526	286.00					22,630.00	
Gonococci.....	51	6	153.00	18.00		262						766.00	
Waters, biological.....	17	12	180.00	120.00		132						1,320.00	
Histological examinations.....	11	1	103.34	10.00		39						390.00	
Rabies.....		1		10.00		4						40.00	
Miscellaneous biological examinations.....	14	7	389.00	165.00		107						872.00	
Vaccine virus.....	4,276	2,011	316.00	271.00									
Antogenous vaccine.....	779	1,000	718.20	984.02									
Miscellaneous serums and vaccines.....	9,953	8,175	14,851.65	10,352.75									
Photographic work.....	3,374	2,606	822.99	844.25									
Natural-history specimens.....	52	66	420.50	396.50									
Shop work.....		1		15.00									
Aquarium tickets, postcards, etc.....			3,726.40	3,607.30									
Supplies and equipment.....	5,195	8,512	2,316.12	3,367.96									
Sales of publications.....			5,134.97	3,184.93									
Refunded, work not done, etc. (deducted).....			(261.86)	(66.10)									
Fines of employees and forfeitures of salaries; credit adjustment of prior year expense.....			484.53	437.90									
Power, steam, etc.....			26,968.75	27,324.80									
<b>Total.....</b>	<b>376,023</b>	<b>304,790</b>	<b>86,113.80</b>	<b>76,849.85</b>	<b>1,382</b>	<b>10,034</b>	<b>5,237.80</b>					<b>54,116.30</b>	
<b>Examinations and Sales of the Cebu Biological Laboratory:</b>													
Miscellaneous biological examinations.....	353	475	1,810.22	1,570.12	2,774	3,796	9,957.50					14,606.00	
Miscellaneous serums and vaccines.....			1,414.80	1,280.24									
<b>Total.....</b>	<b>353</b>	<b>475</b>	<b>3,225.02</b>	<b>2,850.36</b>	<b>2,774</b>	<b>3,796</b>	<b>9,957.50</b>					<b>14,606.00</b>	

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1928, as compared with the fiscal year 1927, by number or quantity and by value arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1927	1928	1927	1928	1927	1928	1927	1928
Examinations and Sales of the Iloilo Biological Laboratory:								
Miscellaneous biological examinations.....	843	865	4,199.57	3,505.10	10,599	9,090	59,275.50	64,985.00
Miscellaneous serums and vaccines..... doses.....			2,775.40	1,668.93				
Total.....	843	865	6,974.97	5,174.03	10,599	9,090	59,275.50	64,985.00
Grand total.....	*4,277,763	4,949,670	391,079.99	388,269.92	2,292,176	2,774,248	1,686,082.70	1,869,366.02

\* This figure is different from that in last year's report; the units of antitetanic serum have been converted into doses.

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1928 as compared with the fiscal years 1926 and 1927

EXPENDITURES.

Item.	Fiscal year.		
	1926	1927	1928
	Pesos.	Pesos.	Pesos.
<b>Salaries and wages, etc.:</b>			
Salaries and wages including accrued leave .....	363,599.64	375,005.81	391,743.50
Travel expenses of personnel .....	11,362.11	10,999.84	15,454.77
<b>Total</b> .....	<b>374,961.75</b>	<b>386,005.65</b>	<b>407,198.27</b>
<b>Apparatus, supplies, etc.:</b>			
Consumption of supplies and materials .....	171,400.24	171,817.25	184,620.94
Apparatus and equipment, including books .....	12,600.00	12,600.00	14,100.00
<b>Total</b> .....	<b>184,000.24</b>	<b>184,417.25</b>	<b>198,720.94</b>
<b>Miscellaneous:</b>			
Postal, telegraph, telephone and cable service .....	6,000.00	8,825.73	9,000.00
Freight, express and delivery service .....	3,500.00	2,270.70	3,498.80
Printing, and binding reports, documents, and publications .....	34,900.00	34,900.00	35,900.00
Illumination and power service .....	2,086.69	2,500.00	3,000.00
Miscellaneous service .....	10,978.51	10,202.04	13,868.17
Maintenance and repair of equipment .....	5,042.19	5,000.00	5,000.00
For the acquisition and transportation of certain species of fish desired for cultivation .....	1,623.99	2,000.00	
Uncollectible debts .....			0.20
Deterioration of supplies and sales stock .....	476.65		
<b>Total</b> .....	<b>64,608.08</b>	<b>65,698.47</b>	<b>70,267.17</b>
<b>Distribution of tikitiki extract, antityphoid vaccine, and antidyenteric serum:</b>			
Salaries and wages, including accrued leave .....	2,909.53	2,709.10	2,684.82
Consumption of supplies and materials .....	23,774.80	17,498.05	15,379.06
Other services .....	741.65	196.48	133.08
<b>Total</b> .....	<b>27,425.98</b>	<b>20,398.63</b>	<b>18,196.91</b>
<b>Special fund (Developing home canning and food preservation industry, Acts 3281 and 3308):</b>			
Salaries and wages, including accrued leave .....	3,246.99	18,098.16	3,866.84
Traveling expenses of personnel .....	3,276.86	6,260.68	
Freight, express and delivery service .....	179.67	645.36	372.89
Postal, telegraph, telephone and cable service .....	131.91	397.84	220.98
Illumination and power service .....		10.00	
Miscellaneous service .....	188.19	176.11	212.37
Consumption of supplies and materials .....	1,558.44	1,166.52	
Printing and binding reports, documents and publications .....	911.45	605.60	290.05
Maintenance and repair .....		31.64	
Purchase of equipment .....	233.81	429.06	24.33
<b>Total</b> .....	<b>14,722.32</b>	<b>22,815.91</b>	<b>4,487.46</b>

## THE BUREAU OF SCIENCE

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1928 as compared with the fiscal years 1926 and 1927—Ctd.

## EXPENDITURES—Continued

Item.	Fiscal year.—		
	1926	1927	1928
	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
<b>Special appropriation:</b>			
For investigation of soils .....			3,000.00
Purchase of two engines for the manufacture of vaccines and serums at Alabang.....			12,000.00
<b>Total</b> .....			15,000.00
<b>Reorganization of Division of Fisheries, Act 3307:</b>			
Salaries and wages, including accrued leave.....		24,072.87	101.26
Traveling expenses of personnel.....		2,697.66	
Freight, express, and delivery service.....		467.71	104.02
Postal, telegraph, telephone, and cable service.....		16.67	4.00
Miscellaneous service.....		405.67	1.10
Consumption of supplies and materials.....		14,929.48	229.08
Purchase of equipment.....		630.13	
<b>Total</b> .....		43,220.19	439.46
<b>Grand total</b> .....	665,718.32	722,556.10	714,310.21

## INCOME.

Receipts from operation.....	373,570.71	387,576.16	384,419.31
Sales of supplies.....	17.34	1,161.34	422.73
Sales of fixed assets.....	1,916.73	917.12	1,918.00
Other income.....	1,649.53	1,425.37	1,509.88
<b>Total</b> .....	377,154.31	391,079.99	388,268.92
<b>Appropriation account:</b>			
Appropriation.....	650,996.00	656,520.00	734,600.00
Special fund, Act 3231 (balance) and Act 3308 (balance).....	44,869.41	30,147.09	7,331.18
Special fund, Act 3307 (balance).....	110,000.00	110,000.00	66,779.81
<b>Total</b> .....	805,865.41	796,667.09	808,710.99

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# TWENTY-EIGHTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

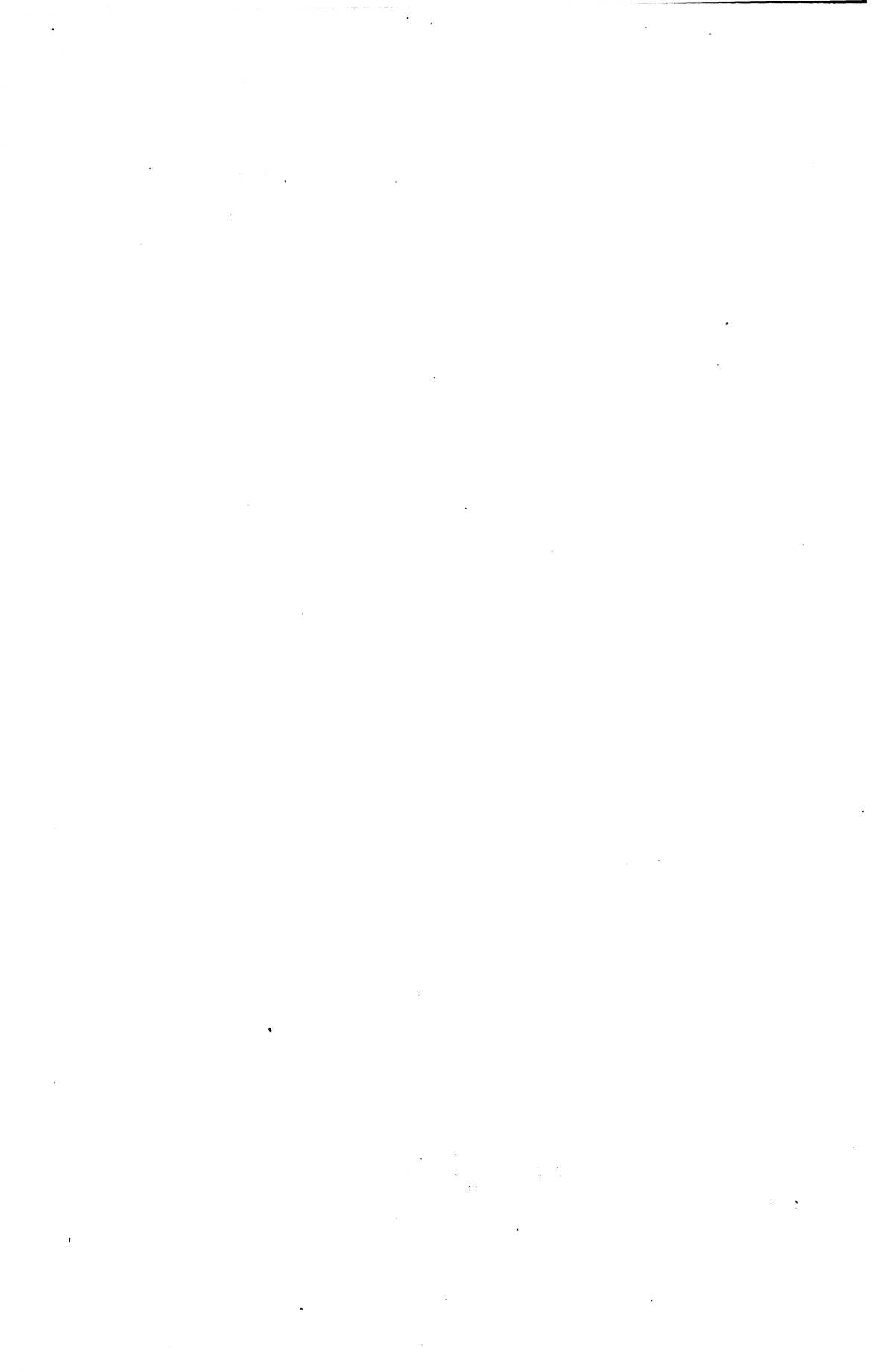
WILLIAM H. BROWN

DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1929



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1930





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January 1930  
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## TWENTY-EIGHTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,  
BUREAU OF SCIENCE,

MANILA, *February 15, 1930.*

SIR: I have the honor to submit the following report of the Bureau of Science covering the fiscal and calendar year 1929. The first part of the report deals with the Bureau as a whole, while in the latter part the work of the various divisions is given more in detail.

### EXPENDITURES, INCOME, AND FREE WORK

The expenditures for the year 1929 were ₱700,781.90, which is ₱13,528.31 less than for 1928 and ₱21,774.20 less than for 1927. The cash income amounted to ₱409,722.14 for 1929 and was larger than for any previous year.

The free work done for other Government entities would have had a cash value of ₱2,037,905.95 according to the Bureau of Science schedule of charges. The cash income and the value of the above free work amounted to ₱2,467,628.09. Subtracting from this the total expenditures of the Bureau there is left a balance of ₱1,767,099.78, which represents the actual profit to the Government of operating the Bureau of Science. The actual cost to the Government is the amount expended, ₱700,781.90, minus the total income, ₱409,722.14, which leaves ₱291,059.76; for which the Bureau did ₱2,037,905.95 worth of free work for Government entities or ₱7 worth of free work for each peso expended. In addition free work amounting to ₱106,735.33 was done for semi-Government companies cooperating with the Bureau, or for the poor. The free work mentioned above includes only the actual tests and examinations made and supplies furnished and does not take account of the fact that a considerable proportion of the funds of the Bureau of Science are expended in ways that are of direct value to the people of the Philippine Islands and for which no charges can be cal-

culated. Among such items are the expenditures for the development of home canning and food preservation, for the development of the fisheries industries, for the prevention of rabies, for the identification of minerals, plants, and animals; and for consultations in regard to various industries. Neither does it take into account the large amount of research, which is of advantage to the public, including such activities as geological and soil surveys; the study of plant diseases; the study of the medicinal constituents of Philippine plants; the cause, cure, and prevention of human diseases; and the commercial uses of various Philippine products.

Tables showing in detail the income and expenses of the Bureau and the work performed are given at the end of this report. Table 1 shows the amount of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with that for the fiscal year 1928 by number or quantity and by value, arranged by subdivisions of the Bureau of Science. Table 2 gives similar data arranged according to the entities for which the work was performed. Table 3 is a comparative statement showing expenditures and income during the fiscal year as compared with the fiscal years 1927 and 1928.

#### ROUTINE

The amount of routine done by the Bureau has been steadily and rapidly increasing for several years. This is due to a considerable extent to the increased appreciation of the work of the Bureau of Science by other Government entities and by the public. The amount of routine has increased to such an extent that it occupies a large part of the time of the staff. This is emphasized by the fact that during 1929, the Bureau made more than 210,000 analyses, tests, and examinations or about 700 for each working day. These figures do not include identifications of plants, animals, and minerals. The amount of routine work done at present not only exceeds that of any past period but, I believe, it is done in a more accurate and satisfactory manner than at any previous time since the establishment of the Bureau. The great amount of routine work performed is shown in detail in Tables 1 and 2 at the end of this report. The Bureau of Science does work and manufactures supplies, mostly free of cost, for practically all Insular Government entities. Brief mention is made below of some of the larger items for various entities.

*Philippine Health Service.*—The Bureau of Science manufactures vaccines and serums in large quantities for the Philippine Health Service. The Bureau of Science sold to the Philippine Health Service 4,190,855 doses of vaccines against cholera, typhoid, cholera and typhoid, dysentery, and smallpox, and furnished free of cost 4,062,020 units of vaccine against cholera, typhoid, cholera and typhoid, and dysentery. In addition considerable amounts of other products were either sold or furnished free to the Philippine Health Service. Although there were no epidemics during the year, the Philippine Health Service took larger amounts of vaccines and serums than in 1928.

The Bureau of Science serves as a laboratory for the Philippine Health Service. During the year there were examined free for the Health Service 42,542 samples of fæces, 10,181 samples of foods, alcohols, and beverages, 6,461 samples of water, and 50,463 rats for plague. In all, free examinations for the Philippine Health Service were made on 117,801 specimens.

The enforcement of the pure-food law is in the hands of the Philippine Health Service, and all analyses and examinations made in connection with the enforcement of this law are conducted by the Bureau of Science for the Philippine Health Service.

*Public Welfare Commissioner.*—The Office of the Public Welfare Commissioner was furnished free with 39,490 bottles of tikitiki extract for the cure of beriberi. These had a sales value of ₱27,643.

*Bureau of Quarantine Service.*—The samples collected by the Bureau of Quarantine Service are sent to the Bureau of Science for analysis. More than 16,551 free examinations for that service were made during 1929.

*Board of Pharmaceutical Examiners and Inspectors.*—The Bureau of Science serves as a laboratory for the Board of Pharmaceutical Examiners and Inspectors and makes all analyses for them in connection with the enforcement of the drug law.

*Bureau of Supply.*—The Bureau of Supply buys many articles on specifications, and these articles are tested by the Bureau of Science. During 1929 there were made 18,816 such examinations without charge for the Bureau of Supply.

In addition to making examinations for the Bureau of Supply the Bureau of Science spent a great deal of time on the formulation of specifications to be used by the Bureau of Supply in the purchase of materials. These specifications have already saved the Government a great deal of money.

*Bureau of Public Works.*—The Bureau of Science examines free of charge all samples of cement, concrete, and artesian-well water for the insular projects of the Bureau of Public Works. During 1929 about 6,461 such free examinations were made. Also a large number of samples was submitted by the Bureau of Public Works for analysis or test for provincial or municipal projects.

#### RESEARCH

The important research done by the United States Army Medical Department Research Board, and that in connection with the Rockefeller Foundation and the Manila Railroad are mentioned under the heading of Coöperation.

The Bureau of Science has been actuated, as in the past, by the belief that the most lasting benefits are obtained not from routine work, however important this may be, but by the establishment of new principles and improved practices which result from investigation. With this idea in mind, as much time and money as possible have been devoted to research. The greatly increased appreciation of the routine work of the Bureau by both Government entities and the public greatly increased the demand on the time of our technical staff for the performance of routine work. The great increase in routine work also required extensive space and an increase in equipment. In spite of the demand of routine, emphasis was laid on research and the accomplishments along this line were not small. The most outstanding accomplishments along research lines are the following:

##### Medical biology.

- The duration of immunity to yaws in Philippine monkeys.
- Serologic studies in experimental yaws.
- The relation with regard to Treponema antigen of the Wassermann and Kahn reactions.

##### Botany.

- A monograph of Philippine Piperaceæ has been prepared for publication.
- Philippine orchids have been the subject of extensive studies.
- New and interesting Philippine plants have been described.
- The presence of coriamyrtine in *Coriania intermedia* Matsum.
- The glucoside in this plant has been isolated.
- The constituents of the rhizome of *Kaempferia galanga* Linn.
- The work has been extended to include other chemical constituents besides the volatile oil already obtained.
- The nitrogen distribution in the leaves of camphor trees, one yielding an oil camphor and the other, a solid camphor.

## Botany—Continued.

The nitrogen partition of "mongo seeds" *Phaseolus radiatus* Linn. Biochemical study of *Clathrocystis aeruginosa* (Kuetz) Henfr.

This alga frequently produces a bad odor along the shore of Laguna de Bay and sometimes in Manila.

The glucosidal principle of *Rourea erecta* (Blanco) Merr. has been isolated. It is hoped that when material is again available next May, more progress can be made in the chemical study of the active principle.

The chemical examination of the bark of the stem of *Strophanthus cumingii* was started and several methods for the isolation of strophanthin have been tried. Some crystals have been obtained, but their chemical nature has not yet been determined.

During 1929, the critical investigation on the internal structures of the leaf and bark of the six important species of cinnamon was completed. The plants included in the above study are *Cinnamomum zeylanicum* Bl., *C. cassia* Bl., *C. mindanaense* Elm., *C. mercadoi* Vid., *C. iners* Reinw., *C. burmanni* Bl.

Three other anatomical investigations were started during the year, as follows: A comparative anatomical study of the leaves and barks of the crystal- and oil-camphor-producing trees from Baguio. Comparative anatomical structure of the leaves and stems of *Anamirta cocculus* and *Archangelisia flava*. The structure of the rhizome of *Kaempferia galanga*.

Field-control experiments on the die-back disease of cacao have been conducted; as a result, disease has been largely eliminated and trees that heretofore had not borne any sound fruit are beginning to produce.

A preliminary survey for anthracnose on mango was made in Rizal, Laguna, and Batangas Provinces. Infection was found to be mild during the dry months, except in a few humid places where both the leaves and fruit are moderately attacked. During moist weather, however, the flowers may become severely blighted so that fruits fail to set. Spraying and dusting for control will be tried out during the approaching season.

Field experiments on rice diseases, particularly *Sclerotium*, were carried out at Alabang, Rizal. The beneficial effects of calcium nitrate, applied at the rate of 300 kilograms per hectare, were reflected in 60 to 70 per cent increase in production. Potassic fertilizers increased both the resistance and yield of grain. Burning the rice stubble in infected fields followed by plowing, together with the adoption of measures to prevent the transfer of the disease by animals or laborers, practically eliminated the disease in the experimental paddies.

General plant-disease survey work has been carried on in northern Luzon.

Tomato wilt, caused by *Phytophthora solanacearum*, was found to be widespread in many of the provinces, in some places 50 to 70 per cent of the plants being diseased.

**Botany—Continued.**

Tobacco mosaic was noted as prevalent in six of the northern provinces, with 50 to 75 per cent infection in certain fields. Other mosaic diseases were recorded on tomato, sugar cane, pepper, cucurbits, corn, cowpea, and apalia.

In Batangas and Cavite Provinces a brief survey of coffee diseases revealed that almost all of the old plantings of *Coffea arabica* were severely infected with rust (*Hemileia*), as a result of which *C. arabica* is being rapidly supplanted by more-resistant species, such as *C. liberica*, *C. robusta*, and *C. excelsa*, which are being planted on a large scale. These species, while considerably resistant, are by no means immune. Rust was also found to be prevalent and severe on *C. arabica* in the northern provinces.

A black leaf-spot and a stem rot of the peanut were found common and destructive.

Laboratory investigations on the strains of anthracnose attacking such plants as the mango, cacao, anona, chico, atis, guava, avocado, cassava, and madre cacao, were made to determine their cultural variations and virulence to the different hosts.

Some culture studies have also been made on strains of *Sclerotia* from rice and a pathogenic *Fusarium* on rice. A sclerotical disease of corn is likewise under investigation.

A critical study of the wood-destroying genus *Ganoderma* is nearing completion.

**Fisheries.**

A chaetodont new to the Philippines has been described.

Investigation on fish preservation at Estancia. Greatly improved methods and products have resulted from this study.

Two Japanese fishing methods used by Japanese fishermen in Philippine waters. This study will make the Japanese methods available to Filipinos.

**Philippine Portunidæ.**

Effective types of fish corrals in the Visayas.

Fishing methods of Manila Bay.

Fishing methods of Laguna de Bay.

Kanduli fisheries in Laguna de Bay.

Dalag fisheries in Laguna de Bay.

Ipon fisheries of northern Luzon.

**Philippine Priacanthidæ.****Organic chemistry.**

Philippine starches.

Chaulmoogryl substituted phenols and chaulmoogryl-hydroxy ethyl benzoate.

Chaulmoogryl amino phenols and chaulmoogryl benzylamine.

Composition of Philippine coffee.

Resins in the seed coats of Philippine chaulmoogra seeds (*Hydnocarpus alcalæ*).

Chaulmoogryl brom and chlor phenols.

The seguidillas bean has been found to have a high content of a valuable oil.

**Organic chemistry—Continued.**

Composition of Philippine bagasse.

Water-white coconut oil and coconut flour have been produced by a simple process. The flour makes excellent cakes.

Philippine black coral.

Composition of some Philippine fruits, vegetables, and forage plants.

Philippine camphor.

Statistics and tests of gasoline marketed in the Philippine Islands.

The vitamin content of Philippine foods.

Philippine eucalyptus oil. The yield in the Philippines has been found to be surprisingly high.

Thiochaulmoogra compounds.

A very exact analysis has been made of Philippine lumbang oil.

**Inorganic chemistry.**

The method of determination of available alkalinity in commercial lime.

An inexpensive method for improving the appearance of buntal fiber or of articles made of such material has been devised.

A study of the mechanical properties of the common Philippine bamboo has been completed. The strength of bamboo has been found to be surprisingly great.

The nail-holding power has been determined for Philippine woods used as ties.

Spike-holding power of woods used for ties as compared with creosoted apitong.

Chemical, mechanical, and microscopical analyses of papers with the end in view of drafting paper specifications for the use of the Government.

Artesian-well waters in Manila and neighboring municipalities.

Relative radioactivity of deep-well waters in Manila and vicinity.

Investigation of Philippine vitrifiable clays.

**Soils and fertilizers.**

Reconnaissance soil survey of the mainland of Albay Province.

Investigation of the relation of soil type to the growth of abacá and the quality of fiber.

The biological method for the determination of soil reaction.

Sugar-cane bagasse and waste molasses as sources of energy for the bacteria in the fixation of atmospheric nitrogen.

**Geology and mines.**

Study of the geology of the region in the neighborhood of the site of the Botocan River hydroelectric development project.

Geologic investigation of earth fissure at Loay, Bohol, and investigation of artesian-well sites in Camote Island, Cebu.

Geologic reconnaissance of Culion Island.

Lead and zinc prospects in Baguio.

Examination of gold prospects in the Angat mineral district.

Geologic reconnaissance of Calivo, Capiz, and vicinity.

Mayon Volcano and its eruptions.

## Geology and mines—Continued.

A geological study of the Angat-Novaliches region.

Potable artesian water in Rizal Province, Luzon.

Drilling on limestone reefs in Cebu.

Antamokite, a new mineral.

Geology and underground-water resources of central Panay.

Summary of Philippine land shells.

Underground-water resources of the Ilocos Central Plain.

The coral reefs of the Philippine Islands.

Statistics of mineral production in the Philippine Islands.

The chromite deposits of Zambales. This deposit has proved to be very extensive and valuable.

The lead and zinc deposits of eastern Marinduque.

## COÖPERATION

*United States Army Medical Department Research Board.*—

As in the past the United States Army Medical Department Research Board occupied quarters in the main building of the Bureau of Science. Coöperation with the board has been a great help to the Bureau of Science and the results of the board's work are of value not only to the Bureau but to the Philippines as a whole. The Bureau of Science has placed its facilities at the disposal of the board and the appreciation of the board, both verbal and written, has been very gratifying. During the year, there has been no change in personnel. The board has consisted of Maj. J. S. Simmons, as president, and Maj. Joe H. St. John and Capt. F. H. K. Reynolds as members. In addition, two sergeants, five privates, and a secretary worked with the board.

The board does no routine work; its activities are confined to research. The investigations conducted by the board were as follows:

Some experiments dealing with the possibility of insect transmission of leprosy which were begun by Col. Edward B. Vedder several years ago have been continued. Additional experiments have also been made to determine the time required for lepra bacilli to be eliminated by *Aedes ægypti*.

A study was made of pathological materials from cases of so called non-venereal or "tropical bubo." Neither cultures nor animal inoculations were effective in demonstrating the etiological factor.

A survey of melitensis-abortus infections conducted during the year included agglutination tests with sera from a large group of Filipinos and Americans and also of sera from cattle, carabaos, and goats. So far the only animal showing a positive ag-



glutination test for this group of organisms was an Indian bull imported to Manila for beef. Considered as a whole, the results appear to indicate that the prevalence of *melitensis-abortus* infections is probably not great in this locality.

The etiology of equine dhobie itch, an annoying chronic skin disease of horses and mules, was investigated. It was proven that the condition is not due to a *Trichophyton* or to similar organisms as had been previously suspected; and it was observed that the infection disappeared when animals were kept in screened stalls at night.

Experiments, which are still in progress, were planned in an attempt to develop a practicable method for the immunization of large numbers of horses and mules against tetanus.

After experimental use of many chemotherapeutic agents in the treatment of trypanosome infections in small laboratory animals, one chemical was selected for use in horses and mules infected with surra. Use of this preparation, called "Drug 76," alternately with tartar emetic has resulted in the cure of two animals. Further experiments are now in progress.

A survey of parasites in one hundred dogs killed at the city pound in Manila showed a surprisingly small number of species and individuals per dog. *Ankylostoma caninum* was found in all dogs, but 30 per cent of the animals had less than fifty worms each; *Dypilidium caninum* in 17 per cent with the number per dog not exceeding twenty; *Toxacara canis* 4 per cent, and *Wuchereria immitis* 10 per cent. In a blood survey of one hundred other dogs for *Babesia canis*, 5 per cent were found infected.

The field investigations of native carriers of malaria, and the mosquito surveys, conducted in 1928 on Corregidor Island have been followed by a most satisfactory reduction in the incidence of malaria at Fort Mills.

In April, 1929, during a survey at Camp John Hay, Mountain Province, the following mosquitoes were found breeding:

*Anopheles maculatus*, *A. formosus*, *A. lindesayi* (not previously reported in the Philippines), *Lutzia fuscana*, and *Culex quinquefasciatus*; a few malaria cases or carriers were also observed. However, blood specimens from eighty Igorote children were all free from malaria plasmodia.

In December, 1929, a malaria survey was made of about one thousand Filipino school children at or near Fort Stotsenburg. The low malaria-carrier rate and the low admission rates for malarial fevers at the present time in this post, which until a few years ago was known as a "pest hole" of malaria, fur-

nish striking evidence of the effectiveness of energetic application of modern malaria-control measures.

From an analysis of the results of these various field investigations, it has been concluded that from 70 to 80 per cent of all malaria-parasite carriers in a Filipino community may be identified within a short time and with very little labor as follows: (a) Examine all children under 15 years of age for splenic enlargement. (b) Examine "thick smears" of blood only from persons in the families of the children with splenic enlargement.

Experimental studies have been made of the epidemiology, transmission, etiology, symptomology, immunity, treatment, and prevention of dengue. A few of the outstanding observations were:

Proof that *Aedes albopictus*, a common Oriental mosquito that is prevalent in Manila, is just as effective as *A. ægypti* in transmitting dengue.

Development of a technic for feeding *A. ægypti* artificially on blood or other materials injected beneath a clean piece of guinea-pig or chicken skin.

Demonstration of the fact that normal *A. ægypti* may be infected with dengue virus by feeding on a suspension of dengue-infected mosquitoes.

The infection of one of seven Philippine monkeys (*S. philippinensis*) and three of four Japanese monkeys (*S. fuscatus*) with dengue.

Studies in immunity, during which it was demonstrated that Filipinos living in endemic areas near Manila are immune; while Ifugaos living at an elevation of about 5,000 feet near Baguio are susceptible to dengue.

Demonstrations of the fact that dengue virus as it exists in infected *A. ægypti* can pass through a bacteria-retaining diatomaceous earth filter.

Observations of diagnostic importance concerning the leucocytic reactions produced by dengue; particularly, the changes that occur in the mature and young types of granulocytes.

The publications prepared by the board during the year are as follows:

Malaria on the Island of Corregidor. I. Report of Carrier Survey, July, 1928, Military Surgeon (May, 1929). II. Report of Mosquito Survey, December, 1928. Military Surgeon (June, 1929). J. S. Simmons and J. H. St. John.

Infection of the lung by a nematode of the genus *Cyathostoma*. Journ. Am. Med. Assoc. 92 (1929) 1816-1818. J. H. St. John, J. S. Simmons, and L. L. Gardner.

- Dengue fever transmitted by *Aedes albopictus* Skuse. (Preliminary note.) *Am. Journ. Trop. Med.* (January, 1930). J. S. Simmons, J. H. St. John, and F. H. K. Reynolds.
- Transmission of dengue virus from infected to normal *A. ægypti*. (Preliminary note.) *Am. Journ. Trop. Med.* (June, 1929). J. H. St. John, J. S. Simmons, and F. H. K. Reynolds.
- Transmission of dengue fever by *Aedes albopictus* Skuse. *Philip. Journ. Sci.* 41 (1930). J. S. Simmons, J. H. St. John, and F. H. K. Reynolds.
- Transmission of the virus of dengue fever from mosquito to mosquito. *Philip. Journ. Sci.* 41 (1930). J. H. St. John, J. S. Simmons, and F. H. K. Reynolds.
- Observations on equine dhobie itch in the Philippines. (Submitted for publication, *Philip. Journ. Sci.*) F. H. K. Reynolds, J. S. Simmons, and J. H. St. John.
- The survival of various microorganisms within the gastrointestinal tract of *A. ægypti*. (To be published later.) J. H. St. John, J. S. Simmons, and F. H. K. Reynolds.

*Rockefeller Foundation.*—During 1929, the Rockefeller Foundation had no one stationed regularly at the Bureau of Science until Dr. Paul F. Russell arrived to take up the study of malaria. Doctor Russell has been given quarters in the Bureau of Science and the facilities of the Bureau, and we expect much good will come of his detail to the Bureau of Science.

Early in the year the Bureau coöperated with Dr. Clark Yeager in his work on the possible danger of artesian wells becoming polluted by the movement of organisms from latrines through the soil. Experimental holes for this work were drilled on the premises of the Bureau of Science and examination of the microorganisms were made by the staff of the division of medical biology.

*Manila Railroad.*—As during the past four years, the work in coöperation with the Manila Railroad Company has been conducted by Dr. T. Dar Juan, who has been stationed in the Bureau of Science. The Manila Railroad pays the salary of Doctor Dar Juan, bears a part of the expenses, and furnishes him with an assistant. The investigative work is primarily along lines that are of interest to the railroad but also of great value to the Government. In addition to research activities Doctor Dar Juan supervises the control analyses of coal, cement, lubricants, and other materials.

In addition to the control analyses of materials and supplies purchased by the Manila Railroad Company, service tests were conducted on three coals offered in the local market, also on

various grades of lubricants and fuel oils, both for steam and internal-combustion engines, to determine their value and suitability for the use of the company. Whenever time was available the consumption of fuel of various trains and types of locomotives was also tested.

As in past years part of the time was devoted to the supervision of the paints and alloys laboratory of the Bureau of Science. During this year the work of this section has increased considerably as a natural sequel to the paint specifications drafted in 1928 and adopted by the Insular Government Committee on Standardization of Supplies. The year 1929 has been a very busy one for the section in trying the specifications in actual practice, in making control analyses of paints purchased by the Bureau of Supply, in working out alterations and modifications in the methods of analysis, and in settling controversies between interested parties for whom the use of specifications is a new thing. It is, however, very gratifying to note that as time passes, both local and foreign manufacturers and dealers realize the advantages of being guided by specifications in their commercial transactions with both the Government and the public in general. Purchase under specification has created a state of affairs whereby it is possible to take advantage of a lawful and honest competition among bidders; furthermore, it simplifies the selection of the most desirable kind and minimizes controversy and criticism in making awards.

The work on paint and paint materials above described has left very little time for activities along other lines of investigation. Research work performed in a desultory and intermittent manner is unsatisfactory and not conducive of results. It is hoped that as the various parties concerned become accustomed to the use of specifications, the amount of work done for the Bureau of Supply will decrease as has been the case with other specifications and leave the members of this section more time for other activities. Construction work, at least, in the City of Manila has shown a recent turn toward the use of lumber substitutes of various types met in the trade under the names of Celotex, Upson board, Plaster board, etc. Work on the insulating properties of these materials has been started in a preliminary manner but has had to be discontinued to give way to work on paint and paint materials. In view of the increased use of these lumber substitutes, it is hoped that it will be possible to continue the work already begun.

*Metropolitan Water District.*—As in past years the Metropolitan Water District has supplied a chemist particularly for the chemical examination of the water of Manila. The chemist makes several determinations daily of the chlorine content of the city water, while a bacteriologist of the Bureau of Science examines the water several times each day for bacterial content. The results of these examinations are highly satisfactory and indicate that the city water as it comes from the tap is safe for drinking and other domestic purposes.

#### WORK DONE BY THE BUREAU OF SCIENCE FOR THE PUBLIC

The work of the Bureau of Science for the public covers a wide field and directly or indirectly touches almost every phase of human activity in the Philippines. Most of the activities of the Bureau are of great importance to the public but are carried on so unobtrusively that the public hears or sees nothing of them. The preceding pages are occupied largely by a consideration of the finances of the Bureau of Science, the relation of the Bureau to other Government entities, and the research of the Bureau. In this section the activities are briefly reviewed in reference to the direct relation to public welfare.

The health of the public is protected against epidemic diseases by vaccines manufactured by the Bureau of Science. Eight million three hundred thousand doses of these vaccines were dispensed in 1929. Among the most important of these were vaccines against smallpox, cholera, typhoid, and dysentery.

Smallpox, which used to be a tremendous scourge and caused terrible epidemics, is now little feared owing to the use of vaccine. The efficiency of this vaccine is due to a considerable extent to improvements introduced in its manufacture by the Bureau of Science. The last cholera epidemic was ended with the use of Bureau of Science vaccine against cholera. So long as the vaccination is continued there should be no further epidemics. Vaccine has also been a great agency in the control of typhoid. More recently the Bureau of Science perfected an antidyenteric vaccine suitable for local conditions and which has no painful reaction.

The Bureau of Science helps the health conditions in the Islands in many other ways. Important among these is the examination of foods submitted by various agencies, including the Philippine Health Service and the Bureau of Customs. Such substances are examined to see that they meet the requirements

of the Food and Drugs Act. Particularly important is the examination of imported canned goods such as salmon and sardines. Some of the local products examined include ice cream, coconut and other vegetable oils, meats, lard, milk, soft drinks, alcoholic beverages, bread, confectionery, fruits, vegetables, fish, sugar, molasses, soaps, cheese, dyes, flour, and cereals. During 1929 over seventeen thousand examinations were made on food substances and soft drinks. Bacteriologic examinations are also made on the food handlers in Manila. Waters all over the Philippines are examined both bacteriologically and chemically and no waterworks project is started until the Bureau of Science certifies that the water is suitable for human consumption. More than nine thousand examinations of water were made in 1929.

The Bureau of Science also assists the Quarantine Service in keeping out epidemic diseases. In 1929 fifty-one thousand rats were examined for plague as a protection against the introducing of this disease into the Islands.

Better known is the antirabic treatment against rabies. Each treatment consists of twenty-five injections which are furnished free. More than three thousand four hundred such treatments were given during 1929. This antirabic treatment is also used by the City Veterinarian of Manila to vaccinate dogs.

The Bureau of Science assists the Bureau of Health, the Quarantine Service, and other Government entities as well as private doctors in making diagnoses by examining specimens, such as fæces, blood, sputum, and urine. Nearly one hundred thousand such examinations were made in 1929. For the protection of the public the Food and Drugs Act of the Islands requires that the containers of drugs and biologic products be properly labeled, not mislabeled, and that the labels state accurately the constituents of the drug. Under this law, drugs are collected by the Board of Medical and Pharmaceutical Examiners and Inspectors and analyzed by the Bureau of Science; if found to be mislabeled, they cannot be sold.

The strength of cement and other structural materials that go into the construction of buildings, and the strength of the resulting concrete are very important from the standpoint of public safety. The Bureau of Science is required to test all cement used in Government structures and all cement used in buildings in the City of Manila, also the resulting concrete in these structures. Twenty-four thousand such tests were made in 1929.

The Bureau of Internal Revenue is in charge of the supervision of weights and measures used to weigh and measure articles sold in the Philippine Islands, but the Bureau of Science carries on the examination and certification of standard weights and measures.

The Bureau assists in the development and in the promotion of the mining industry by geologic survey work, investigating economic mineral deposits, assaying ores and bullion, testing ores for milling purposes, identifying minerals, and examining mines and prospects for private parties with the view of assisting in their development. Among the mineral deposits discovered is an extensive deposit of chromium in Zambales. Chromium is used in hardening steel such as that used in the armor of battleships, projectiles, safe vaults, and other materials requiring toughness and hardness. All the chromium used in the United States is imported and so the location of a very extensive deposit in the Philippines may prove to be of great value to the American steel industries. Sites for artesian wells are located for the Bureau of Public Works.

The Bureau works for the farmers by examining soils and fertilizers. All fertilizers sold are required to be registered in the Bureau of Science, and the Bureau inspects fertilizers to see that the farmer gets the composition guaranteed by the manufacturer.

The Bureau also aids the farmer by investigating the cause, prevention, and remedies of plant diseases and by giving information and advice on these subjects.

People interested in fisheries consult the Bureau on their problems, and the Bureau recommends to the Secretary of the Department of Agriculture and Natural Resources the formulation of rules and regulations for the protection of fish and the fishing industries.

A popular activity of the Bureau is the demonstration of methods of canning and preserving fruits and vegetables. These demonstrations are given by the Bureau of Science demonstrators throughout the Archipelago. The recipes used were developed in the Bureau, and their demonstration to housewives has resulted in extensive use of homemade preserves. This activity has also resulted in the establishment of commercial canneries. During the year, demonstrations were given in sixty towns in twelve provinces.

The demonstrators, in addition to doing demonstration work in provincial towns, have also collected Filipino recipes for

cooking; five hundred seven such recipes have been tried in the laboratory. The best of these, together with foreign recipes suitable or modified to be suitable for the Philippines, will be printed in a cookbook and will be used by the demonstrators for the instruction of the public.

The Bureau of Science is open to the public for consultations on all matters pertaining to science, and the Bureau makes examinations for the public of almost all conceivable kinds of articles. These examinations include medical specimens, cotton goods, paper, leather goods, galvanized iron, mineral oils, food products, paints, and practically anything that requires testing.

Consultations and advice are given free to manufacturers of and merchants dealing in soaps, oils, paints, dairy products, soft drinks, ice, artesian water, etc.

The researches conducted by the Bureau of Science have aided the development of industries in the Philippines and the promotion of sanitation and the development of medicine.

Researches conducted by the Bureau of Science have resulted in the establishment of numerous industries and the improvement of a great many more, while the possibilities of still other industries have been pointed out. These include glass, paper, vitrified brick, medicinal remedies, paint oils including lumbang, and numerous others.

Original work done by the Bureau of Science along medical lines has been very important. An enumeration of all of it would require much space, but one example may be mentioned here. For many years beriberi was a cause of much infant mortality, until scientists working in the Bureau brought forward tikitiki extract as a remedy. Tikitiki extract is now made by a number of firms and also by the Bureau of Science. The Bureau's product is distributed free by the Public Welfare Commission through its puericulture centers. During 1929, the Bureau of Science furnished the Public Welfare Commission without cost 39,490 bottles of tikitiki extract.

#### PUBLICATIONS AND LIBRARY

The Philippine Journal of Science, embodying the results of the research work of the Bureau, was issued in three volumes in 1929 with an aggregate of 1,504 pages, 254 plates, and 124 text figures. The contents of the three volumes are given later in this report under the heading, Publications.



The Philippine Journal of Science is sent to 932 paid subscribers and exchanges, and 105 copies are distributed free for review, to associate editors, and other parties. The total mailing list is 1,037. This is distributed as follows: Philippines, 90; remainder of Asia, 199; Europe, 291; North America, 345; South America, 31; Africa, 33; Australia and neighboring islands, 48. These figures show that the Journal is widely distributed to scientific institutions in all parts of the world.

One monograph was issued during the year and one is in press.

The library has continued to grow in size and usefulness and has maintained its high standard of excellence. During the year, 3,637 bound volumes and 7,527 unbound volumes, parts, and pamphlets were added, making a total of 120,009 bound and unbound volumes, parts, and pamphlets at the close of the year. The library received 2,322 scientific serials of which 454 are paid subscriptions, 704 exchanges, and 1,164 free. The number of publications used and charged out was 66,897 or a daily average of 183 publications. The number of visitors recorded in the library was 24,910.

#### MUSEUM DISPLAY

The Bureau of Science is visited by a great many people who desire to know something of the scientific work of the Bureau. Excursions of school children accompanied by teachers from Manila and neighboring provinces frequently visit the Bureau of Science, so that during the course of the year many thousands of people pass through the Bureau. In order to demonstrate the work of the Bureau and to give instruction to these people the Bureau has continued the enlargement of its series of cases in the corridors on the first floor in which there are displayed collections of birds, fishes, insects, shells, corals, sponges, and other animals, as well as plants and plant diseases. The cases also contain exhibits illustrating the work of the Bureau and products manufactured by the Bureau. This exhibition has proved very popular and has attracted an increased number of visitors.

#### AQUARIUM

As in past years, the Bureau of Science continued to operate the Aquarium in the bastion of the Real Gate of the Walled City where a considerable variety of interesting and curious fishes and other marine animals are displayed for the benefit of the public and tourists. During the year there were 23,608 paid admissions; 4,098 free admissions to elementary students,

officers and sailors of the Japanese Navy, and others; and 2,288 half-fee admissions to high-school students.

#### IMPROVEMENTS

The work of the Bureau of Science and, in consequence, the number of persons on the staff have increased so greatly that the work is seriously hampered by the crowded condition in all the laboratories. In order to remedy the situation the Bureau in 1928 asked the Legislature for an appropriation of ₱250,000 for building the west wing of the main building. That year the Legislature appropriated the sum of ₱150,000 for a wing and in 1929 the Bureau of Public Works prepared plans for this addition. In 1929 the Legislature appropriated an additional ₱70,000 for this project. Plans for the wing are now completed and bids have been opened, so it is expected that the award of the contract for the construction of the building will be made early in 1930 and that the building will be completed about the middle of 1930.

During the latter part of the year, work was started on the connection between the two parts of the cement laboratory. This work will be completed early in 1930 and will greatly improve the facilities of the cement laboratory.

A green house with glass roof and wire screen sides has been constructed near the northwest corner of the Bureau of Science grounds in Manila. Also for botanical work, the Bureau of Science has obtained permission from the Government to use a part of the land at the corner of Gral. Luna and San Luis Streets. The ground has been leveled, and a fence around the lot is in process of construction.

#### PERSONNEL

The great increase in the demand for work by other Government entities and by private individuals and the enlargement of the activities of the Bureau have necessitated an increase of 15 in the number of personnel. The total number of employees on the pay roll as of December 31, 1929, was 360. Of these 132 composed the technical staff, 25 were clerical, while 203 were laborers, including janitors, carpenters, gardeners, watchmen, helpers, etc.

#### REPORT BY DIVISIONS

##### MEDICAL BIOLOGY

*Personnel.*—Dr. Gavino Sepulveda, Jr., was appointed as junior bacteriologist February 11. Dr. Ramon A. Acevedo was

appointed as junior bacteriologist February 19. Miss Maria A. Abogadie was appointed as scientific assistant February 11, and resigned effective June 20.

*Coöperation.*—Two members of the staff of the division co-operated by giving instructions in the School of Hygiene, University of the Philippines. Dr. Otto Schöbl gave ten lectures and demonstrations on serum therapy. Dr. Mariano Basaca coöperated in the Department of Bacteriology, School of Hygiene, and with Dr. Clark Yeager, of the International Health Board, in his experiments concerning soil pollution by vibrios and the possible danger of artesian wells becoming polluted through the special system of latrines introduced by Doctor Yeager in the Philippines. Each year the City Veterinarian of Manila vaccinates all licensed dogs in Manila against rabies. The division of medical biology supplies free the vaccines used for this purpose. Dr. Otto Schöbl delivered a series of lectures at the Congress of Philippine Health Service Officers in Baguio.

*Routine.*—The routine work increased even though the general free laboratory service for physicians has been discontinued. The free service was limited to patients who produced a certificate from attending physicians to the effect that a charge for an examination would be a great financial burden to them. The following table shows the routine work accomplished by the division:

*Summary of routine work of the division of medical biology during 1929.*

	Samples or units.	Value.
		<i>Pesos.</i>
<b>Cash work.</b>		
Examinations made in Manila during 1929	691	3,686.37
Vaccines and serums sold from central office	4,296,915	302,480.60
Cebu laboratory examinations and sales	1,555	3,361.83
Iloilo laboratory examinations and sales	2,069	5,886.00
<b>Total</b>	<b>4,301,230</b>	<b>315,414.80</b>
<b>Free work.</b>		
Examinations in Manila	144,001	1,014,274.00
Vaccines and serums	4,072,334	822,714.50
Cebu laboratory	4,334	16,125.00
Iloilo laboratory	7,108	66,450.00
<b>Total</b>	<b>4,227,777</b>	<b>1,919,563.50</b>

*Field work.*—As in previous years the staff of the division of biology was called upon to visit various places in the Archipelago for the purpose of examining waters and proposed water-

works at site. Others had to relieve members of the staff assigned to the Iloilo or Cebu branch laboratory. The following table gives the information as to the number of trips, designation, and purpose:

*Division of medical biology; travel of personnel, 1929.*

Name.	Place.	Date of departure.	Purpose of travel.
Dr. S. Nobleza	Wright, Samar	Jan. 24, 1929	Water examination.
Dr. M. Basaca	Lucena, Tayabas	Jan. 29, 1929	Do.
Dr. S. Nobleza	San Fernando, La Union	Feb. 14, 1929	Do.
Dr. M. Basaca	Baguio, Mountain Province	Mar. 18, 1929	Do.
Dr. R. Acevedo	Alabang, Rizal	Apr. 3, 1929	Assigned to work in the Bureau's laboratory.
Mrs. T. V. Ramirez	Balanga, Bataan	Apr. 6, 1929	Water examination.
Dr. O. Schöbl	Baguio, Mountain Province	Apr. 28, 1929	To deliver lectures at the meeting of the Philippine Health Service Officials.
Dr. J. Ramirez	do	May 8, 1929	Water examination.
Dr. N. Vinteres	Bucay, Abra	June 3, 1929	Do.
Dr. M. V. Mallari	Manila	July 12, 1929	Temporarily assigned to work in the central office.
Dr. N. Vinteres	Narvacan, Ilocos Sur	Aug. 3, 1929	Water examination.
Dr. M. V. Mallari	Iloilo, Iloilo	Aug. 7, 1929	To relieve Doctor Jalandoni who is on leave of absence.
Dr. J. Ramirez	San Narciso, Tayabas	Aug. 24, 1929	Water examination.
Do	Rosales, Pangasinan	Sept. 5, 1929	Do.
Dr. N. Vinteres	Basi, Samar	Sept. 14, 1929	Do.
Mrs. T. V. Ramirez	San Miguel, Bulacan	Sept. 28, 1929	To appear in court as witness.
Dr. N. Vinteres	Cabugao, Ilocos Sur	Oct. 8, 1929	Water examination.
Dr. G. Sepulveda	Carmen, Bohol	Nov. 2, 1929	Do.
Dr. J. Ramirez	Tuy, Batangas	Nov. 11, 1929	Do.

**Research.**—As much time as was left free by the routine work was devoted to investigations. The main problems on yaws and syphilis were continued and as far as finished they were published in the Philippine Journal of Science. The titles of the papers containing the results of the investigations are the following:

Note on the duration of immunity to yaws in Philippine monkeys, by B. Tanabe.

Serologic studies in experimental yaws, by Otto Schöbl.

Experiments concerning the yaws antigen which produces positive Wassermann reaction when injected to suitable experimental animals, by Otto Schöbl and B. Tanabe.

Is the Wassermann reaction provoked in Philippine monkeys by yaws vaccination specific? By I. Miyao.

Following the subcutaneous immunization with yaws vaccine is the skin tissue proper responsible for the productions of Wassermann reagin or do other tissues also participate? By I. Miyao.

The relation with regard to treponema antigen of the Wassermann and Kahn reactions, by Onofre Garcia.

Summary of serologic studies in experimental yaws, by Otto Schöbl.

Laboratory testing of germicides and chemotherapeutic agents, by Otto Schöbl.

#### BOTANY

*Personnel.*—Mr. Jose M. Mendoza was appointed mycologist March 16; Mr. Macario A. Palo, junior mycologist March 16; Mr. Gaudencio M. Reyes, assistant mycologist August 1; Mr. Brigido R. Villanueva, junior botanist October 30; and Dr. Tranquilino Fajardo, assistant entomologist November 11.

*Coöperation.*—Dr. Eduardo Quisumbing coöperated with Dr. R. W. Hegner, of the School of Hygiene of the College of Medicine, University of the Philippines, in supplying him fresh botanical material containing milky juice for the study of certain flagellates.

The coöperative services offered by the systematic section to foreign institutions were rather extensive during 1929 as compared with the previous year. The most outstanding and important is the loan of type and general botanical material to be used for the monographic studies of certain groups of plants.

Material of the herbarium of the Bureau of Science was loaned during 1929 as follows:

- To Dr. E. B. Copeland, University of California; all the Hymenophyllaceæ.
- To Dr. D. F. Van Slooten, director, Buitenzorg Gardens, Java; all the Loranthaceæ and Ebenaceæ.
- To Dr. L. Diels, director, Berlin Botanical Gardens; certain types of the genus *Gnetum*.
- To Harvard University (Gray Herbarium), all the Polygenaceæ.
- To Dr. Fr. Verdoorn, Holland; duplicate material of hepatics for determination.
- To Dr. M. J. Kotalainen, Finland; duplicate material of Musci for determination.
- To Dr. Oakes Ames, Bussey Institution, Mass.; orchid material for verification of Dr. Eduardo Quisumbing's determinations.
- To Dr. E. D. Merrill, director, New York Botanical Gardens; miscellaneous Philippine material for verification of determinations.
- To Dr. W. A. Setchell and Dr. N. L. Gardner, University of California; Algæ for determination.

In addition to the above activity the division also supplied Prof. H. F. Roberts, of the University of Manitoba, coco-root tips embedded in paraffin for cytological studies and Dr. K. A. Ryerson, of the United States Department of Agriculture, seeds from several species of *Ficus* for cytological studies. The division has also rendered valuable service to private individuals who have been interested in many plants having economic value or possessing therapeutic properties by identifying the plants as well as by determining the usefulness and the possibility of commercial and industrial exploitation and by pointing out the physiological actions of the medicinal ones. It has also contributed its share in the solution of some judicial problems in cases of supposed poisoning or in cases where damages were attributed to persons having employed certain plants that are believed to be toxic.

The Bureau of Forestry has detailed one man to work at least part time on forest fungi, particularly the wood-destroying group. Although the coöperative phytopathological laboratory formerly maintained in conjunction with the Bureau of Agriculture has been discontinued as a distinct unit this division is still receiving valuable advice and assistance from that Bureau in the matter of reports on the prevalence of certain plant diseases, the furnishing of plants for experimentation, and the use of certain land. The College of Agriculture, University of the Philippines, has also extended valuable coöperation.

The Bureau of Education also requested a report on cacao diseases in its comparatively recent plantings in Isabela and Nueva Ecija Provinces.

*Routine work.*—The work has been similar to that in previous years and consisted largely in the preparation of botanical material, poisoning, mounting, recording, fumigating, and distributing specimens into the type and the general herbarium, and the preparation of duplicate material for exchange purposes, etc.

The lichen and general collections of the Bureau were overhauled and put into a very workable arrangement. Also new activities were started during 1929, and consisted of the organization of an algal herbarium and an economic herbarium. Extensive collections of algæ have been made and material sent abroad for determinations. This is necessary to enable us to know the names of the algæ of economic importance in the Philippines. An economic herbarium separate from the general

herbarium was needed to facilitate the determinations of the common and introduced ornamentals, etc.

In the course of the year over 3,000 specimens have been determined, for the most part these were destined for the herbarium of the Bureau of Science but included a quantity of miscellaneous determinations for the Bureaus of Forestry, Agriculture, Education, Commerce and Industry, the Philippine Health Service, the College of Agriculture, and the School of Forestry. A total of 6,206 specimens have been mounted during the past year.

The approximate total number of mounted specimens now in the herbarium is 262,382, of which 7,154 were added during the year as follows:

Collections of employees of the Bureau of Science....	1,581
Collections of employees of the Bureau of Forestry....	551
Collections of employees of the Bureau of Agriculture	204
Wenzel .....	846
Miscellaneous .....	91
Extra-Philippine material received by gift, exchange, purchase, special collections, etc. This has been of exceptional value.	
Dr. E. D. Merrill, Squires plants from Indo-China (exchange) .....	328
Dr. Chiao—Nanking plants (exchange).....	112
Singapore Botanic Gardens (exchange).....	300
Dr. E. B. Copeland, ferns (exchange).....	100
Formosan Department of Forestry (exchange).....	25
Cornell University (exchange) .....	119
Dr. Eduardo Quisumbing—miscellaneous Indo-Malaysian Piperaceæ (gift) .....	113
Mrs. M. S. Clemens, Indo-Chinese plants (purchase)	172
Elmer's Bornean plants (purchase).....	1,618

The most valuable additions to the herbarium secured by purchase were the collections of Mr. A. D. E. Elmer from British North Borneo and of Chaplain and Mrs. J. Clemens from the vicinity of Hue, Indo-China.

The herbarium in the past year has arranged additional exchanges with the following:

- Government Museum, Formosa, for Formosan plants.
- Museum d'Histoire Naturelle, Paris, for Indo-Chinese plants.
- Department of Agriculture, Siam, for Siamese plants.
- Buitenzorg Gardens, Java, for Javan and Sumatran plants.
- Utrecht Herbarium, Holland, for Dutch New Guinea plants.
- Dr. E. D. Merrill, for Bornean, Sumatran, Chinese, and Indo-Malaysian plants.

*Research and field work.*—Botanical explorations were carried on in Palawan, west of Sir J. Brooke Point and on Mount Cagua and Mount Balatongan, northwest of Cagayan Province by G. Edaña. These trips brought in about 3,905 and 4,500 specimens, respectively. M. Ramos explored Mount Dos Cuernos, Mount Cresta, and Mount Tubuan in Cagayan Province, bringing in about 5,000 specimens. In addition short trips were made to Mount Labo, Camarines Sur; Baguio and Mount Santo Tomas, Mountain Province; Mount Macolod and Mount Malarayat, Batangas Province; and Mount Maquiling, Laguna Province, by Dr. E. Quisumbing; and to Mount Susongdalaga, Rizal Province; and Mount Mariveles, Bataan Province, by Ramos. About 13,000 specimens were collected.

A study of orchids, which was started in September, 1928, was continued. About 200 species of orchids have been studied, with ample field notes, copious descriptions, and illustrations including photographs of the habit and colored paintings of the flowers of each species. The result of these studies will be used in a book on Philippine orchids, and eventually for a monograph of the whole family.

New or interesting Philippine orchids, I. The research is in progress, and the manuscript will be ready for publication in 1930.

New or interesting Philippine plants, II. This is a continuation of studies on the Philippine flora; the first paper of this series is now in the press.

The presence of coriamyrtine in *Coriaria intermedia* Matsum. In this plant the glucoside has already been isolated; but due to the limited amount of material some other tests as to the identity of the active constituent, such as the confirmation of its physiological action, have had to be postponed until more material is available.

The constituents of the rhizome of *Kaempferia galanga* Linn. The work has been extended to include other chemical constituents besides the volatile oil already obtained.

The nitrogen distribution in the leaves of camphor trees, one yielding an oil camphor and the other, a solid camphor.

The nitrogen partition of mongo seeds, *Phaseolus radiatus* Linn. In this work, Miss Paulina Verzosa is a collaborator.

Biochemical study of *Clathrocystis aeruginosa* (Kuetz) Henfr. This is a joint paper under preparation of which Dr. M. Alicante is the senior author.



A further attempt was resumed to prove the glucosidal principle of *Rourea erecta* (Blanco) Merr. The work of last year was partly successful as a small amount of the glucoside has already been isolated. It is hoped, therefore, that when the material is again available next May, more progress can be made in the chemical study of the active principle.

The chemical examination of the bark of the stem of *Strophanthus cumingii* was started and several methods for the isolation of strophanthin have been tried. Some crystals have been obtained, but their chemical nature is not yet determined.

During 1929, the critical investigation on the internal structures of the leaf and bark of the six important species of cinnamon was completed. The plants included in the study are *Cinnamomum zeylanicum* Bl., *C. cassia* Bl., *C. mindanaense* Elm., *C. mercadoi* Vid., *C. iners* Reinw., and *C. burmanni* Bl.

Three other anatomical investigations were started during the year, as follows:

A comparative anatomical study of the leaves and barks of the crystal and oil camphor-producing trees from Baguio.

Comparative anatomical structure of the leaves and stems of *Anamirta cocculus* and *Archangelisia flava*.

The structure of the rhizome of *Kæmpferia galanga*.

Mr. Jose Mendoza devoted considerable time to field control experiments on die-back disease of cacao. Spraying and pruning were continued in the Lorenzo Ramos orchard at Tanauan, Batangas; as a result most of the disease has been eliminated, and the trees which heretofore had not borne any sound fruit are beginning to produce. Similar pruning and spraying were carried out on nursery plants at the hacienda of Dr. Alfredo Magpantay, Tanauan, before the setting of the seedlings in the permanent orchard. A recent inspection indicates that the die-back organism has been eradicated. An inspection trip to Isabela and Nueva Vizcaya Provinces, made at the request of the Bureau of Education to investigate the prevalence of disease in the surrounding cacao plantations, indicates comparatively little disease in the region. Many of the plantings are comparatively young, however.

Mr. Macario Palo made a preliminary survey for anthracnose on mango in Rizal, Laguna, and Batangas Provinces. Infection was found to be mild during the dry months of April, May, and June, except in a few humid places where both the leaves and the fruit are moderately attacked. During moist weather, however, the flowers may become severely blighted so that fruits fail to

set. Spraying and dusting for control will be tried during the approaching season, at the hacienda Madrigal at Muntinlupa, Rizal.

Field experiments on rice diseases, particularly as caused by *Sclerotium*, was carried out by Mr. G. Reyes at Alabang, Rizal. This consisted largely of fertilizer tests. The beneficial effects of calcium nitrate, applied at the rate of 300 kilograms per hectare, were reflected in 60 to 70 per cent increase in production. Nitrogenous and phosphatic fertilizers, particularly the former, increased susceptibility, while potassic fertilizers increased both the resistance and yield of grain.

As a result of previous field work on rice diseases, the results of which were embodied in recommendations widely disseminated in Ilocos Norte, severe outbreaks of stem rot (*Sclerotium*) have there been averted, the most effective control measure being to drain off the water, adding more only when the soil began to bake.

At Alabang it was also reported that burning the rice stubble in infected fields followed by plowing, together with the adoption of measures to prevent the transfer of the disease by animals or laborers, practically eliminated the disease in the experimental paddies.

In Pampanga Province one large planter has discontinued two very susceptible varieties (Inachupal and Macan China) and substituted Ramai, a highly resistant variety and a good yielder, following the recommendations of this office.

General plant-disease survey work has been carried on in Luzon as time permitted. Dr. T. G. Fajardo and Mr. B. R. Villanueva contributed largely to this during December. Tomato wilt, caused by *Phytophthora solanacearum*, was found to be widespread in many of the provinces; in some places 50 to 70 per cent of the plants were diseased. Tobacco mosaic was noted as prevalent in six of the northern provinces, with 50 to 75 per cent infection in certain fields. Other mosaic diseases were recorded on tomato, sugar cane, pepper, cucurbits, corn, cowpea, and apalia.

In Batangas and Cavite Provinces a brief survey of coffee diseases revealed that almost all of the old plantings of *Coffea arabica* were severely infected with rust (*Hemileia*), and as a result it is being rapidly supplanted by more-resistant species, such as *C. liberica*, *C. robusta*, and *C. excelsa*, which are being planted on a large scale. These species, while considerably resistant, are by no means immune. In one plantation the loss

in *C. robusta* was estimated at about 2.5 per cent. Rust was also prevalent and severe on *C. arabica* in the northern provinces.

A black leaf-spot and a stem rot of the peanut were found common and destructive.

At Baguio a very destructive bark disease of cinchona rapidly killed many of the trees up to seven years old in an experimental planting of the Bureau of Forestry.

Field work in mycology has consisted in several short trips to Los Baños, Laguna, for the collection of material. Mr. Alejandro de Mesa, detailed by the Bureau of Forestry, also secured considerable valuable material in Mindanao.

Laboratory research in phytopathology has been subordinated to field investigations, since practical disease control is essential to immediate progress in agricultural development in the Philippines. The major work in the laboratories, therefore, has been limited to working out the strains of anthracnose attacking such plants as the mango, cacao, anona, chico, atis, guava, avocado, cassava, and madre cacao, to determine their culture variations and virulence to the different hosts.

Some culture studies have also been made on strains of *Sclerotia* from rice and a pathogenic *Fusarium* on rice. A sclerotical disease of corn is likewise under investigation by Miss Mercedes Z. Quijano.

Investigations in mycology have been carried on by Dr. C. J. Humphrey and Miss Simeona Leus. The major work has consisted of a critical study of the wood-destroying genus *Ganoderma*. Several hundred collections from various parts of the world have been studied microscopically and the photographs necessary to show specific differences and variations within the species have been made. This study is practically completed.

*Publications.*—The following research papers were completed and at present are in the press:

New or interesting Philippine plants, by Eduardo Quisumbing.  
Philippine Piperaceæ, by Eduardo Quisumbing.

The following papers, published in the Philippine Journal of Science during the year, were based largely on material furnished by the Bureau of Science:

Bennett, A. Notes on potamogetons. Philip. Journ. Sci. 40 (1929) 183.  
Copeland, E. B. New or interesting ferns. Philip. Journ. Sci. 38 (1929) 129.

- Copeland, E. B. The fern genus *Plagiogyria*. *Philip. Journ. Sci.* 38 (1929) 377.
- Copeland, E. B. New or interesting Philippine ferns, VII. *Philip. Journ. Sci.* 40 (1929) 291.
- Copeland, H. F. Philippine Ericaceæ, I: The species of *Rhododendron*. *Philip. Journ. Sci.* 40 (1929) 133.
- Merrill, E. D. A new Philippine species of *Chloris*. *Philip. Journ. Sci.* 40 (1929) 181.

## GENERAL ZOOLOGY

*Personnel.*—There was no change in the personnel. The position of entomologist remained unfilled. Mr. A. W. Lopez, entomologist of the Philippine Sugar Association, was furnished laboratory facilities in June.

*Coöperation.*—Twenty lots of insects, collected more or less incidentally, were sent to various specialists who contribute articles on entomology for publication in the Philippine Journal of Science. Four lots of miscellaneous insects were sent to the United States National Museum for distribution to specialists.

*Routine work.*—Taxidermic work on private orders and the series of mounted birds in the hall exhibition cases has taken some time. The chief of division has to spend most of his time in work on the Bureau publications.

*Field work.*—No extended field trip was made except that of Francisco Rivera to Cagayan Province, March 1 to June 2. Short trips were made by the various collectors to Montalban, Novaliches, Majayjay, Lake Taal, Mount Macolod, Mount Arayat, Balete Pass, and Baguio. Some field work was done in every month except July, and approximately 460 man-days were devoted to collecting.

*Research and publications.*—Large and important collections of birds were accumulated during the year, but there was no time to prepare reports on them.

## FISHERIES

*Personnel.*—Mr. Wallace Adams was appointed as chief of the division July 13 to assume duties towards the end of the year. Dr. Vicente Aldaba, formerly of the College of Agriculture at Los Baños, was appointed temporary specialist on the Crustacea and started to work January 1. Mr. Agustin Umali was added to the scientific staff of the division as temporary assistant ichthyologist April 3.

*Routine work.*—The varied activities conducted during the year by the members of the staff consisted as usual of the following: Consultations and correspondence pertaining to fish culture, fish preservation, and fishing methods; recording and identification of fishes, crustaceans, reptiles, and batrachians collected or submitted; care of the fish museum containing over 1,400 species of fishes; and the management of the aquarium.

*The aquarium.*—During the year some new features have been added to the aquarium. New labels which can be read at night as well as during the day have been introduced. Two series of balanced aquaria, where foreign species are displayed, were constructed in April. A young tamarao from Mindoro, donated by Mr. N. V. Sinclair after the past carnival season, forms an interesting attraction at one corner of the open space.

*Field work.*—Mr. G. Lopez was in Cebu and Bantayan the first two weeks in January collecting Venus flower baskets, shells, and corals. Doctor Aldaba began a study of the materials, particularly fibers, used in the making of fish corrals, traps, and nets with a view to finding out what kinds are best for the various types of fishing apparatus for the different localities. In order to carry out this study, he examined in detail the nature and construction of the fishing apparatus employed in the different localities in Manila Bay, and incidentally studied their operation and collected samples of them that are of special interest.

February 16, Mr. H. R. Montalban made a survey of the bañgos industry in Cebu, Leyte, Negros, and Panay, and rendered valuable assistance to a number of people in locating suitable sites for fish farms, in showing them how to start the construction of fishponds, and in helping them improve their methods by the use of nursery ponds. After this survey, Mr. Montalban inspected the Bureau of Science experimental station at Estancia, Panay, to see if it needed repairs. On the 25th of the month, Mr. F. Talavera and Doctor Aldaba examined the oyster industry in Obando, Bulacan, and the following day they looked into the conditions of the window-shell fishery in Binakayan, Cavite. Doctor Aldaba continued his investigation at the end of the month on the nature, construction, and operation of fishing apparatus, this time in Laguna de Bay and Lake Taal, and whenever possible he secured samples to add to the collection in the division of fisheries.

April 6 was spent by Mr. Talavera and Doctor Aldaba investigating the dalag fishery in Candaba swamp, obtaining thereby new and valuable information. Mr. Montalban revisited Cebu Province May 1 to continue his survey of the bañgos industry, and while there he assisted a number of people in planning the layout of fishponds, building the embankments, and in constructing nursery ponds. He was ordered to proceed from Cebu Province to Occidental Negros, in response to requests from some people there, to examine sites and determine their suitability for conversion into fishponds. May 6 Mr. J. Montilla went to Baguio to determine the quantity of black bass in Burnham Park Lake available for distribution. About the end of the same month, Doctor Aldaba made a trip to the Bicol provinces to make a study of the fishing methods similar to that he had undertaken in Manila Bay, Laguna de Bay, and Lake Taal. Incidentally on this trip, the carp situation in Lake Bato and Lake Buhi was investigated.

The period from June 29 to September 19 was spent by Mr. Talavera in conducting an investigation of the general fishery conditions and in collecting crustaceans, mollusks, and fishes in Iloilo, Occidental Negros, Bantayan Island, and Cebu. Mr. Lopez was in Calapan practically the whole month of July to collect live fishes for the aquarium. The study of the spawning habits of the dalag and kanduli in Laguna de Bay was started July 17 by Doctor Aldaba. It was found necessary to make observations at different times in order to find the fishes in the different stages of development and to be able to study the different conditions of fishing, so that periodical visits had to be made to places around the lake. This study was completed in December. Mr. Montilla made another trip to Baguio July 22 and obtained from there a consignment of black bass, which he planted in Lake Bana-ao. On his return from the north, he brought to Manila about 240 of this fish, which are now being reared in one of the Bureau of Science ponds.

In compliance with a request from the Department of Agriculture and Natural Resources, a site was examined in Dagat-dagatan July 24 by Mr. Montalban and Mr. C. Martin to determine its suitability for conversion into a salt-water experimental fish farm. July 30 and August 5, the same members of the staff looked over the Arrenda in Taytay to see if it could be

used for a fresh-water experimental fish farm. For the third time, Mr. Montalban went to Cebu Province August 31 to inspect the nursery ponds for bañgos fry in Mactan and a fish farm in Toledo, which had been constructed under his supervision, and examined sites for fishponds. Upon his return to Manila, he was ordered to proceed to Estancia September 14 to conduct experiments on fish preservation. There he worked with sardines in the preparation of binoro and tinapa on a commercial basis. It was shown that in removing the heads and entrails of the sardine, four important products could be obtained from the fish instead of one produced locally; namely, the binoro itself which is better preserved and more sanitary and attractive in appearance, the oil coming from the fat, the fertilizer from the head and the intestine, and the sauce or "patis" from the liquor extracted from the binoro on pressing and salting. By the use of a vertical smoke house, about two thousand smoked sardines, or tinapa, could be produced at one time instead of one hundred produced locally. Also there was great economy effected in labor, time, and floor space. Mr. Montalban was in Estancia November 2 for the second time to finish his work on fish preservation for the season. The improved binoro he prepared was demonstrated in Capiz, Iloilo, and Occidental Negros, where it received favorable reception and comment from a large number of people.

The latter part of September was spent by Mr. Martin studying the Japanese "utase" fishing method in Manila, and on the 27th Doctor Aldaba went to San Pablo to examine the blue-green algæ in Sampaloc Lake, which were found to be responsible for the bad odor occurring periodically in that locality. Mr. Talavera accompanied Doctor Aldaba October 20 to Laguna Province in the neighborhood of Calamba and San Pablo to look for possible sites for a fresh-water experimental fish farm.

*Research and publications.*—Investigations conducted by this division were undertaken both in the field and in the laboratory. Doctor Aldaba carried on a series of studies of the fishery methods of Manila Bay, Laguna de Bay, Taal Lake, and Bicol Provinces and made an intensive study of the spawning habits of the kanduli and dalag in Laguna de Bay. Mr. Talavera has made a study of the general fishing methods of the Visayas, and in the laboratory he has worked up the Bureau of Science col-

lection of swimming crabs. The observation of the two Japanese fishing methods being operated in Philippine waters was completed during the year by Mr. Montalban and Mr. Martin. Mr. Montalban described a new chætodont from the Philippines, conducted experiments on fish preservation on a commercial basis at Estancia, and observed with Mr. Talavera the habits and characteristics of fishes in the Aquarium. Mr. Martin worked up the Philippine Priacanthidæ. Mr. Montilla completed his investigation of the ipon fisheries of northern Luzon. As a result of the varied investigations during the year the following papers have been prepared:

- A chætodont new to the Philippines, by Heraclio R. Montalban.
- Investigation on fish preservation at Estancia, Panay, Philippine Islands, by Heraclio R. Montalban.
- Two Japanese fishing methods used by Japanese fishermen in Philippine waters, by Heraclio R. Montalban and Claro Martin.
- Notes on the aquarium, by Heraclio R. Montalban and Florencio Talavera.
- Notes on Philippine Portunidæ, by Florencio Talavera.
- Six effective types of fish corrals in the Visayas, by Florencio Talavera.
- Fishing methods of Manila Bay, by Vicente Aldaba.
- Fishing methods of Laguna de Bay, by Vicente Aldaba.
- Kanduli fisheries in Laguna de Bay, by Vicente Aldaba.
- Dalag fisheries in Laguna de Bay, by Vicente Aldaba.
- Ipon fisheries of northern Luzon, by José R. Montilla.
- Philippine Priacanthidæ, by Claro Martin.

#### INORGANIC CHEMISTRY

*Personnel.*—Mr. Rafael T. Simpao, a graduate of the University of the Philippines, was appointed temporary scientific assistant March 16, to occupy the position left vacant by the resignation of Mr. Gil Opiana in October, 1928. Mr. Emilio del Prado, assistant chemist, resigned July 15. Mr. del Prado's position is temporarily occupied by Miss Justina Ruperto.

*Routine work.*—The routine work received during the year 1929 was considerably more than in 1928. The increased activity in public works undertaken by the Government necessarily increased the work of the cement laboratory as compared with the previous year. In the following table are given in detail the nature and amount of work received during the year 1929 as compared with 1928:



*Routine work performed in the division of inorganic chemistry in 1929 and 1928.*

Nature of samples received.	1929		1928	
	Samples.	Determinations.	Samples.	Determinations.
<b>Water laboratory.</b>				
Waters.....	329	3,623	377	3,707
Cements (chemical).....	191	772	172	688
Rocks, ores, and minerals.....	49	268	31	71
Electrolytes and standard solutions.....	103	38	48	69
Chemical products.....	27	30	8	11
Telephone and telegraph wires.....	7	25		
Boiler scale.....	1	1	4	32
Miscellaneous samples.....	5	18	6	32
<b>Total.....</b>	<b>712</b>	<b>4,775</b>	<b>646</b>	<b>4,610</b>
<b>Paints and alloys laboratory.</b>				
Paints and paint materials.....	68	628	86	532
Mineral oils and lubricants.....	28	98		
Metals and alloys.....	45	157	61	177
Inks, varnishes, and miscellaneous products.....	41	295	169	900
<b>Total.....</b>	<b>182</b>	<b>1,178</b>	<b>316</b>	<b>1,609</b>
<b>Weights and measures laboratory.</b>				
Measures of length.....	37	37	12	12
Measures of capacity.....	66	66	139	139
Weights.....	156	156	185	185
Gasoline truck tanks and pumps.....	2	8	26	104
Scales and other weighing devices.....	5	20		
Coins.....	1,514	1,514		
Thermometers and hydrometers.....	8	16		
Miscellaneous.....	34	135	35	140
<b>Total.....</b>	<b>1,822</b>	<b>1,952</b>	<b>397</b>	<b>580</b>
<b>Cement laboratory.</b>				
Cements (physical test).....	21,324	27,721	17,447	22,681
Concrete cubes and cylinders.....	12,708	12,708	9,244	9,244
Reinforcing steel, plates, and cables.....	135	275	107	221
Manila rope.....	198	396	104	208
Cloth and other fabrics.....	75	450	105	630
Sand, gravel, and broken stone.....	75	375	100	500
Lime and limestone.....	21	42	20	40
Asphalt.....	12	60	4	20
Miscellaneous.....	65	171	11	33
<b>Total.....</b>	<b>34,613</b>	<b>42,198</b>	<b>27,142</b>	<b>33,577</b>
<b>Fuel laboratory.</b>				
Coal (Manila Railroad Co.).....	<sup>a</sup> 202	1,212	<sup>c</sup> 188	828
Coal (Bureau of Supply).....	<sup>b</sup> 26	156	<sup>d</sup> 49	294
Coal, private sources.....	30	178	18	78
Fuel oil.....	14	20	7	10
<b>Total.....</b>	<b>272</b>	<b>1,566</b>	<b>207</b>	<b>1,210</b>
<b>Grand total.....</b>	<b>37,601</b>	<b>51,669</b>	<b>28,708</b>	<b>41,586</b>

<sup>a</sup> 108,730 tons.

<sup>b</sup> 7,296 tons.

<sup>c</sup> 82,839 tons.

<sup>d</sup> 11,620 tons.

*Field work.*—The only field work done during the year was in connection with the investigation of the artesian well waters in Manila and vicinity.

*Research.*—In spite of the heavy routine work of the staff of the division, three papers were completed during the year. They are as follows:

The determination of available alkalinity in commercial lime, by C. M. Jovellanos.

An inexpensive method for improving the appearance of buntal fiber or of articles made of such material, by S. del Mundo.

The mechanical properties of the common Philippine bamboo, by J. C. Espinosa.

The following papers are in preparation:

Nail-holding power of Philippine woods.

Spike-holding power of woods used for ties as compared with creosoted apitong.

Chemical, mechanical, microscopical analysis of papers with the end in view of drafting paper specifications for the use of the Government.

Artesian-well waters in Manila and neighboring municipalities.

Relative radioactivity of deep-well waters in Manila and vicinity.

Investigation of Philippine vitrifiable clays.

#### SOILS AND FERTILIZERS

*Personnel.*—In July Dr. Marcos M. Alicante transferred to the staff of the Philippine Sugar Association but his main assignment is still in this laboratory. Mr. Roberto Oliver, a graduate of the University of Minnesota, joined the staff. The chief of the division was assigned to the Department of Agriculture and Natural Resources from April 1 to December 9. During the fertilizer season a member of this division was assigned to Iloilo to carry on the fertilizer inspection work.

*Routine work.*—The routine work of the division has been increasing due primarily to the great demand for fertilizers in the sugar regions of the Islands, and to the growing use of fertilizer in the rice region of central Luzon. Owing to the attack of the coconut leaf miner in central Luzon, an increase in the use of fertilizer for the coco palm may be expected in view of the desire of many planters to rehabilitate the coconut plantations in a short time. The importance of an adequate knowledge of soil conditions with reference to the productive capacity of the lands is receiving recognition. Although the personnel is inadequate to meet the activities of the division, a large volume

of work was accomplished due to the interest taken and the spirit of coöperation among the members of the division.

*Coöperation with fertilizer factories.*—This division is frequently called upon to render technical advice to local fertilizer manufacturers. The exploitation of guano has grown hand in hand with the growth of the fertilizer industry. The use of guano has been encouraged in connection with the manufacture of fertilizer with chemical ingredients. The division is frequently called upon to do umpire work and to render adequate valuation of local fertilizer materials. Controversies concerning the value of one class of fertilizer as compared with another have been referred to this laboratory for comment and recommendation.

*Coöperation with the Philippine Sugar Association.*—This laboratory is in close coöperation with the Philippine Sugar Association in connection with soil investigations of the principal sugar regions of Luzon, Panay, and Negros. The technical staff of the Philippine Sugar Association is given facilities in this laboratory to carry on the work. It is believed that this co-operative work will be of great service to the sugar industry.

*Coöperation with other entities.*—The Bureau of Agriculture continues to send samples of soils and fertilizers from time to time in connection with its experimental work. The various agricultural schools under the Bureau of Education also send soil samples for analysis and consult the division on soil problems encountered. The division has been called upon to study certain irrigated areas and analyze irrigation waters in relation to soil fertility of the locality. Agricultural companies and private parties have frequently consulted the division with regard to the adaptability of crops for certain kinds of soils.

*Field work.*—Considerable field work has been done during the year in the western half of Albay Province. Chemical analyses of the soil samples for this region have been undertaken and will be of help in the development of the abacá and coconut industries for which the region is especially adapted.

A trip to Muñoz, Nueva Ecija, in compliance with the request of the Bureau of Education, was made in order to find out the cause of low yield of rice on certain areas of the land covered by the farm school.

*Research.*—The following investigations have been undertaken during the year:

Reconnaissance soil survey of the mainland of Albay Province. (Under way.)

Investigation on the relation of soil type to the growth of abacá and the quality of fiber. (Completed.)

The biological method for the determination of soil reaction. (Completed.)

Sugar-cane bagasse and waste molasses as source of energy for the bacteria in the fixation of atmospheric nitrogen. (Completed.)

#### ORGANIC CHEMISTRY

*Personnel.*—Dr. R. Schulten was appointed chemist and placed in charge of drug analysis. Dr. A. J. Hermano was placed in charge of the food laboratories. Dr. D. M. Birosel returned after a year's separation from the Bureau of Science. Miss Luz Baens was appointed assistant in research organic chemistry. Mr. Anacleto D. Francisco and Mr. F. M. Yenke were employed as assistants in the food analysis laboratories. During the year Mr. Francisco Agcaoili and Mr. Abelardo Valenzuela resigned from the Government service.

*Routine work.*—As in previous years, a large part of the routine work consisted in the analysis of foods and drugs of all kinds in connection with the enforcement of the Food and Drugs Act. The importation or sale of foods and drugs found adulterated, misbranded, or otherwise unfit for human consumption is prohibited by other Government agencies on the basis of Bureau of Science analyses. The conservation of health, lives, and money as a direct result of this work must be very great.

Approximately 50,000,000 pesos worth of coconut oil is exported annually from the Philippines. The evaluation and financing of these shipments by the banks are accomplished through analyses made by the Bureau of Science.

In addition to the analyses made in large numbers as part of the regular routine, such as those just mentioned, many requests for information and numerous miscellaneous samples for analysis are received, covering almost every interest and activity. A student wrote for a recipe for making soap. A manufacturer had trouble with the process employed in reclaiming his used Diesel-engine lubricating oil and sent samples of his oil and chemicals for aid in locating the trouble. The Manila police seized some homemade hand grenades and brought them to the Bureau of Science for a determination of their construction and explosive quality. A high degree of skill and accuracy and a wide range of information are necessary to meet successfully the varied demands encountered in the public service.

The work done in the past year is presented briefly in the following table:

Drug analyses.	Samples.
Alkaloids .....	23
Ointments .....	36
Ampules .....	39
Pills .....	94
Liniments .....	6
Alcohol .....	13
Tikitiki (complete) .....	1
Unknown drugs (complete) .....	6
Toxicological examinations .....	22
Soap .....	22
General examinations .....	584
<b>Total</b> .....	<b>846</b>
<hr/>	
<b>Petroleum products, etc.</b>	
Gasoline .....	27
Kerosene .....	10
Lubricating oils .....	23
Fuel oils .....	32
Asphalt .....	9
Miscellaneous petroleum products.....	10
Floor wax .....	22
Miscellaneous (photomicrographs, explosives, etc.)..	45
<b>Total</b> .....	<b>178</b>
<hr/>	
<b>Copra products, etc.</b>	
Coconut oil .....	676
Copra .....	24
Copra cake .....	3
Miscellaneous oils, tallow, etc.....	69
<b>Total</b> .....	<b>772</b>
<hr/>	
<b>Food analyses.</b>	
Meat and its products, including salmon, sardines, hams, sausages, shrimps, lard, etc.....	7,113
Grain products, including rice, flour, bread, etc.....	1,706
Beverages, alcoholic and non-alcoholic.....	1,254
Sugar and molasses .....	453
Milk and its products, including fresh and canned milk, ice cream, butter, cheese, etc.....	502
Miscellaneous, including foods, condiments, color- ing matters, and preservatives.....	724
<b>Total</b> .....	<b>11,752</b>
<hr/>	

*The manufacture of tikitiki extract.*—During the year 45,074 bottles of tikitiki extract were prepared, the sale value of which was ₱31,551. Of these, 3,260 bottles were sold for ₱2,282, and 41,892 bottles, with a sale value of ₱28,974, were given to other Government agencies for free distribution. The tikitiki plant is inadequate in size and obsolescent from the point of view of efficiency, but funds for its improvement or replacement are not available.

*Research.*—The preparation of a new series of chaulmoogra compounds was continued, and several of these researches were completed. Knowledge of the chemistry of chaulmoogra oil is invaluable since compounds of this drug are used in the treatment of leprosy.

The nutritive value of rice protein was investigated in continuation of the work on the vitamin content of foods.

The composition of alcoholic beverages in the Philippines was determined. Work on foods, beverages, and drugs is carried on continuously as a matter of the greatest public benefit.

The separation of a series of lauric acid derivatives from coconut oil was started and is being carried on. Coconut oil is one of the important exports of the Philippines.

Isolation of the alkaloids from derris root, which is sometimes used illegally as a poison for fish, is nearly completed.

Philippine black coral was made the material for an investigation as comparatively little has been published about this interesting substance.

The results of tests of gasoline marketed in the Philippines were summarized and discussed in a semipopular paper.

Researches were conducted on camphor and on eucalyptus oil prepared from Philippine trees. The purified substances were prepared, together with some derivatives, yields were determined, and comparisons made with the published results of similar work in other countries.

*Publications.*—During the year 1929 the following researches were published:

Relative vitamin A content of four Oriental foods, by H. E. Sherman.  
Relative content of water-soluble vitamin B in thirty Oriental foods, by H. E. Sherman.

Relative water-soluble vitamin C content of nine Oriental fruits and vegetables, by H. E. Sherman.

Certain proteins added to mung bean, or to white or red sorghum vulgare, increase the fertility of mice, by H. E. Sherman.

- Chemical analyses of thirty-seven Oriental foods, by H. E. Sherman and T. C. Wang.
- Calcium, iron, and magnesium content of sixteen Chinese foods, by H. E. Sherman and T. C. Wang.
- An alkaloidal constituent of *Artabotrys suaveolens* Blume, by Joaquin Marañon.
- Photomicrographs of Philippine starches, by R. N. Allen.
- Chaulmoogryl substituted phenols and chaulmoogryl hydroxy ethyl benzoate, by Irene de Santos and A. P. West.
- An aid in bending glass tubing in the laboratory, by R. N. Allen.
- Chaulmoogryl amino phenols and chaulmoogryl benzylamine, by Irene de Santos and A. P. West.
- Composition of Philippine coffee, by A. Valenzuela.
- Resins in the seed coats of Philippine chaulmoogra seeds (*Hydnocarpus alcalæ*), by Irene de Santos and A. P. West.
- Chaulmoogryl brom and chlor phenols, by Pura Santillan and A. P. West.
- Seguidillas bean, by F. Agcaoili.
- Composition of Philippine bagasse, by A. Valenzuela and A. P. West.

The following papers are in press:

- Water-white coconut oil and coconut flour, by A. O. Cruz and A. P. West.
- Philippine black coral, by R. N. Allen.
- Composition of some Philippine fruits, vegetables, and forage plants, by A. Valenzuela and P. J. Wester.
- Philippine camphor, by A. P. West and H. Taguibao.
- Statistics and tests of gasoline marketed in the Philippine Islands, by R. N. Allen.
- The vitamin contents of Philippine foods. I. Vitamins A and B in *Basella rubra*, *Capsicum frutescens*, and *Vigna sinensis*, by A. J. Hermano.
- Philippine eucalyptus oil, by H. Taguibao and A. P. West.
- Thiochaulmoogra compounds (thiochaulmoogramide, anilide, and toluides), by Irene de Santos and A. P. West.
- Analysis of Philippine lumbang oil, by A. O. Cruz and A. P. West.

#### FOOD PRESERVATION

*Personnel.*—Miss Maria Y. Orosa, chief of the division, has been absent abroad on a scholarship. The following were appointed senior demonstrators: Misses Angelina Fajardo, Lourdes S. Duterte, Natividad Brodeth, and Remedios M. de Ubago. Misses Cristeta Valensoy, Josefa M. Benitez, Sofia Reyes, Filomena Yulo, Magdalena Sevilla, Alice Casals, and Maria Concepcion Samson were appointed junior demonstrators. Misses Tarcila Abad, Remedios M. de Ubago, Magdalena Agcaoili,

Magdalena Sevilla, and Maxima Lumain resigned from the service.

*Coöperation.*—Coöperation was furnished the De Santos Fruit Packing Company, Banahaw, The Philippine Fruit Products, and a considerable number of small-factory owners in the provinces. Among the latter are Mrs. Amparo Gaston, of Silay, Occidental Negros; Miss Maria Elumba, of Surigao, Surigao; Mrs. Sabina Montelibano, of Bacolod, Occidental Negros; Mrs. Maria Fernandez, of Davao, Davao; Miss Pacita Santos, of Surigao, Surigao; Mrs. Matilde Gomez, of Calbayog, Samar; Mrs. Josefa Zialcita, of Maasin, Leyte; Mrs. Amalia Mercedes Tan, of Ormoc, Leyte; Mrs. Victoria Velez, of Palompon, Leyte; Mrs. Florentina Tengtio, of Romblon, Romblon; Mrs. Rosa Valencia, of Pontevedra, Capiz. There are many others who intend to go into the business.

Special conferences and lectures were given to private individuals regarding preserving jars, cans, sterilizer, sealing machines, and other utensils used for canning purposes.

Special lectures and demonstrations were given to help the domestic-science and home-economics teachers in the provinces and in Manila.

Many Government officials coöperated in the food-preservation campaign. Prizes were offered by high Government officials to women who prepared the best preserves. This has done much to arouse the people's interest.

The food-preservation division has participated in almost all the provincial carnivals and garden days. It is indeed very surprising to find how extensively food preservation is now being taught in the private and public schools.

*Routine work.*—The room of the food-preservation division is crowded with students every day. Prominent ladies and wives of high Government officials have come to learn the scientific method of preserving fruits and vegetables. Several have complained about the heat in the laboratory, but in spite of this, they never cease to come. About 1,757 women have taken lessons in the laboratory. This does not include the observers and excursionists from the different private and public schools who come during Saturdays to the laboratory. We also had some male students and it is gratifying to know that at present some of them are selling on a small scale.

*Field work.*—The demonstrators spent most of the time in the provinces, leaving two or three demonstrators in the central



office. Usually a senior and a junior demonstrator are sent together to a province to conduct the demonstration work. They stay in a province for several months, the length of stay depending upon the attendance and the cooperation given to them by the officials.

The following table shows the sixty towns in twelve provinces that were visited where 4,602 women took lessons from the demonstrators in the provinces:

*Provinces and municipalities visited by food-preservation demonstrators and the attendance at each place.*

Abra.	
Bangued .....	232
Bucay .....	388
Dolores .....	90
Lagangilang .....	232
Tayum .....	208
Bohol.	
Calape .....	45
Dimiao .....	80
Guindulman .....	50
Inabanga .....	21
Jagna .....	93
Loay .....	90
Maribojoc .....	31
Panglao .....	38
Tagbilaran .....	54
Tubigon .....	58
Ubay .....	24
Camarines Sur.	
Libmanan .....	33
Naga .....	307
Pamplona .....	29
Pasacao .....	78
San Fernando .....	72
Capiz.	
Dao .....	24
Dumalag .....	27
Pontevedra .....	24
Ilocos Sur.	
Cabugao .....	8
Lapog .....	16
Magsingal .....	31
Narvacan .....	176
Santa Maria .....	22
Santo Domingo .....	56
Sinait .....	22
Vigan .....	98

*Provinces and municipalities visited by food-preservation demonstrators  
and the attendance at each place—Continued.*

Iloilo.	
Miagao .....	22
Oton .....	30
Isabela.	
Angadanan .....	49
Cabagan .....	90
Cauayan .....	38
Echague .....	104
Naguilian .....	24
Tumauni .....	73
Marinduque.	
Boac and Mogpog .....	173
Gasán and Buenavista .....	60
Mindoro.	
Calapan .....	201
Naujan .....	74
Romblon.	
Odiongán, Tablas .....	81
Romblon .....	102
Sorsogon.	
Bulan .....	99
Bulusan .....	73
Casiguran .....	31
Gubat .....	76
Irosin .....	42
Juban .....	66
Sorsogon .....	74
Surigao.	
Bucuag .....	62
Guigaguit .....	85
Mainit .....	36
Placer .....	63
Surigao .....	71
Total .....	4,602

*Research.*—The demonstrators when in the provinces collect native recipes from the housewives. These recipes are of different types, and are tried in the central office. About five hundred seven recipes have been collected and tested. Those that are successful will be included in the pamphlet to be given to the public.

GEOLOGY AND MINES

*Personnel.*—Mr. A. D. Alvir, geologist, resigned on April 15. Mr. Quirico A. Abadilla was appointed temporary geologist

June 15. Mr. Abadilla graduated as Mining Engineer in 1920 from the Colorado School of Mines, and from 1920 to 1925 worked as plane-table engineer and later as geologist for the Compañía Mexicana de Petroleo El Aguila in Mexico, and from 1925 to 1928 as division geologist for the Lago Petroleum Corporation in Venezuela. His long experience in geological work makes him a valuable addition to the staff of the division. Mr. Antonio Loredó was appointed as scientific assistant on February 7, 1929.

*Coöperation.*—Through the kindness of Mrs. Ida S. Oldroyd, curator of the Stanford Conchological Museum, Stanford University, California, the Quadras collection of shells, which was sent to her in the early part of the year, has been compared, named, and labeled by her at very low cost. Mrs. Oldroyd was well qualified to undertake this work, as she had been employed from time to time for similar work by the University of California, the American Museum of Natural History, and the United States National Museum. The Bureau of Science now possesses very probably one of the best collections of shells in the Far East, consisting of over 13,000 species and over 50,000 specimens. The collection, which has been recently returned to the Bureau, is being catalogued and indexed so as to make the specimens available for study and research, and it is expected that in the course of two or three months the Bureau of Science will be prepared to identify with greater facility shell specimens that are brought to the Bureau by educational institutions and private collectors.

With the coöperation of the Bureau of Coast and Geodetic Survey a start has been made toward completing the coral collection with specimens having labels giving precise locality, depth and temperature of water, bottom material, and other allied data.

The trip of Dr. L. A. Faustino to Java as a member of the Philippine delegation to the Fourth Pacific Science Congress has been fruitful. By personal contact with other delegates a closer coöperation was established between the geological surveys of other countries around the Pacific and the Philippine Islands in the matter of geological mapping, revision of data with regard to mineral resources, systematic study of tropical weathering, and stratigraphic and palæontologic correlation. More literature

and specimens are now received from the different countries in exchange for our own material, and certain phases of geological work which we cannot undertake for lack of personnel may be studied by our colleagues abroad and the results made available for use in the Philippines.

In order to help parties interested in the development of the mining industry Mr. Abadilla made an examination of the lead and zinc prospects at Mount Colgan, Benguet, Mountain Province, and also of the gold prospects in the Angat region, Bulacan.

At the request of the Manila Electric Company Mr. V. Elicaño made a study of the feasibility of the proposed Botocan River hydroelectric development from the geological standpoint. In the course of this study an opportunity was taken to make a geological section between Luisiana, Laguna Province, and Mauban, Tayabas Province, since no information of the geology of the region is available except for a similar section made several years ago between Tanay, Rizal, and Infanta, Tayabas.

At the request of the Bureau of Health a geological reconnaissance of Culion Island was made by Mr. Alvir with the object of looking into the advisability of drilling artesian wells for irrigation purposes.

The Bureau of Public Works again this year set aside the amount of ₱3,600 to cover the field expenses incurred by the Bureau of Science in the investigation of underground-water resources of certain localities. This year the investigation of artesian-well sites in Camotes Islands, Cebu, was undertaken by Doctor Faustino; and with a similar object Mr. Abadilla made a geological study of the region around Calivo, Capiz.

The division has also extended its coöperation to the Bureau of Customs, College of Medicine, University of the Philippines, and the Philippine Mint in work requiring assays of jewelry samples, smelting and preparation of dental alloys, and the determination of silver in Philippine coins.

*Routine work.*—The routine work in the division consisted in the usual consultations on geological and mining subjects, the examination and identification of rocks, minerals, and fossils, the study of drilling samples from wells drilled by the Bureau of Public Works, and the regular work of assaying, smelting, refining, and drafting. The kind and amount of routine work in the assay laboratory consisted of the following:

	Samples.
Assays for gold only.	
Ores .....	405
Bullion .....	65
Old jewelry .....	2
Assays for gold and silver.	
Ores .....	33
Bullion .....	41
Jewelry .....	1
Assay for platinum: Ores .....	2
Assay for silver only.	
Silver drillings .....	117
Coins .....	31
Smelting and refining.	
Platinum waste .....	2
White-gold waste .....	2
Old jewelry .....	2
Dental alloy .....	1
Determination for gold or silver plating: Jewelry.....	13
Preparation of gold-plating solution.....	2
	<hr/>
Total .....	719
	<hr/> <hr/>

*Field work.*—The following field trips were made by the staff of the division for the purposes mentioned below:

Mr. V. Elicaño.

Collection of samples of quartz and quartzose sand in Lubang Island, Mindoro, March 9 and 10, accompanied by Mr. F. D. Reyes.

Study of the geology of the region in the neighborhood of the site of the Botocan River hydroelectric development project, March 18 to April 8, and November 9 and 10. Expenses paid by the Manila Electric Co.

Dr. L. A. Faustino.

Geologic investigation of earth fissure at Loay, Bohol, and investigation of artesian well sites in Camotes Island, Cebu, March 13 to 21. Expenses in connection with the latter work were paid by the Bureau of Public Works.

Attended the Fourth Pacific Science Congress in Java, April 27 to June 27.

Mr. A. D. Alvir.

Geologic reconnaissance of Culion Island, Palawan, March 2 to 24. Expenses paid by the Bureau of Health.

Mr. Q. A. Abadilla.

Examination of lead and zinc prospects in Baguio, Mountain Province, June 26 to July 3. Expenses paid by Mr. H. P. Whitmarsh.

Mr. Q. A. Abadilla.—Continued.

Examination of gold prospects in the Angat Mineral District, August 23 to 30.

Geologic reconnaissance of Calivo, Capiz, and vicinity, November 5 to December 11. Expenses paid by the Bureau of Public Works.

*Research.*—In addition to the geologic studies undertaken as a result of the various field trips made, Doctor Faustino has classified fossil specimens into family groups and localities and Mr. Abad has undertaken the petrographic study of Zambales rocks.

*Publications.*—The following articles were published:

Mayon Volcano and its eruptions, by L. A. Faustino.

A geological study of the Angat-Novaliches region, by A. D. Alvir.

Potable artesian water in Rizal Province, Luzon, by A. D. Alvir.

Mines and the mining industry, by L. A. Faustino and V. Elicaño; Engineering progress in the Philippines. (World Engineering Congress, Tokyo, Japan.)

Drilling on limestone reefs in Cebu, by L. A. Faustino. (Proc. Fourth Pac. Sc. Congress, Java.)

Living coral reefs of the Philippine Islands, by L. A. Faustino. (Proc. Fourth Pac. Sc. Congress, Java.)

The following articles are in press:

Antamokite, by A. D. Alvir.

Geology and underground-water resources of central Panay, by A. D. Alvir.

Summary of Philippine land shells, by L. A. Faustino.

The following manuscripts are completed:

Underground-water resources of the Ilocos Central Plain, by L. A. Faustino and J. M. Feliciano.

The coral reefs of the Philippine Islands, by L. A. Faustino.

The mineral resources of the Philippine Islands for 1926, 1927, and 1928, containing the following articles:

Statistics of mineral production in the Philippine Islands, by L. F. Abad.

General survey, by V. Elicaño.

The chromite deposits of Zambales, by V. Elicaño.

The Tumbaga gold mines, by A. D. Alvir and L. F. Abad.

The lead and zinc deposits of eastern Marinduque, by A. D. Alvir and L. F. Abad.

The Masbate mineral district in 1926, 1927, and 1928, by R. Abarquez.

The Angat mineral district, by Q. A. Abadilla.

Fuel minerals in 1926, 1927, and 1928, by L. A. Faustino.

Nonmetallic minerals in 1926, 1927, and 1928, by L. A. Faustino.

The Malangas coal field and the National Coal Company, by G. Russel, formerly general manager of the National Coal Company.

Mining legislation in 1926, 1927, and 1928.

LIBRARY

*Personnel.*—A number of changes were made in the library staff during the year. Mr. Cirilo B. Perez was appointed chief of the administration division and librarian April 1; Mr. Basilio Hernandez, assistant chief of the library division May 16; Miss Maxima C. Magsanoc, senior assistant librarian May 1; Miss Leonila Resurreccion, junior librarian Sept. 2; Miss Concepcion Banzon, junior librarian Oct. 2; Mr. Sergio P. Duque was retained as library apprentice.

*Accessions.*—There were 3,637 bound volumes added during the year; one volume was withdrawn, bringing the total number of bound volumes, on December 31, to 66,873. The number of unbound volumes, parts, and pamphlets added was 7,527, bringing the total number of unbound volumes, parts, and pamphlets to 53,136, after deducting those withdrawn for binding. Eighty maps and charts were added bringing the total number of maps and charts to 1,009.

The library has been fortunate in having been able to secure the back files of the following journals:

- Architectural Record 1-64 (1891-1928).
- International Sugar Journal 1-10 (1899-1909).
- Journal de Botanique 1-23 (1887-1913).
- Journal of Chemical Education 1-5 (1915-28).
- Revue Mycologique 1-28 (1879-1908).

*Book orders.*—Five requisitions for books amounting to an estimated cost of ₱4,804 were approved for direct purchase. Most of these books have been received.

*Cataloguing and classification.*—The record of the material classified and catalogued during the year is as follows:

Volumes .....	401
Pamphlets .....	1,130
Volumes in magazine binders.....	578
Continuation and serials .....	4,929

In addition to the above, analytic cards were prepared for 20 serials including 5 local periodicals. The number of cards added to the catalogue was 11,230, bringing the total number of cards to 175,045. There were about 14,000 cards for photographs typewritten, of which 9,500 have been filed.

*Periodicals.*—The record of current periodicals received by purchase, exchange, and gift compared with the record for 1928 is as follows:

	1928	1929
Periodicals received by—		
Purchase .....	454	454
Exchange .....	699	704
Gift .....	1,081	1,164
Total current periodicals .....	2,234	2,322

The above figures also include the annual reports, transactions, proceedings, and other serials of infrequent issue.

*Cuts.*—The number, care, and use of cuts were as follows:

On hand December 31, 1928.....	7,893
Added .....	371
On hand December 31, 1929.....	8,264
Prepared for the shelves .....	409
Circulated .....	38

*Binding.*—Two thousand books and periodicals were sent to the Bureau of Printing for binding; 3,269 volumes have been returned including 1,669 volumes reported at the bindery at the beginning of the year, leaving only 400 volumes on January 1, 1930. Of the binding work done in the library, 36 were bound in regular binding, 927 were provided with pamphlet binders and 578 with magazine binders. There were 282 folders and envelopes made and 440 books and pamphlets mended.

*Use of the library.*—The use of the library falls under two main heads; namely, the circulation of books and periodicals to readers in response to specific requests and the reference service which includes the aid rendered in the use of books, the answering of specific questions, and the search for material relating to certain subjects. In addition to the above, the library rendered another form of service which might be called extension work. During the year 1,503 notification cards (Bureau of Science Form No. 160) have been sent out to library patrons whose attention was called to articles of interest to them. It is very pleasing to report that almost all of the persons who received the above-mentioned notification cards either came to the library or sent for the material to which their attention was called. As usual, a quarterly list of books and other publications recently added to the library was issued and sent to patrons who make use of the library.



*Circulation.*—The total number of books and other publications recorded as circulated was 10,598. Publications were used in the library as follows:

Bound volumes .....	30,177
Serials .....	25,192
Pamphlets .....	930
Total .....	56,299

The above figures were based only on the number of publications actually found on the tables as noted at the close of every working day and do not include numerous publications that were returned to the shelves immediately after their use. The total number of registered attendance during the year was 24,910, an increase of more than 10,000, over the attendance for the previous year.

*Reference and bibliographic service.*—The reference questions received in 1929 show the usual wide variety of subjects. There were 290 inquiries attended to that required some search. In addition, ten inquiries from China, eight from the United States, one from India, one from Germany, one from Australia, and eighty-one from twenty-three provinces in the Philippines were answered by letter. The above figures do not include numerous inquiries received by telephone as well as those of the students from the high schools, colleges, and universities in Manila that could be answered by the catalogue and ready reference books.

Twenty-four reference lists consisting of 195 typewritten pages on the following subjects were compiled and copies furnished those who requested them:

- Irrigation in Australia, China, Indo-China, Japan, Java, Siam, South Africa, and the United States of America.
- History of education in the Philippines.
- Catalase activity of the leaves of plants.
- Cold storage of fruits.
- Manuring of coconuts.
- Experimental, serodiagnosis, and treatment of syphilis.
- Food and nutrition in the Philippines.
- Coffee.
- Intussusception with special reference to intestinal and gastric intussusception.
- Replaceable bases in soils.
- Camphor.
- Corn mold, *Fusarium moniliforme*.
- Castor bean or castor-oil plant.
- Betel leaf and betel-nut industry.

Duck industry in the Philippines with special reference to the balut industry.

Preservation of meat with special reference to pork and sausage making.

Published writings of some deceased Filipino masters of medicine and pharmacy.

Eucalyptus.

Eugenics.

Published scientific contributions of the alumni of the College of Veterinary Science, University of the Philippines.

Of our bibliographic undertakings mention should be made of the compilation by the cataloguer of the list of current periodicals in the library on astronomy and physics and on geology, mining, metallurgy, and allied subjects.

*Coöperation.*—The library coöperated with the Department of Library Science of the University of the Philippines by attending to its twenty-three students who were assigned to practice in the library. As usual, requests from the College of Agriculture Library, Culion Leper Colony, and the biological laboratories in Iloilo and Cebu received our immediate attention.

#### PUBLICATIONS

*Personnel.*—Miss Winifred I. Kelly, chief editorial clerk, resigned March 11. Miss Dorothy Boozer, copy editor, resigned December 4.

*The Philippine Journal of Science.*—The Philippine Journal of Science was published monthly, in three volumes for the year. Each volume consists of four numbers and is separately pagged and indexed.

The following table shows the number of pages, plates, and text figures contained in Volumes 38, 39, and 40:

	Volume 38, January to April 1929.	Volume 39, May to August 1929.	Volume 40, September to Decem- ber, 1929.	Total.
Pages.....	525	416	563	1,504
Plates.....	84	70	100	254
Text figures.....	94	7	23	124

In the following table is shown the distribution according to continents of subscribers, exchanges, reviews, and free copies of the Philippine Journal of Science. These figures show that the Journal is widely distributed to scientific institutions in all parts of the world.

	Paid sub- scrip- tions.	Ex- changes.	Review sub- scrip- tions.	Free.	Total.
Philippines.....	28	14		48	90
Asia, excluding the Philippines.....	87	110	1	1	199
Europe.....	24	244	22	1	291
North America.....	87	226	11	21	345
South America.....	10	21			31
Africa.....	12	21			33
Australia and neighboring islands.....	10	38			48
Total.....	258	674	34	71	1,037

The number for January, 1930, was issued in December; page proof for the February number and galley proof for the March number were returned to the printer; galley proof for the April number was received from the printer by the close of the year; and copy for the numbers for May and June, 1930, has been sent to the printer.

The following are the titles and the names of authors of the papers published in the Philippine Journal of Science during 1929:

VOLUME 38, JANUARY TO APRIL

*No. 1, January, 1929*

- SHERMAN, HARTLEY EMBREY. Relative vitamin A content of four Oriental foods.
- SHERMAN, HARTLEY EMBREY. Relative content of water-soluble vitamin B in thirty Oriental foods.
- SHERMAN, HARTLEY EMBREY. Relative water-soluble vitamin C content of nine Oriental fruits and vegetables.
- SHERMAN, HARTLEY EMBREY. Certain proteins added to mung bean, or to white or red Sorghum vulgare, increase the fertility of mice.
- SHERMAN, HARTLEY EMBREY, and TSAN CH'ING WANG. Chemical analyses of thirty-seven Oriental foods.
- SHERMAN, HARTLEY EMBREY, and TSAN CH'ING WANG. Calcium, iron, and magnesium content of sixteen Chinese foods.
- NAÑAGAS, JUAN C. A study on the cranial capacity of Filipinos.
- HERRE, ALBERT W. An American cyprinodont in Philippine salt ponds.
- COPELAND, E. B. New or interesting ferns.

*No. 2, February, 1929*

- ALEXANDER, CHARLES P. Tipuloidea of the Tongariro National Park and Ohakune district, New Zealand (Diptera).
- ROXAS, HILARIO A. Sex studies on Philippine frogs and toads, I. Male intersexuality in *Rana vittigera* Weigmann.
- GERICKE, W. F. Some relations of maintained temperatures to germination and the early growth of wheat in nutrient solutions.
- ALLEN, RAY N. Photomicrographs of Philippine starches.

*No. 3, March, 1929*

- MARAÑON, JOAQUIN M. An alkaloidal constituent of *Artabotrys suaveolens* Blume.
- SANTOS, JOSÉ K. Histological and microchemical studies on the bark and leaf of *Artabotrys suaveolens* Blume from the Philippines.
- SKVORTZOW, B. W. Fresh-water diatoms from Korea, Japan.
- SANTOS, IRENE DE, and AUGUSTUS P. WEST. Chaulmoogryl substituted phenols and chaulmoogryl hydroxy ethyl benzoate.
- ALLEN, RAY N. An aid in bending glass tubing in the laboratory.
- BLATTNY, CTIBOR. Fauna Philippinica, *Scydmaenidæ*, Coleoptera.
- KRÖBER, O. Thereviden (Diptera) von den Philippinen, aus Japan und Formosa.
- BERNHAEUER, MAX. Die Staphyliniden der Philippinen. 25. Beitrag zur indo-malayischen Staphyliniden-Fauna.
- FELICIANO, JOSÉ M. Concretions in water-laid tuff in the Philippine Islands.

*No. 4, April, 1929*

- REYES, F. D., and A. O. CRUZ. Cogon and rice straw as raw material for paper manufacture.
- COPELAND, EDWIN BINGHAM. The fern genus *Plagiogyria*.
- SKVORTZOW, B. W. Marine diatoms from Dairen, South Manchuria.
- MANALANG, C. The buccopharyngeal armature of Philippine anophelines.
- MANALANG, C. Report of a case of rhinosporidiosis.
- TUBANGUI, MARCOS A. *Paradistomum gregarinum*, a new name for the trematode *Paradistomum magnum*.
- SANTOS, IRENE DE, and AUGUSTUS P. WEST. Chaulmoogryl amino phenols and chaulmoogryl benzylamine.
- HERRE, ALBERT W., and JOSÉ MENDOZA. Bañgos culture in the Philippine Islands.

INDEX.

VOLUME 39, MAY TO AUGUST

*Nos. 1-4, May-August, 1929*

- MCKINLEY, EARL BALDWIN. Filterable virus and rickettsia diseases.
- INDEX.

VOLUME 40, SEPTEMBER TO DECEMBER

*No. 1, September, 1929*

- FAUSTINO, LEOPOLDO A. Mayon Volcano and its eruptions.
- TANABE, B. Note on the duration of immunity to yaws in Philippine monkeys.
- SCHÖBL, OTTO. Serologic studies in experimental yaws.
- SCHÖBL, OTTO, and BUNSHIRO TANABE. Experiments concerning the yaws antigen which produces positive Wassermann reaction when injected in suitable experimental animals.
- MIYAO, ISAO. Is the Wassermann reaction provoked in Philippine monkeys by yaws vaccination specific?

- MIYAO, ISAO. Following the subcutaneous immunization with yaws vaccine is the skin tissue proper responsible for the production of Wassermann reagin or do other tissues also participate?
- GARCIA, ONOFRE. The relation of the Wassermann and Kahn reactions with regard to treponema antigen.
- SCHÖBL, OTTO. Summary of serologic studies in experimental yaws.
- SCHÖBL, OTTO, and ISAO MIYAO. Immunologic relation between yaws and syphilis.
- FUNKHOUSER, W. D. New archipelagic Membracidæ.

*No. 2, October, 1929*

- COPELAND, HERBERT F. Philippine Ericaceæ, I: The species of Rhododendron.
- MERRILL, ELMER D. A new Philippine species of Chloris.
- BENNETT, A. Notes on potamogetons.
- ROXAS, MANUEL L. The manufacture of sugar from nipa sap.
- HERRE, ALBERT W. Description of a new Philippine shark.
- CUSHMAN, R. A. Baker's Entomologica Malayana: The braconid genera Fornicia Brullé and Odontofornicia Enderlein.
- ALEXANDER, CHARLES P. New or little-known Tipulidæ from the Philippines (Diptera), V.
- VALENZUELA, ABELARDO, and AUGUSTUS P. WEST. Composition of Philippine bagasse.
- SCHÖBL, OTTO. Laboratory testing of germicides and chemotherapeutic agents.

*No. 3, November, 1929*

- COPELAND, EDWIN BINGHAM. New or interesting Philippine ferns, VII.
- ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), IV.
- VALENZUELA, ABELARDO. Composition of Philippine coffee.
- LARA, HILARIO, and CARMELO REYES. Effect of splenectomy upon the production of antibodies in dogs.
- ALVIR, A. D. A geological study of the Angat-Novaliches region.

*No. 4, December, 1929*

- LIGHT, S. F. Notes on Philippine termites, III.
- KREKICH-STRASSOLD, H. Die Anthiciden der Philippinen, II.
- SANTOS, IRENE DE, and AUGUSTUS P. WEST. Resins in the seed coats of Philippine chaulmoogra seeds (Hydnocarpus alcalæ).
- SANTILLAN, PURA, and AUGUSTUS P. WEST. Chaulmoogryl brom and chlor phenols.
- COLE, HOWARD IRVING. The constituents of Hydnocarpus wightiana oil, I.
- COLE, HOWARD IRVING. Reduction of irritation by iodized ethyl esters of Hydnocarpus wightiana oil.
- AGCAOILI, F. Seguidillas bean.
- MUNDO, SALVADOR DEL. An inexpensive method for improving the appearance of buntal fiber or of articles made of such material.

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), V.

ERRATA.

INDEX.

*Monographs.*—Monograph 26, Second Ten-year Index, The Philippine Journal of Science, Volume 11 (1916) to Volume 28 (1925), is in galley proof.

Monograph 27, Filterable Virus and Rickettsia Diseases, by Earl B. McKinley, was issued December 31.

*Annual reports.*—The Twenty-sixth and Twenty-seventh Annual Reports of the Bureau, for 1927 and 1928, respectively, were issued during 1929.

*Popular bulletins.*—Popular Bulletin 5, Bañgos Culture in the Philippine Islands, by Albert W. Herre and Jose Mendoza, was sent to the printer.

*Miscellaneous work.*—Two hundred forty-six printing jobs, including labels for various divisions of the Bureau, forms, envelopes, etc., for most of which it was necessary to read proof, passed through the publications division.

Respectfully submitted,

WILLIAM H. BROWN,  
*Director, Bureau of Science.*

To the Honorable  
The SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.

Subdivision of the Bureau of Science.	Cash work.			Free work.				
	Samples or units.		Pesos.	Samples or units.		Pesos.		
	1928	1929	1928	1929	1928	1929		
General, inorganic, and physical chemistry:								
Metals and alloys.....	22	24	275.00	267.00	29	20	382.00	256.00
Rocks, minerals, natural pigments, and similar substances.....	42	40	342.00	464.00	7	22	85.00	251.00
Clays, shales, limestones, limes, wall plasters, and slugs.....	27	24	290.00	188.00	2	2	20.00	10.00
Coal analyses.....	29	27	1,000.00	902.00	47	* 108,755	1,645.00	* 9,540.43
Oil analyses.....	2	5	48.00	135.00	38	31	505.00	408.00
Paints and varnishes.....	12	13	286.00	271.00	34	43	662.00	911.00
Waters.....	97	91	2,506.00	2,175.00	249	258	4,312.00	4,659.00
Crude chemical and miscellaneous analyses.....	56	48	1,083.00	330.00	4	1	71.00	2.00
Standard solutions.....	17	16	82.00	66.39				
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	102	89	509.00	348.00	54	53	186.00	287.00
Cements.....	3,515	1,670	5,530.95	2,372.40	14,111	19,627	18,498.40	25,960.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	5,974	7,691	8,358.00	9,925.00	3,752	5,296	4,187.00	5,474.00

\* This figure is different from that in last year's report; the charge on coal analysis to Manila Railroad Co. was computed at the rate of ₱0.08 per ton analyzed.

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivision of the Bureau of Science.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
General, inorganic, and physical chemistry—Ctd.								
Standardization and correction of units of measure—								
Length.....	21	7	31.50	10.50	23	27	34.50	40.50
Capacity.....	65	11	169.00	70.00	25	20	50.00	40.00
Weight.....	129	28	392.00	206.50	6	135	126.00	257.00
Other measures.....		30		62.00				
Miscellaneous inorganic work and analyses.....	33	24	309.00	180.20	58	104	1,263.00	372.00
Total.....	10,143	9,838	21,211.45	17,972.99	18,439	134,394	32,026.90	48,468.73
Soils and fertilizers:								
Soil analyses.....	13	6	417.00	97.00	63	46	1,967.00	956.00
Commercial fertilizers.....	89	42	805.00	279.00		5		20.00
Guano, copra cake, ashes, and similar materials.....	37	47	258.00	343.00	38	23	334.00	316.00
Insecticide, fungicide, sea-water tests, and other miscellaneous analyses.....	77	111	216.00	256.00	8	19	46.00	74.00
Fertilizer tags sold (less cost of printing).....	264,091	178,374	6,406.64	5,351.22				
Registration of fertilizers.....	15	17	750.00	850.00				
Total.....	264,322	178,597	8,852.64	7,176.22	109	93	2,347.00	1,366.00
Organic chemistry:								
Toxicological analyses.....	3	5	115.00	160.00	26	19	1,305.00	1,700.00
Essential oils and essences.....	3	2	30.00	30.00		1		10.00



Petroleum products.....	709	118	5,102.75	1,282.00	27	6	52.00
Vegetable oils and copra products.....		733	4,401.50			21	147.00
Varnishes, linseed oils, and waxes.....		21	268.00		8	13	224.00
Gums, resins, and similar materials.....	1		5.00				
Papers, textiles, and similar materials.....	2		10.00				
Foods, alcohols, and beverages.....	519	545	2,742.50	2,986.00	9,048	10,409	123,244.00
Food preservatives and coloring matters.....	5	3	26.00	12.00	31	15	160.00
Medicines and similar articles.....	19	26	182.00	335.00	527	1,489	8,893.00
Tikritki extract.....	3,420	3,260	2,394.00	2,294.30	51,893	41,892	36,325.10
Miscellaneous organic analyses and examinations.....	9	2	136.00	4.00	12	14	96.00
<b>Total.....</b>	<b>4,690</b>	<b>4,715</b>	<b>10,743.25</b>	<b>11,772.80</b>	<b>61,572</b>	<b>53,379</b>	<b>173,717.40</b>
<b>Mines:</b>							
Assays.....	180	532	755.00	1,564.00	23	122	604.00
Smelting and refining of gold and other precious metals.....	13,523	6,010	606.98	359.64	118	387	68.05
Drafting.....	2	7	1.50	17.62			
<b>Total.....</b>	<b>13,705</b>	<b>6,549</b>	<b>1,363.48</b>	<b>1,941.26</b>	<b>141</b>	<b>509</b>	<b>672.05</b>
<b>Biological laboratory:</b>							
Faeces.....	75	75	231.70	253.34	49,614	54,576	484,874.50
Sputum.....	33	40	99.00	116.00	936	1,384	2,808.00
Blood.....	13	52	68.67	312.00	780	1,230	7,117.00
Diphtheria.....	4	9	20.00	43.33	1,610	576	8,050.00
Widal tests.....	14	13	46.38	38.00	146	442	438.00
Wassermann and Kahn tests.....	59	72	595.00	800.00	2,071	2,271	20,710.00
Leprosy.....	1	1	3.00	3.00	22	19	66.00
Urinæ.....	225	284	837.77	1,104.70	4,739	9,001	23,482.00
Gonococci.....	6	14	18.00	42.00	262	359	786.00
Waters, biological.....	15	66	150.00	655.00	6,437	8,940	64,365.00
Histological examinations.....	1	7	10.00	70.00	47	100	470.00
Rats for plague.....					51,601	51,000	206,404.00
Rabies.....	1		10.00		10	9	100.00
Ice creams, milk, soft drinks, etc.....	7	31	165.00	65.00	3,298	5,688	32,818.00
<b>Cebu biological laboratory.....</b>	<b>475</b>	<b>316</b>	<b>1,570.12</b>	<b>1,536.43</b>	<b>3,796</b>	<b>4,324</b>	<b>14,606.00</b>

TABLE 1.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged by subdivisions of the Bureau of Science—Continued.

Subdivision of the Bureau of Science.	Cash work.			Free work.		
	Samples or units.	Pesos.	Samples or units.	Pesos.		
	1928	1929	1928	1929	1928	1929
Biological laboratory—Continued.						
Holio biological laboratory.....	865	851	3,505.10	4,084.70	9,090	7,098
Miscellaneous biological examinations.....		27	184.00			8,406
Total.....	1,794	1,858	7,389.74	9,257.50	134,459	155,423
Serum section of the biological laboratory:						
Autogenous vaccine..... ampules.....	1,020	1,427	954.02	1,341.70	60	20
Vaccine virus (fresh)..... units.....		2,025,237	21,502.40			
Vaccine virus (dried)..... do.....	3,403,651	1,247,600	72,978.80	49,904.00		1
Dysentery vaccine..... ampules and cc.....		240,239	48,325.50			1,564,025
Cholera vaccine..... do.....		77,729	14,985.30			376,000
Typhoid and paratyphoid A and B vaccine..... ampules.....		1,108	557.40			242,003
Combined cholera, typhoid, and paratyphoid vaccine..... ampules and cc.....		684,899	137,189.40			1,880,000
Streptococcus and Staphylococcus albus and aureus vaccine..... ampules.....	1,236,206		224,399.82		2,558,932	
Antitetanic serum..... do.....		890	542.60			1
Antidysenteric serum..... do.....		6,110	12,066.00			
Normal horse serum..... do.....		11,125	17,042.80			10,304
Miscellaneous serums and vaccines..... ampules, cc, and units.....		1,143	1,287.60			
Total.....		1,865	1,392.60			517,444.00
Total.....	4,640,877	4,299,372	298,332.64	306,157.80	2,558,992	4,072,354
					517,504.00	822,734.50

Miscellaneous:								
Photographic work.....	3,539	3,294	1,280.30	1,809.65	536	671	175.60	853.60
Natural-history specimens	67	33	496.50	211.50				
Shop work.....	1	3	15.00	17.00				
Aquarium tickets, postcards, etc.			3,607.30	5,055.60				
Supplies and equipment.....	10,532	8,072	4,086.09	2,782.12				
Sales of publications.....			3,184.93	4,917.01				
Refunded, work not done, etc. (deducted)			(66.10)	(258.90)				
Fines of employees and forfeitures of salaries, credit adjustment prior year expense.....			447.90	12,992.93				
Power, steam, etc.....			27,324.80	27,659.06				
Miscellaneous income.....				258.10				
Total.....	14,189	11,402	40,376.72	55,444.07	536	671	175.60	853.60
Grand total.....	4,949,670	4,512,331	388,269.92	409,722.14	2,774,248	4,416,823	1,869,369.02	2,144,641.28

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
Bureau of Agriculture:								
Waters, chemical.....					4		100.00	
Standard solutions.....	6		18.00					
Clays, shales, limestones, limes, wall plasters, and slugs.....					1		10.00	
Soil analyses.....					60	42	1,890.00	880.00
Guano, copra cake, ashes, and similar materials.....					38	20	384.00	292.00
Fooda, alcohols, and beverages.....					147	211	1,867.00	2,983.00
Commercial fertilizers.....						5		20.00
Vegetable oils and copra products.....						21		147.00
Miscellaneous organic analyses and examinations.....						11		66.00
Antitetanic serum.....		74		148.00				
Miscellaneous serums and vaccines.....doses	31		62.00		2		4.00	
Photographic work.....	114	85	26.80	49.80		6		24.00
Supplies and equipment.....	76	620	4.15	41.25				
Total.....	227	779	110.95	239.05	252	316	4,205.00	4,362.00
Bureau of Audits:								
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....					14		14.00	
Sea-water damage test.....						1		2.00

Petroleum and copra products and similar materials.....	8		264.00	
Miscellaneous inorganic analyses.....	78		5.00	
Medicines and similar articles.....	5		100.00	
Miscellaneous biological examinations.....	3		150.00	
Total.....	22	87	278.00	257.00
Bureau of Coast Surveys:				
Waters, chemical.....	37	1	148.00	4.00
Miscellaneous inorganic work and analyses.....	1		5.00	
Varnishes and linseed oils.....	1		25.00	
Tikitiki extract.....	60		42.00	
Total.....	60	39	178.00	4.00
Bureau of Commerce and Industry:				
Petroleum and copra products and similar materials.....	5		44.00	
Guano.....		2	16.00	
Photographic work.....	106		21.50	
Total.....	106	2	44.00	16.00
Bureau of Customs:				
Metals and alloys.....		2		27.00
Rocks, ores, minerals, natural pigments, and similar substances.....		8		16.00
Standard solution..... liters	1		3.00	
Physical test of wire, twine, fibers, textiles, papers, and similar articles.....		4		19.00
Paints and varnishes.....	1		3.00	
Waters, chemical.....	1		4.00	
Varnishes and linseed oils.....	1		5.00	
Miscellaneous organic analyses and examinations.....	3		20.00	
Essential oils and essences.....		1		10.00
Petroleum products.....	5	3	95.00	34.00
Foods, alcohols, and beverages.....	7	10	115.00	75.00

## THE BUREAU OF SCIENCE

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
Bureau of Customs—Continued.								
Assays.....								
Supplies and equipment.....	4	4	0.30	0.20	5	11	20.00	49.00
Medicines and similar articles.....					109	702	565.00	3,580.00
Waters, biological.....					56		560.00	
Photographic work.....	50		10.30					
Total.....	54	5	10.60	3.20	188	741	1,387.00	3,760.00
Bureau of Education:								
Waters, chemical.....						1		25.00
Soil analyses.....					3	4	77.00	76.00
Waters, biological.....						1		10.00
Photographic work.....	53	21	10.90	5.40				
Supplies and equipment.....	16	39	50.67	136.00				
Antitetanic serum..... ampules		5		10.00				
Total.....	69	65	61.57	151.40	3	6	77.00	111.00
Bureau of Forestry:								
Rocks, ores, minerals, natural pigments, and similar substances.....						1		5.00
Clays, shales, limestones, limes, wall plasters, and slags.....						2		10.00
Waters, chemical.....						1		20.00
Guano.....						1		8.00

Petroleum products.....	114	394	22.54	112.80	1	11.00
Photographic work.....	114	334	22.54	112.80	6	54.00
Total.....						
Bureau of Internal Revenue: Standardization and correction of units of measure—						
Length.....		14			25	21.00
Capacity.....					20	40.00
Weight.....					125	205.00
Petroleum products.....		1			1	4.00
Foods, alcohols, and beverages.....		9			3	2.00
Medicines and similar articles.....		24			174	130.00
Total.....						814.50
Bureau of Justice:						
Toxicological analyses.....					2	200.00
Photographic work.....	18	71	16.00	83.40		
Medicines and similar articles.....					5	70.00
Blood.....					1	2
Miscellaneous biological examinations.....					2	75.00
Total.....	18	71	16.00	83.40	6	12
Bureau of Labor:						
Supplies and equipment.....	2		10.00			
Bureau of Lands:						
Supplies and equipment.....		12		18.00		
Bureau of Non-Christian Tribes:						
Rocks, minerals, natural pigments, and similar substances.....					2	20.00
Waters, chemical.....					2	50.00
Photographic work.....	44	3	18.40	1.60		
Total.....	44	3	18.40	1.60	4	70.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
Bureau of Posts:								
Metals and alloys.....					4			55.00
Miscellaneous inorganic work and analyses.....					1		30.00	60.00
Photographic work.....		9		6.00				
Total.....		9		6.00	1	6	30.00	115.00
Bureau of Printing:								
Metals and alloys.....					6		95.00	
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....					6		60.00	
Smelting and refining of gold and other precious metals.....grams.....					118		16.42	
Total.....					130		171.42	
Bureau of Prisons:								
Waters, chemical.....					1			30.00
Foods, alcohols, and beverages.....					5		175.00	
Feces.....					39			195.00
Diphtheria.....					1			5.00
Widal tests.....					6		6.00	18.00
Wassermann and Kahn tests.....					345		3,450.00	1,430.00
Waters, biological.....					5	9	50.00	95.00



			3	1	11.00	12.00
Miscellaneous biological examinations.....			60		60.00	
Autogenous vaccine..... ampules						
Vaccine virus, fresh.....	8,800	88.00				
Vaccine virus, dried.....	100	4.00				
Dysentery vaccine..... ampules and cc.	5,500	1,100.00				
Streptococcus and Staphylococcus albus and aureus vaccine..... ampules	1	.40				
Antitetanic serum..... do.	102	204.00				
Antidysenteric serum..... do.	125	125.00				
Normal horse serum..... do.	35	35.00				
Miscellaneous serums and vaccines..... ampules, cc. and units	150	75.00				
<b>Total.....</b>	<b>10,469</b>	<b>14,813</b>	<b>494.50</b>	<b>420</b>	<b>3,752.00</b>	<b>1,785.00</b>
<b>Bureau of Public Works:</b>						
Metals and alloys.....	5	20.00		1		5.00
Paints and varnishes.....				4	191.00	48.00
Waters, chemical.....	34	810.00	970.00	104	2,600.00	2,254.00
Cements.....	1,547	4,763.20	2,010.40	106	1,060	1,342.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	4,107	5,787.00	4,926.00	3,730	5,285	4,093.00
Miscellaneous inorganic work and analyses.....	1		12.00			5,410.00
Waters, biological.....	8		80.00	1	20	10.00
Supplies and equipment.....	6		18.00			200.00
Roofing materials.....			65.00	3	3	22.00
Petroleum products.....	13			1		12.00
<b>Total.....</b>	<b>7,175</b>	<b>5,215</b>	<b>11,425.20</b>	<b>3,949</b>	<b>6,461</b>	<b>7,055.20</b>
<b>Bureau of Quarantine Service:</b>						
Crude chemical and miscellaneous analyses.....				1		2.00
Faeces.....				9,923	9,160	49,615.00
Wassermann and Kahn tests.....				2	4	20.00
Waters, biological.....				1		10.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage.—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
Bureau of Quarantine Service—Continued.								
Rats for plague.....								
Urine.....					677	431	2,708.00	1,724.00
Miscellaneous biological examinations.....						1		4.00
Vaccine virus, fresh..... units.....	15,000	17,000	150.00	170.00		6,954		34,760.00
Dysentery vaccine..... ampules and cc.....	228	100	78.00	20.00				
Antitetanic serum..... ampules.....		30		60.00				
Supplies and equipment.....	15	15	0.75	0.75				
Total.....	15,243	17,145	228.75	250.75	10,603	16,551	52,353.00	88,121.00
Bureau of Supply:								
Metals and alloys.....	4	1	50.00	19.00	6	5	49.00	34.00
Rocks, minerals, natural pigments, and similar substances.....					4	12	65.00	225.00
Clays, shales, limestones, limes, wall plasters, and slugs.....	1		10.00		1		10.00	
Coal analyses.....					21	25	735.00	875.00
Paints and varnishes.....		3		28.00	13	39	205.00	327.00
Waters, chemical.....					1	4	25.00	100.00
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	45	30	315.00	84.00	22	37	67.00	189.00
Cements.....	435	105	586.00	128.00	13,584	18,387	17,974.00	24,402.80

Standardization and correction of units of measure—

Length.....				9		13.50		8.00
Capacity.....				25		50.00		
Weight.....				1		1.00		
Other measures.....	1		5.00					
Miscellaneous inorganic work and analyses.....				50	24	1,209.00		307.00
Petroleum products.....					1			5.00
Vegetable oils and copra products.....	8	5	89.00	3		74.00		
Foods, alcohols, and beverages.....	5	10	75.00	2	3	24.00		36.00
Medicines and similar articles.....	1		10.00		48			970.00
Tikihiki extract.....	757	300	529.90					
Waters, biological.....				4			40.00	
Roofing materials.....				5	15		24.00	60.00
Varnishes, linseed oils, and waxes.....				5	13		88.00	224.00
Miscellaneous biological.....				2	1		100.00	50.00
Combined cholera-typhoid and paratyphoid vaccine.....								
.....ampules and cc.....	30		12.00					
Antitetanic serum.....	56		231.00					
.....ampules.....	320	8	8.00					
Antidyenteric serum.....		13	457.00					
Supplies and equipment.....	184		79.00					
Total.....	1,759	563	2,342.90	13,759	18,616	20,753.50		28,807.80

Bureau of the Treasury:								
Standardization and correction of measures of weight.....					7			7.00

Executive Bureau:								
Toxicological analyses.....				1		75.00		
Foods, alcohols, and beverages.....				1		60.00		
Medicines and similar articles.....				1		5.00		
Photographic work.....	22		4.93					
Supplies and equipment.....		1	0.50					
Total.....	22	1	4.93	3		140.00		

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
Philippine Constabulary:								
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel.....					3		15.00	
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....					10	9	48.00	58.00
Medicines and similar articles.....					1	2	20.00	10.00
Toxicological analyses.....					9	7	275.00	600.00
Miscellaneous organic work and examinations.....						1		10.00
Blood.....					9	22	675.00	1,650.00
Water, biological.....						1		10.00
Vaccine virus, fresh.....	4,700	3,000	47.00	30.00				
Dysentery vaccine..... ampules and cc.....		2,200		440.00				
Streptococcus and Staphylococcus albus and aureus vaccine..... ampules.....	738	6	186.00	2.40				
Antitetanic serum..... do.....		24		48.00				
Antidysenteric serum..... do.....		30		30.00				
Supplies and equipment.....	360	180	18.00	9.00				
Total.....	5,798	5,440	251.00	559.40	32	42	1,028.00	2,338.00

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Philippine Health Service:						
Waters, chemical		92	150	1,295.00		1,998.00
Toxicological analyses		13	10	730.00		900.00
Foods, alcohols, and beverages		8,879	10,181	109,640.00		120,158.00
Food preservatives and coloring matters		31	15	310.00		150.00
Medicines and similar articles		14	11	278.00		175.00
Physical tests of wire, twine, fibers, textiles, papers, and similar articles		2		2.00		
Tilitiki extract	bottles		100		70.00	
Vegetable oils and copra products		2		34.00		
Varnishes and linseed oils		1		14.00		
Feces		38,045	42,542	653,775.00		425,638.00
Sputum		116	179	348.00		537.00
Blood		7	10	177.00		30.00
Diphtheria		1,595	448	7,975.00		2,240.00
Widal tests		16	18	48.00		54.00
Wassermann and Kahn tests		526	140	5,260.00		1,400.00
Leprosy		19		57.00		
Urine		213	282	852.00		1,162.00
Gonococci						
Waters, biological		5,111	6,461	51,105.00		76,225.00
Histological examinations		8	1	80.00		10.00
Rats for plague		50,924	50,463	203,696.00		201,852.00
Rabies		2	1	20.00		10.00
Milk, ice cream, and soft drinks			5,622			85,969.00
Miscellaneous biological examinations		3,186	1,267	31,835.00		8,414.00
Autogenous vaccine	ampules		20		20.00	
Vaccine virus, fresh	units			1,967,900	19,679.00	
Vaccine virus, dried	do.			1,247,500	49,900.00	

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	1928	1929	1928	1929	1928	1929	1928	1929
	Samples or units.	Pesos.	1928	1929	1928	1929	1928	1929
<b>Philippine Health Service—Continued.</b>								
Dysentery vaccine.....ampules and cc.	230,980	46,196.00				1,564,020		312,804.00
Cholera vaccine.....do.	60,000	12,000.00				376,000		75,200.00
Typhoid and paratyphoid A and B vaccines.....ampules						242,000		48,400.00
Combined cholera, typhoid, and paratyphoid vaccine.....ampules and cc.	684,250	136,850.00				1,860,000		376,000.00
Streptococcus and Staphylococcus albus and aureus vaccines.....ampules	1,184,690	198,819.50			2,556,840		517,008.00	
Antitetanic serum.....do.	225	90.00						
Antidysenteric serum.....do.	2,166	4,332.00						
Normal horse serum.....do.	283	250.00				10,304		10,304.00
Miscellaneous serums and vaccines.....ampules, cc, and units	236	117.50						
Photographic work.....	313	157.08						
Supplies and equipment	202	30.00						
<b>Total.....</b>	<b>4,535,225</b>	<b>4,194,215</b>	<b>270,026.58</b>	<b>270,037.96</b>	<b>2,665,642</b>	<b>4,190,126</b>	<b>1,584,589.00</b>	<b>1,749,680.00</b>
<b>Philippine General Hospital:</b>								
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel					4			20.00
Petroleum and copra products and similar materials.....					1			8.00

Tikiki extract..... bottles.....				1,150	950	805.00	665.00
Foods, alcohols, and beverages.....				5	1	60.00	12.00
Medicines and similar articles.....					2		20.00
Vaccine virus, fresh..... units.....	10	1	1.00	0.10			
Typhoid and paratyphoid A and B vaccines..... ampules.....		330		132.00			
Antitoxic serum..... do.....		2,255		4,510.00			
Antidysenteric serum..... do.....	2,559		3,554.90				
Normal horse serum..... do.....		575		575.00			
Photographic work.....				586	665	175.60	829.60
<b>Total.....</b>	<b>2,569</b>	<b>5,466</b>	<b>3,555.90</b>	<b>7,522.10</b>	<b>1,686</b>	<b>1,068.60</b>	<b>1,526.60</b>
<b>City of Manila:</b>							
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	295	223	382.00	295.00		225.00	
Toxicological analyses.....					3		
Foods, alcohols, and beverages.....					2	20.00	
Medicines and similar articles.....					3	60.00	20.00
Miscellaneous organic analyses and examinations.....	1		10.00		9	90.00	20.00
Blood.....					4		800.00
Rabies.....					1	40.00	10.00
Supplies and equipment.....	842	780	47.24	39.00			
<b>Total.....</b>	<b>1,138</b>	<b>1,003</b>	<b>439.24</b>	<b>334.00</b>	<b>21</b>	<b>485.00</b>	<b>350.00</b>
<b>Metropolitan Water District:</b>							
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	1,181	3,185	1,553.00	3,526.00			
Waters, biological.....					1,126	11,260.00	14,790.00
Supplies and equipment.....	222	126	72.09	22.22			
<b>Total.....</b>	<b>1,403</b>	<b>3,311</b>	<b>1,625.09</b>	<b>3,548.22</b>	<b>1,126</b>	<b>11,260.00</b>	<b>14,780.00</b>

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.			Free work.		
	Samples or units.		Pesos.	Samples or units.		Pesos.
	1928	1929	1928	1928	1929	1928
Board of Pharmaceutical Examiners and Inspectors: Medicines and similar articles.						
Provinces and municipalities: Rocks, minerals, natural pigments, and similar substances.	1		16.00			
Waters, chemical.	6	16	160.00	450.00		
Standardization and correction of units of measure—						
Length.	11		16.50			
Capacity.	18		36.00			
Weight.	51		128.00			
Medicines and similar articles.	3	2	15.00	50.00		
Tikitiki extract.	500		350.00			
Antitetanic serum. . . . . ampules		20		40.00		
Normal horse serum.		24		24.00		
Waters, biological.	2	5	20.00	50.00	12	120.00
Supplies and equipment.		17		1.26		
Total.	592	84	741.50	615.26	12	120.00
United States Army and Navy:						
Clays, shales, limestones, limes, wall plasters, cements, and slags.		2		22.00		
Oil analysis.				23.00		



Physical tests of wire, twine, fibers, textiles, papers, and similar articles.....	1			5.00	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron, and steel roofing materials.....	25			33.00	
Coal analyses.....	2			9.00	
Waters, chemical.....	3	300.00		105.00	
Crude chemical and miscellaneous analyses.....	9	324.00		111.00	
Cements.....	38	1,005.00		68.25	
Waters, biological.....	1	19.00		10.00	
Paints and varnishes.....	1	10.00		120.00	
Standardization and correction of miscellaneous measures.....	2	60.00		10.00	
Miscellaneous inorganic work and analyses.....	5			10.00	
Medicines and similar articles.....	14	44.00			
Petroleum products.....	1	10.00			
Foods, alcohols, and beverages.....	19	364.00		124.00	
Tikitiki extract.....	11	79.00		30.00	
Rats for plague.....	7			1.40	
Rabies.....	2				106
Vaccine virus, fresh..... units.....	22,130	23,000	1,351.00	1,050.00	1
Dysentery vaccine..... ampules and cc.....	100			5.00	
Cholera vaccine..... do.....	38,140	17,700	7,628.00	2,965.00	
Antidysenteric serum..... do.....	930			814.00	
Shop work.....	1			10.00	
Supplies and equipment.....	91	90	6.93	4.50	
<b>Total.....</b>	<b>60,471</b>	<b>41,906</b>	<b>11,200.93</b>	<b>5,510.15</b>	<b>110</b>
Office of the Governor-General:					
Waters, biological.....					2
Photographic work.....		84	1.00	78.40	
Supplies and equipment.....	2				
<b>Total.....</b>	<b>2</b>	<b>84</b>	<b>1.00</b>	<b>78.40</b>	<b>2</b>
					20.00
					464.00

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
University of the Philippines:								
Cements.....	40		48.00					
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.....	240	266	269.00	279.00				
Smelting and refining of gold and other precious metals.....						387		68.05
Medicines and similar articles					1		5.00	
Faces.....					591		2,955.00	3,098.00
Waters, biological					843			8,480.00
Waters, chemical					7	1	65.00	8.00
Vaccine virus, fresh.....		500		5.00				
Dysentery vaccine.....		30		12.00				
Combined cholera-typhoid and paratyphoid vaccines.....		150		30.00				
Antitetanic serum.....	560	24	138.00	48.00				
Antidysenteric serum.....		54		54.00				
Miscellaneous serums and vaccines.....		12		12.00				
Photographic work.....	99	217	147.60	193.75				
Natural-history specimens.....	1	1	100.00	2.00				
Supplies and equipment.....	2	6	10.00	37.00				
Total.....	942	1,260	712.60	672.75	599	1,880	8,026.00	11,604.05

Department of Commerce and Communications:						
Metals and alloys.....					4	60.00
National Museum:						
Photographic work.....		23.70				
Public Welfare Commissioner:						
Tikiti extract.....						
Miscellaneous biological examinations		150.00				
Dysentery vaccine.....		20.00				
Typhoid and paratyphoid A and B vac-		42.00		2,090		482.00
cine.....		27.00				
Antitetic serum.....		64.00				
Antidysenteric serum.....		27.00				
Miscellaneous serums and vaccines						
.....ampules, cc, and units		10.00				
Supplies and equipment.....	2					
Total.....	88	74.00	264.00	52,400	39,491	35,649.00
Mint of the Philippine Islands:						
Metals and alloys.....					2	45.00
Assays.....					111	90.00
Total.....					113	90.00
Miscellaneous:						
Metals and alloys.....	18	225.00	228.00	17	2	288.00
Rocks, minerals, natural pigments, and similar						
substances.....	41	326.00	464.00		1	5.00
Clays, shales, limestones, limes, wall plasters,						
and slugs.....	26	280.00	166.00			
Coal analyses.....	20	700.00	797.00	26	108,780	910.00
Oil analyses.....	2	48.00	112.00	38	31	506.00
Paints and varnishes.....	10	226.00	128.00	16	3	283.00
Waters, chemical.....	47	1,212.00	755.00	1	8	25.00
Crude chemical and miscellaneous analyses.....	18	78.00	219.00	4		71.00
Total.....						
						8,665.48
						408.00
						36.00
						250.00

\* This figure is different from that in last year's report; the charge on coal analysis to Manila Railroad Co. was computed at the rate of ₱0.08 per ton analyzed.

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.			Free work.		
	Samples or units.	Pesos.	Samples or units.	Samples or units.	Pesos.	Pesos.
	1928	1929	1928	1929	1928	1929
Miscellaneous—Continued.						
Standard solution.....liters.	11	15	64.00	63.39		
Physical tests of wire, twine, fibers, textiles, papers, and similar articles.	57	58	194.00	259.00	3	21.00
Cements.	14	12	114.75	167.75	421	377.20
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc.	151	378	367.00	866.00	15	59.00
Standardization and correction of measurements—						
Length.....	10	7	15.00	10.50		
Capacity.....	47	11	133.00	70.00		
Weight.....	78	28	264.00	206.50	5	125.00
Other measures.....	24	24	47.00	47.00	3	45.00
Miscellaneous inorganic work and analyses	19	23	265.00	168.20	6	19.00
Soil analyses.....	13	6	417.00	97.00		
Commercial fertilizers	89	42	805.00	279.00		
Guano, copra cake, ashes, and similar materials.....	37	47	258.00	343.00		
Insecticide, fungicide, sea-water tests, roofing materials, and miscellaneous analyses	64	109	151.00	247.00		
Fertilizer tags sold (less cost of printing)	264,091	178,374	6,406.64	5,351.22		
Registration of fertilizers.....	15	17	750.00	850.00		



TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.				Free work.			
	Samples or units.		Pesos.		Samples or units.		Pesos.	
	1928	1929	1928	1929	1928	1929	1928	1929
Miscellaneous—Continued.								
Dysentery vaccine..... ampules and cc.		579		402.50		5		3.50
Cholera vaccine..... do.		24		16.80				
Typhoid and paratyphoid A and B vaccine..... ampules		670		392.60		3		2.10
Combined cholera-typhoid and paratyphoid vaccine..... ampules and cc.		346		211.30				
Streptococcus and Staphylococcus albus and aureus vaccine..... ampules	8,175	636	10,352.75	484.60		1		.70
Antitetanic serum..... do.		906		1,254.00				
Antidysenteric serum..... do.		6,397		11,237.40				
Normal horse serum..... do.		174		310.00				
Miscellaneous serums and vaccines..... ampules, cc, and units.		1,181		977.80				
Photographic work.....	2,606	1,873	844.25	701.34				
Natural-history specimens.....	66	32	396.50	209.50				
Shop work.....	1	2	15.00	7.00				
Aquarium tickets, postcards, etc.....			3,607.30	5,055.60				
Supplies and equipment.....	8,512	6,163	3,367.96	2,375.44				
Sales of publications.....			3,184.93	4,917.01				
Refunded, work not done, etc. (deducted)			(66.10)	(258.90)				
Fines of employees and forfeitures of salaries; credit adjustment prior year expense.....			437.90	12,992.93				

Power, steam, etc.....		27,324.80	27,659.06				
Miscellaneous income.....			4,187.66				
<b>Total.....</b>		<b>304,790</b>	<b>215,893</b>	<b>76,849.85</b>	<b>103,737.93</b>	<b>10,034</b>	<b>126,649</b>
<b>Examinations and sales of the Cebu biological laboratory:</b>							
Feces.....	30			94.00	158		823.00
Sputum.....	12			36.00	64		192.00
Blood.....	17			134.67	6		18.00
Diphtheria.....					17		86.00
Widal test.....	7			21.00	1		3.00
Wassermann and Kahn tests.....	37		1,570.12	375.00	24	14,606.00	240.00
Leprosy.....	1	475		3.00	1,043		3,129.00
Urine.....	186			741.92	95		396.00
Gonococci.....	4			12.00	2,557		7,671.00
Waters, biological.....	5			50.00	351		3,510.00
Histological.....	1			10.00			
Miscellaneous biological examinations.....	16			58.84	8		48.00
Autogenous vaccine.....	240			240.00	10		10.00
Vaccine virus, fresh.....	131			9.20			
Cholera vaccine.....	5			3.50			
Typhoid and paratyphoid A and B vaccine.....	8			5.60			
Combined cholera-typhoid and paratyphoid vaccine.....	7			4.90			
Streptococcus and Staphylococcus albus and aureus vaccines.....	22		1,280.24	15.40			
Antitetanitic serum.....	185			555.00			
Antidyenteric serum.....	429			772.20			
Normal horse serum.....	50			90.00			
Miscellaneous serums and vaccines.....	162			129.60			
<b>Total.....</b>	<b>475</b>	<b>1,555</b>	<b>2,850.36</b>	<b>3,361.83</b>	<b>4,334</b>	<b>14,606.00</b>	<b>16,125.00</b>

TABLE 2.—Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1929, as compared with the fiscal year 1928, by number or quantity and by value, arranged with reference to Government and other patronage—Continued.

Customer.	Cash work.			Free work.		
	Pesos.			Pesos.		
	Samples or units.	1928	1929	Samples or units.	1928	1929
Examinations and sales of the Iloilo biological laboratory:						
Fæces.....		156	581.44	5,816		56,812.00
Sputum.....		52	157.00	36		108.00
Blood.....		115	460.10	10		39.00
Diphtheria.....		14	70.02	16		80.00
Widal test.....		73	232.00	6		18.00
Wassermann and Kahn tests.....		139	1,376.67	22		220.00
Leprosy.....		12	36.00	328		984.00
Urine.....	865	225	832.37	9,090	64,985.00	256.00
Gonococci.....		42	127.10	8		24.00
Waters, biological.....		2	18.00	464		4,640.00
Histological examinations.....		5	50.00			
Milk, ice cream, and soft drinks.....						
Miscellaneous biological examinations.....		16	94.00	325		3,250.00
Autogenous vaccine.....ampules		100	97.00	3		9.00
Vaccine virus, fresh.....units		65	13.00	10		10.00
Combined cholera, typhoid, and paratyphoid A and B vaccine.....ampules and cc.		116	81.20			
Antitetanic serum.....ampules		41	123.00			
Antidysenteric serum.....do.	820		1,477.80			
			1,668.93			





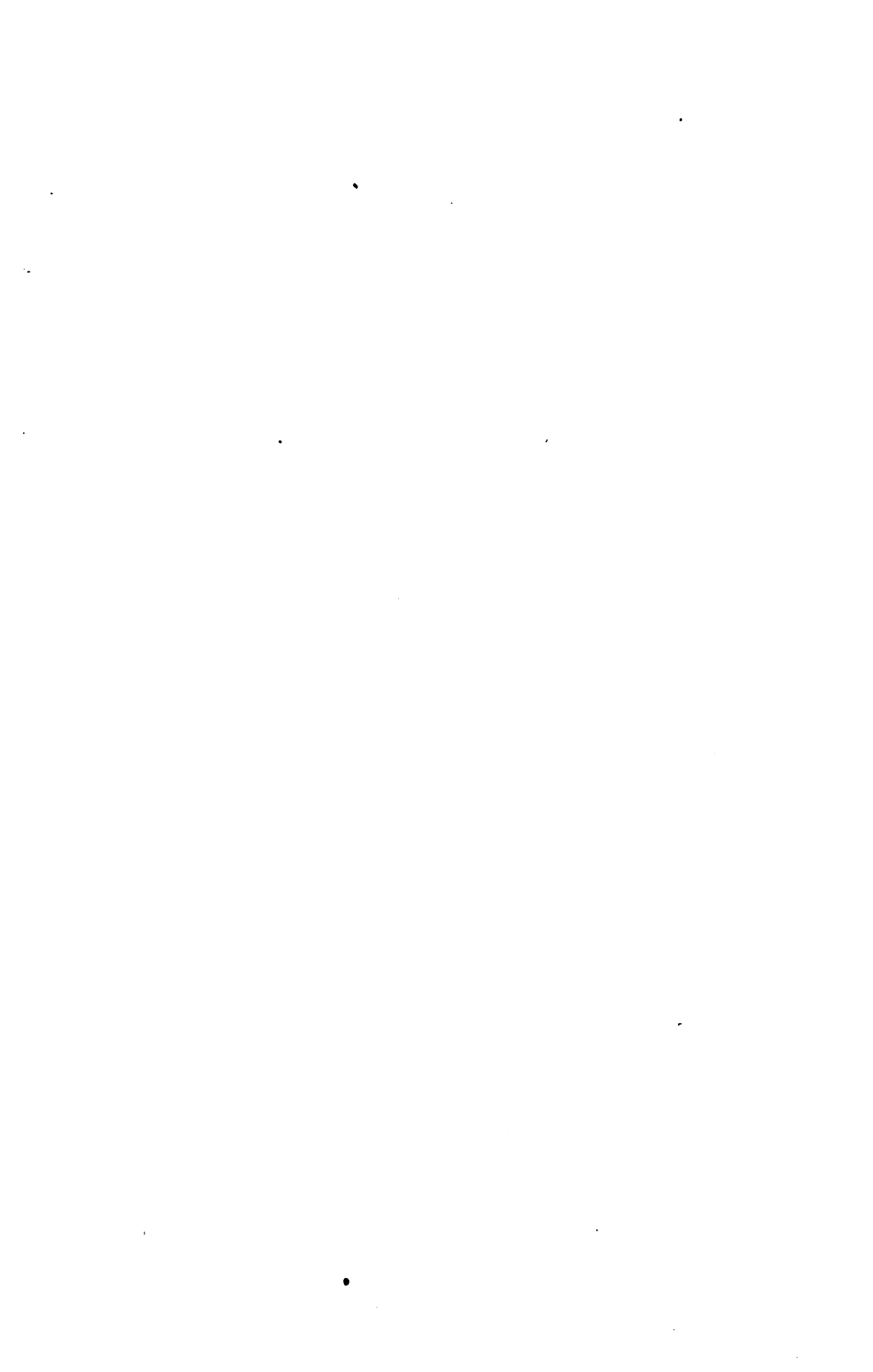
TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1929 as compared with the fiscal years 1927 and 1928.

## EXPENDITURES.

Item.	Fiscal year.		
	1927	1928	1929
	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
<b>Salaries and wages, etc.:</b>			
Salaries and wages, including accrued leave.....	375,005.81	391,743.50	416,970.18
Travel expenses of personnel.....	10,999.84	15,454.77	18,419.01
Total.....	386,005.65	407,198.27	435,389.19
<b>Apparatus, supplies, etc.:</b>			
Consumption of supplies and materials.....	171,817.25	184,620.94	157,783.51
Apparatus and equipment, including books.....	12,600.00	14,100.00	10,800.00
Total.....	184,417.25	198,720.94	168,583.51
<b>Miscellaneous:</b>			
Postal, telegraph, telephone, and cable service....	8,825.73	9,000.00	10,000.00
Freight, express, and delivery service.....	2,270.70	3,498.80	3,500.00
Printing and binding reports, documents, and publications.....	34,900.00	35,900.00	35,900.00
Illumination and power service.....	2,500.00	3,000.00	1,607.98
Miscellaneous service.....	10,202.04	13,868.17	14,000.00
Maintenance and repair of equipment.....	5,000.00	5,000.00	3,915.69
For the acquisition and transportation of certain species of fish desired for cultivation.....	2,000.00		
Uncollectible debts.....		0.20	
Deterioration of supplies and sales of stock.....			
Total.....	65,698.47	70,267.17	68,923.67
<b>Distribution of tikitiki extract, antityphoid vaccine, and antidyenteric serum:</b>			
Salaries and wages, including accrued leave.....	2,709.10	2,684.82	2,611.71
Consumption of supplies and materials.....	17,493.05	15,379.06	9,268.10
Other services.....	196.48	133.03	191.05
Total.....	20,398.63	18,196.91	12,060.86
<b>Special fund (developing home-canning and food-preservation industry, Acts 3231 and 3308):</b>			
Salaries and wages, including accrued leave.....	13,093.16	3,366.84	
Traveling expenses of personnel.....	6,260.63		
Freight, express, and delivery service.....	645.36	372.89	
Postal, telegraph, telephone, and cable service....	397.84	220.98	
Illumination and power service.....	10.00		
Miscellaneous service.....	176.11	212.37	
Consumption of supplies and materials.....	1,166.52		
Printing and binding reports, documents, and publications.....	605.60	290.05	
Maintenance and repair.....	31.64		
Purchase of equipment.....	429.06	24.33	
Total.....	22,815.91	4,487.46	

TABLE 3.—Comparative statement showing expenditures and income during the fiscal year 1929 as compared with the fiscal years 1927 and 1928—Continued.

Item.	Fiscal year.		
	1927	1928	1929
Special appropriation:	<i>Pesos.</i>	<i>Pesos.</i>	<i>Pesos.</i>
For investigation of soils.....		3,000.00	3,000.00
Purchase of two engines for the manufacture of vaccines and serums at Alabang.....		12,000.00	
Purchase of a machine for testing concrete.....			12,000.00
Total.....		15,000.00	15,000.00
Reorganization of division of fisheries, Act 3307:			
Salaries and wages, including accrued leave.....	24,072.87	101.26	199.80
Traveling expenses of personnel.....	2,697.66		446.57
Freight, express, and delivery service.....	467.71	104.02	20.07
Postal, telegraph, telephone, and cable service.....	16.67	4.00	
Miscellaneous service.....	405.67	1.10	7.00
Consumption of supplies and materials.....	14,929.48	229.08	151.23
Purchase of equipment.....	630.13		
Total.....	43,220.19	439.46	824.67
Grand total.....	722,556.10	714,310.21	700,781.90
INCOME.			
Receipts from operation.....	387,576.16	384,419.31	393,545.40
Sales of supplies.....	1,161.34	422.73	680.16
Sales of fixed assets.....	917.12	1,918.00	1,120.00
Other income.....	1,425.37	1,509.88	14,876.58
Total.....	391,079.99	388,269.92	409,722.14
Appropriation account:			
Appropriation.....	656,520.00	734,600.00	761,420.00
Special fund, Act 3231 (balance) and Act 3308 (balance).....	30,147.09	7,381.18	2,843.72
Special fund, Act 3307 (balance).....	110,000.00	66,779.81	66,340.35
Total.....	796,667.09	808,710.99	830,604.07



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# TWENTY-EIGHTH ANNUAL REPORT OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

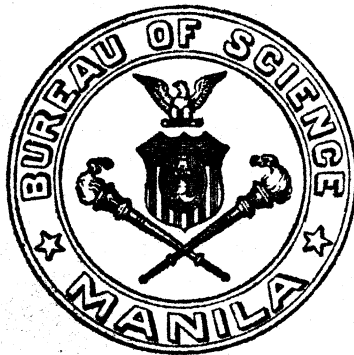
TO THE HONORABLE  
THE SECRETARY OF AGRICULTURE AND  
NATURAL RESOURCES

BY

WILLIAM H. BROWN

DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING DECEMBER 31, 1929



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