THE STRUCTURE AND SCOPE OF THE USPHS COMMUNICABLE DISEASE CENTER

by

Justin M. Andrews, Senior Scientist (R)
U. S. Public Health Service

The Communicable Disease Center was established July 1, 1946 by direction of Surgeon-General Thomas Parran to continue certain of the activities of the Malaria Control in War Areas organization and to perform other specified functions. Accordingly, it is necessary to review briefly the history of the parent agency which was developed to meet a wartime need in order to understand the basic structure and scope of the peacetime Communicable Disease Center.

The Office of Malaria Control in War Areas was instituted in Atlanta early in 1942. Its program, as developed by the first Medical Officer in Charge, Dr. L. L. Williams, in response to a request made to the Federal Security Administrator by the Secretary of War, was one of direction and coordination of Federally implemented State health department activities aimed at the protection of military personnel against malaria in the United States, Puerto Rico and British Jamaica. This operational objective involved major and minor drainage, filling, and antilarval efforts against vectorial anophelines around Army, Navy and war industrial areas where malaria might be transmitted. (See Fig. 1) When military training and production were at their height, these areas numbered some 2200 or more. This was known as the War Area Program and included, in addition to the environmental control activities, 1) wide scale

application of epidemiologic, parasitologic, and entomologic procedures for the guidance and evaluation of control operations and 2) community educational projects designed to acquaint the populace with the basic facts concerning the nature, transmission and prevention of malaria. In certain areas, including the Territory of Hawaii, Aedes egypti and dog-fly control were undertaken as a part of the War Area Program.

Reported malaria prevalence was at an all-time low when this program was commenced in 1942, as shown in Fig. 2, and, in spite of the introduction of large numbers of susceptibles into areas where malaria was or had been endemic, it continued to decline. By 1944 and 1945, large numbers of service casualties, prisoners of war and discharged veterans who had been exposed to malaria overseas were evacuated or returned to the United States and grave fears were expressed by health authorities that the introduction and dissemination throughout the country of so many actual or potential gametocyte carriers might serve to generate numerous and extensive epidemics of malaria. The significance of this possibility was admittedly indeterminate but it certainly could not be ignored. Accordingly, the so-called Extended Malaria Control Program was developed by MCWA in 1945 to protect civilians against the threat of malaria from military personnel. Instead of being focalized around military establishments, this project was operated where conditions for the transmission of malaria, imported or otherwise, were known to exist, i.e., those counties in which malaria had been reported to be most highly endemic in recent years (see Fig. 3). Residual DDT was applied within domestic premises in these areas.

Not acc.

In the meantime, murine typhus fever appeared to be on the increase judging by morbidity reports (see Fig. 4) and was invading areas in which it had not been noted previously (see Fig. 5). The far-flung organization of MCWA with its multispecialist personnel, available equipment and other facilities offered a splendid opportunity for bolstering State resources in checking the advance of this steadily infiltrating disease. Thus, in 1945, the Typhus Control Program was added to the operational responsibilities of MCWA.

Veterans returning from overseas were carriers not only of malaria but of numerous other infections many of which were unknown or rare in certain parts of this country. While every reasonable effort is made by Medical Department personnel of the Armed Forces to detain such individuals until they are cured, it seemed probable that missed, relapsing or incompletely treated cases of malaria, filariasis, schistosomiasis, leishmanisis, oriental hookworm disease, and possibly other parasitoses might present themselves to practicioners in any State in the Union. To aid physicians and technicians in the diagnosis of tropical and parasitic diseases, special informational and training facilities were established in MCWA.

This hasty sketch of operational activities conveys only a superficial realization of the services necessary to support them. Personnel trained and experienced in insect and rodent control were needed for the successful conduct of this program but few were left in the country after military demands had been satisfied. Thus it was necessary to train large numbers of inexperienced individuals. To do this rapidly, audio-visual teaching techniques were used and, because suitable materials for this

purpose did not exist, these had to be created. Field, laboratory and office facilities had to be established and staffed for mapping and surveying, the collection, staining and examination of thousands of thick blood films; the regular searching for and enumeration of larval and adult mosquitoes and other insects; and the development of improved methods, equipment, and materials for the effective application of insecticides and rodenticides. Special investigations of operational significance were carried by MCWA alone or in cooperation with the National Institute of Health, the Health and Safety Division of the Tennessee Valley Authority, the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, and various universities and State health departments. These researches have shown that foreign strains of malaria parasites, which might be introduced into this country by veterans or travellers, are transmitted as readily as native strains by Nearctic vectors; have shed light on the frequent failure of DDT as a residual mosquito larvicide, on its general insecticidal efficiency against mosquitoes, house-flies and rat fleas, variations in durability and effectiveness as a residual mosquito imagocide, and on its effect upon certain aquatic organisms other than insect larvae; have extended knowledge concerning flight habits, range and sanitary threshold of Anopheles quadrimaculatus, on the significance of Anopheles crucians as a malaria vector; and on the measurement of fly densities and evaluation of fly control. Numerous new distribution records and taxonomic studies have been published concerning mosquitoes and new techniques have been devised for marking insects for flight range studies. A list of these and other research publications is appended.

V-J Day found MCWA with rapidly declining war-connected responsibilities. Troops were being demobilized; camps were being inactivated. But the basic organization of physicians, engineers and biologists which had become skilled and experienced in collaborative attack against insect- and rodent-borne diseases remained. In the opinion of many health authorities it seemed desirable to continue it as a peacetime agency (1) as a safeguard against a recurrence of that unfortunate state of affairs which prevailed in 1942 when this Nation could not find enough competent insect- and rodent-control personnel to service the Army and Navy overseas and to protect the health of its civilians at home, (2) as a prevention against the establishment of exotic infections introduced into this country by returning veterans, occupational troops or as a result of global air traffic, and (3) to combat certain endemic infections, notably murine typhus, sylvatic plague, and insect-borne infections which are progressively entrenching themselves in new sections of the United States. It was for these reasons that the Surgeon-General of the U. S. Public Health Service ordered the conversion of MCWA to the Communicable Disease Center.

The purposes and functions of the daughter organization comprise certain inherited elements and a few new ones. Collectively, they offer services to States which may be grouped as follows:

1. Field investigation and control, through State and Territorial Health Departments, of communicable diseases where Federal assistance is requested and existing provisions are not adequate.

(2) Field training in public health.

(3) Production of audio-visual and other aids for technical and professional training relative to communicable diseases and their control.

(4) Evaluation and consultation concerning techniques and practices in public health diagnostic laboratories.

To give administrative and technical direction to these objectives, the MCWA organization was revised and supplemented so that the pattern shown in the accompanying charts finally evolved. Organically, the Communicable Disease Center is a Field Station of the States Relation Division in the Bureau of States Services. Fig. 6 shows the lines of authority of its administrative head, the Officer in Charge, and the interrelationships of the Headquarters and Field Organizations in the various States. These latter now number 15. 1/

Alabama, Arkansas, California, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

The Headquarters of the Communicable Disease Center is located in Atlanta, Georgia, as are all the Divisions except the Technical Development Division which is in Savannah, Georgia. The relationships and principle functions of these components are indicated in Fig. 7 and are discussed in more detail below.

The members of the Executive Office are concerned collectively with the formulation and transmission of overall policy to Divisions

and the Field Organization and in the administrative direction of the Communicable Disease Center program. The three Service Chiefs are responsible for the technical direction and coordination of the divisional programs included within their respective Services - Epidemiology and Laboratory, Operations, Training and Production.

The divisional functions are as follows:

1) Epidemiology -

a) Maintains the statistics of reported morbidity and mortality concerning diseases of operational or investigational concern to the Communicable Disease Center and makes periodic analyses and interpretations of them for use in planning and evaluating programs.

b) Assists in field investigations by measuring effectiveness of control measures on human populations in terms of specific morbidity and mortality experience.

c) Assists States requesting Federal aid in analyzing and advising with regard to epidemic phenomena.

d) Supplies statistical planning and interpretive assistance to divisional and other programs.

2) Laboratory - It is not intended that laboratory activities of the Communicable Disease Center will duplicate unnecessarily those of the National Institute of Health, as the principal objective for the former will be to support field investigations and to provide services to State health laboratories not now included in the NIH program.

a) Provides diagnostic facilities - bacteriologic, serologic, parasitologic, virologic, and rickettsial - necessary for the prosecution of epidemiologic field activities.

b) Maintains mobile laboratory units to assist epidemiologists in response to requests from States for epidemic aid.

c) Provides instructors and other teaching facilities for training courses of a laboratory nature.

d) Reviews and evaluates technical procedures in diagnostic laboratories.

e) Provides consultation for the correction of substandard techniques and for the improvement of administrative practices.

f) Develops standardized laboratory techniques to be used for survey purposes so that data collected at different times and places may have a greater degree of comparability than at present.

g) Provides State and local health laboratories with series of protozoologic, helminthic, bacteriologic, entomologic, and other specimens to assist in the training of technicians, as a reference museum and for circulation to local clinical laboratories.

3) Engineering -

a) Provides facilities for meeting emergency measures necessary for the suppression of insect-borne diseases.

b) Assists States in the control of certain endemic diseases transmitted by insects or rodents by providing demonstration programs or specialized professional or technical personnel to supervise such operations where justification for them is based on high disease rates and assurance of local participation in preventive programs.

c) Provides facilities for dontrolled field-testing on a large scale of new or improved materials and equipment designed for communicable disease control.

d) Assists other Federal agencies and States in making surveys and recommendations regarding impoundment design, construction and maintenance for the purpose of minimizing malaria hazards.

4) Entomology -

a) Identifies insects and other arthropods concerned in the transmission of communicable diseases.

b) Appraises the effectiveness of disease-control measures by determining changes in the densities of insect vector populations.

5) Technical Development -

a) Develops and tests new methods of controlling diseases spread by insects and rodents.

b) Develops and tests new and improved equipment used in the control of communicable diseases.

c) Develops new and improved insecticides and rodenticides and determines the effectiveness and durability of

new and existing compounds for the destruction of insects and rodents transmitting disease.

d) Devises new and improved methods of excluding rodents from structures occupied or used by man.

e) Evaluates communicable disease control practices in terms of hazard to wild life or interference with agricultural activities.

6) Training - It is not intended for the training activities of CDC to infringe in any way upon the prerogatives or fields of endeavor of schools or teaching departments of public health, hygiene, preventive medicine, sanitary engineering, or diagnostic laboratory technique.

a) Instructs employees entering the Center either as commissioned officers or civil servants concerning the history, interrelationships, and practices of the various units of the Communicable Disease Center, the U. S. Public Health Service and other public health organizations.

b) Provides training for the employees of State or local health departments or of other Federal agencies concerned with the prevention of disease in effective control practices for insect and rodent-borne diseases and in the laboratory diagnosis of communicable diseases.

c) Provides training facilities for the orientation and specialized training of sub-professional state and local public health workers not eligible to attend

professional schools of public health.

d) Provides internship training in public health for inexperienced graduates of schools and departments of hygiene and public health.

7) Production - The production and distribution of audio-visual and other teaching aids will be restricted to the development of these materials for the assistance of professional and technical schools and individuals engaged in instruction and research concerning communicable disease. It is not planned to engage in lay health educational activities.

a) Develops and produces motion pictures, film strips and manuals illustrating, describing and documenting investigations and control procedures pertaining to communicable diseases. Series have been planned and are partially completed on the following subjects: malaria, typhus, tropical diseases and preventive medicine.

b) Analyzes and assists in the utilization of these and other teaching aids with the object of improving new training materials.

8) Library and Reports -

a) Maintains a reading library for the use of investigators, instructors, and students of communicable disease research and control.

b) Maintains a library of motion pictures and film

strips for the use of institutions, instructors and students in the field of communicable disease control.

c) Prepares quarterly field bulletins, annual reports and a running history of the MCWA--CDC development and other program information materials.

d) Provides non-technical editorial assistance in the preparation of manuscripts to be submitted for publication.

e) Consolidates records of routine disease control activities, extracting and analyzing such information as may be requested by staff.

9) Administrative -

a) Establishes and administers personnel policies and procedures for both headquarters and field organizations.

b) Insures maintenance of Civil Service position standards.

c) Recruits personnel; advises on selection of candidates; determines qualifications.

d) Prepares consolidated budget; controls allotted funds; certifies and maintains accounting records of expenditures; audits payrolls, miscellaneous vouchers and travel vouchers.

e) Purchases supplies, equipment and materials; maintains records of CDC property; ~~prepares~~ provides warehousing and distribution facilities.

f) Repairs and maintains automotive and other equipment.

g) Prepares maps, charts and other drafted materials.

h) Reproduces manual letters, field memoranda, etc. and distributes all such materials to the Headquarters and Field Organizations.

i) Prepares and processes machine records based on administrative, operational, investigational and vital statistics data.

Of the various field programs carried on by the Communicable Disease Center, the following have entomological interest. Complete details regarding the work cannot be given in all instances as certain of the investigational projects are incomplete and results of others are still to be published.

Malaria Control Program. The next year will see the virtual liquidation of the War Area Malaria Control Program for the operation of which MCWA was activated. Comparable activities on a smaller scale will be continued in Puerto Rico at the request of Army and Navy Departments. Mosquito control work is being done in the vicinity of Veterans Administration Hospitals as this organization has no provision for this type of service. Many of the patients brought together in these hospitals are suffering from malaria and other diseases acquired in the tropics and it is imperative that complete mosquito control be effected adjacent to these hospitals. This project is now known as The Military Areas Malaria Control Program. It consists almost entirely of larviciding which is being carried on currently in 27 different zones.

The Extended Program, DDT residual spraying in houses in malarious areas, will probably be maintained through 1948 to reduce the likelihood of liberating foreign strains of malaria from returning veterans and may be continued longer as the most promising approach to the goal of malaria eradication in the United States. This work is being carried on in 265 counties in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee and Texas. From July 1st through September 30th of this year, 518,748 house sprayings were completed.

Allocations of funds to States for malaria control are based on a formula in which a standard budgetory item for the support of the State-wide organization is supplemented by amounts corresponding to each State's relative share of the reported malaria mortality experienced by the thirteen most malarious States during recent years. Federal dollar participation in this program is now roughly 75 to 80 per cent of the total, but is diminishing each month. It is hoped that by the beginning of the next fiscal year, local sponsorship of costs will be increased to 50 per cent or more with Federal assistance being restricted to supplying technical personnel, equipment and materials.

Impounded Water Studies. As a continuing element in the national malaria prevention program, areas in which water is to be impounded by the United States Engineer Department are studied by Communicable Disease Center engineers and entomologists in association with State Health Department representatives with the objects of determining 1) the extent of probable malaria hazard contingent upon uncontrolled impoundment and 2) how this risk, if any, may be minimized by proper design, construction and

maintenance of the impoundment basin. The Communicable Disease Center is reimbursed for these services by the United States Engineering Department. During the first quarter of this fiscal year, 26 of these projects were completed and final reports were submitted, field work was finished on 9 more and requests were received for surveys of 9 additional impoundments. Similar cooperative service is being rendered to other Federal agencies concerned in the impoundment of water in potentially malarious areas. A notable contribution to the literature of sanitary science and practice is a compendious volume, now in press, entitled "Malaria Control on Impounded Water" which represents the joint effort of members of the Health and Safety Department, Tennessee Valley Authority and the Communicable Disease Center of the U. S. Public Health Service.

Aedes aegypti Control Program. These mosquito control activities, a combination of DDT treatment and general sanitation, were originally undertaken at the request of the Navy and are being continued in 16 costal areas of Alabama, Florida, South Carolina and Texas as a protection against dengue fever and the potential threat of yellow fever. Local health departments furnished 57 per cent of the costs during the first quarter of this fiscal year. All new projects are required to obtain at least 50 per cent of their support from local sources.

Typhus Control Program. Grants-in-aid on a formula basis - standard budgetary item for the Statewide organization plus amounts corresponding to each State's relative share of the recent typhus morbidity reported in the nine States where the bulk of the Nation's typhus occurs - were made to Alabama, Florida, Georgia, Louisiana,

Mississippi, North Carolina, South Carolina, and Texas with special projects being supported in Arkansas and Virginia. Anti-typhus operations, including rat-proofing of buildings, rat poisoning, and the residual dusting of rat runs, burrows and harborages with 10 per cent DDT dust (see Fig. 8) were carried on in 130 counties of the 11 States.

This latter procedure effects an average decrease of tropical rat fleas, Xenopsylla cheopis, of nearly 90 per cent per rat and might thus be expected to exert a reductive effect upon the incidence of murine typhus in man. The number of cases of typhus fever reported throughout the country dropped from a peak of 5353 in 1944 to 5180 in 1945. Current figures indicate that the decline will be even greater this year. A comparison of reported typhus prevalence in the 124 dusted counties and the 810 undusted counties of the same States indicated that the disease subsided more rapidly in the former during the first 9 months of 1946 as the reduction in the dusted area was 37 per cent and in the remaining counties was 18 per cent. Typhus control activities are supported locally to the extent of nearly 70 per cent of their cost.

Muscogee County Insect Control Program. This project offered free DDT treatment to every one of the 23,959 dwellings or business establishments in Muscogee County, Georgia and was accepted in over 95per cent of these units. Its purposes were 1) to serve as an incentive to promote individual improvement of environmental sanitation of homes, yards and business places, 2) to benefit the communities by reducing the number of disease-bearing insects and insect pests, and 3) to determine how successfully DDT spraying and dusting operations on a county- and community-wide basis could suppress mosquitoes, flies, fleas, bed-bugs,

and cockroaches. Both hand labor and power methods were used to apply DDT in dwelling, privies, garages, barns, business houses, food establishments, dairies and to areas and surfaces where it might be effective against roaches. The different types of structures were treated a variable number of times according to the results of inspection. The project was evaluated entomologically both by making regular insect surveys and density determinations in and around the principle city of Muscogee County, Columbus, and by making comparable observations in another city across the river from Columbus in which no organized insect control program was carried out. Mosquito densities were sampled by means of light traps and by collections at diurnal resting places. Fly populations were estimated by using strips of adhesive fly paper exposed for 24 hours each week and by making enumerations with Scudder's fly-counting grill. Efforts were made to appraise changes in roach colonizations with traps but these were not successful. No evidence other than the testimony of home occupants was obtained concerning variations in abundance of fleas and bedbugs. From all accounts, the project has been highly successful and a summary of results obtained will be published. About 40 per cent of the cost is being borne by the Communicable Disease Center.

Malaria Field Studies. At Manning, South Carolina, near the Santee-Cooper impoundment, a Communicable Disease Center study is being carried on primarily to determine the effect on malaria prevalence of DDT residual spraying of houses and latrines as practiced by MCWA and CDC. During the last two years, the Santee-Cooper area has been the only one in the county with notable prevalence of malaria and even this has declined markedly. Clinical and parasitologic surveys for malaria are made in the

area at frequent intervals and the densities of local anopheline populations are determined regularly. Thus, in addition to the fulfillment of its primary objective, this program provides valuable opportunity to maintain a watchful eye on this most recent outpost of endemic malaria in the country - with the view of obtaining early indications of potential upswing in malaria prevalence in time to prevent an epidemic spread of the disease.

At the Emory Field Station in Baker County, Georgia, another field study is under way, sponsored jointly by Emory University and the Communicable Disease Center. This area is of entirely different topography than the Manning station being representative of the limestone section in Southwest Georgia, notorious for its high malaria endemicity until recent years. Regular observations are being continued upon local malaria prevalence, adjacent anopheline densities and ecology and associated ground-water changes. The Communicable Disease Center is especially interested in the investigation of over-wintering habits of anophelines and in the malaria case-finding activities. This area is also considered to be a lookout station where painstaking surveillance may pay huge dividends in guarding against the return of malaria.

It is hoped to establish in other States two more such combined observation posts and research projects in areas which have been highly malarious in the past and which represent additional types of environment where promonitory indications of returning malaria might be reasonably expected.

Typhus Field Studies. This project is headquartered in Thomasville, Georgia, and is being carried on in four counties of South Georgia where

murine typhus has been prevalent in the past. Its primary mission is to determine the effect on the incidence of human typhus of dusting rat runs and other harborages with DDT. Comparison of results obtained is being made with other typhus control methods. Field observations are being made on multipurpose insecticides which have some promise of reducing rat mites and lice as well as fleas.

Anopheline Host Preference Studies. The laboratory procedures concerned with these studies were commenced in 1944 at the Carter Memorial Laboratory in Savannah, Georgia, but have since been transferred to the Virus Laboratory in Montgomery, Alabama. This is an extended investigation of the natural feeding habits of the more abundantly represented species of Anopheles. Recently engorged female anophelines are collected in many different States. Blood from their stomachs is collected on filter paper and is sent to the laboratory. By means of a precipitin technique, it is possible to determine whether or not the blood came from man, cow, horse, pig or chicken. The results of these tests are correlated with circumstances relating to the capture of the mosquito. They have already yielded information of importance in connection with the Extended Program of Malaria Control.

Dysentery Control Project. This is a cooperative undertaking with the National Institute of Health. Its headquarters are at Pharr, Texas. The primary objective is to determine whether or not the control of flies by insecticides will reduce significantly the prevalence of diarrheal disease. For this purpose, five small cities in Hidalgo County in the Rio Grande Valley are being intensively treated with DDT to control flies while nothing of the sort is being done in four other nearby cities where

original flies densities were comparable. Excellent but expensive fly control has been obtained by the methods used. If results indicate that flies are concerned in the transmission of infectious diarrheas, the next study will be to ascertain the possibility of developing economically feasible programs of fly control for the prevention of diarrhea.

Neurotropic Disease Insect Control Project. The headquarters for this project are in Montgomery, Alabama, adjacent to the CDC Virus Laboratory. The object of this investigation is to determine whether or not the sudden and relatively complete reduction of insect populations of certain species is attended by measurable interference in the develo-ment of incipient epidemics of virus diseases. It is to be emphasized that this is not a state-aid operational project. Funds for this Project will be spent only where there appears to be reasonable hope of obtaining scientific information concerning the significance of insects in the transmission of virus diseases. The late summer and fall months of 1946 were spent in developing and improving rapid fly-control technique.

Encephalitis Studies. The Communicable Disease Center, in recognition of the threat of introduced and extended encephalitic prevalence on the West Coast, is cooperating in a modest way with the Hooper Foundation on studies of possible insect vectors and arian reservoirs of this disease.

Other predominantly intramural activities of the Communicable Disease Center involve entomology to some extent. Thus a considerable portion of the in-service and special training programs is devoted to instruction in distinguishing basic types of insects or even in recog-nizing a limited number of species. Trainees are given reference col-

collections of insects, including representative forms of importance in their special activities, to take back with them. The 6-weeks course given by the Parasitology Branch of the Laboratory Division to Federal, State, and local health laboratory technicians includes brief orientation with respect to insects which may be sent to the laboratories from which the students come. The same Branch of the Laboratory Division maintains a large reference museum of insects and, together with the Entomology Division, operates a central insect identification service for the field organization. Entomologic as well as other specimens are supplied to State health laboratories as a part of the Extension Service of the Laboratory Division.

A major portion of the Technical Development Division is devoted to insecticide investigations. These include studies of various candidate chemicals possessing some activity as larvicides or imagocides against mosquitoes, house-flies, and the ectoparasites of domestic rodents. Investigations are under way concerning the deteriorating influence of surface treatments and environmental changes on residual deposits, the effects of DDT larviciding on various wild life forms including fish, plankton, birds, mammals and other insects, and different methods of applying insecticides rapidly to large areas.

In summary, these are some of the functions and activities of the Communicable Disease Center - with special emphasis on those concerned with entomology. Collectively, they represent a purposeful effort on the part of the Federal government to translate scientific facts about certain communicable diseases into field-tested control and prevention practices and by demonstration and training to familiarize the personnel

of State and local health departments with easy, economical methods of applying them. In addition, the Communicable Disease Center assists, where directed, in the suppression of health hazards of interstate and extracontinental scope. In reaching these objectives, the Communicable Disease Center desires to cooperate to the fullest possible extent not only with other Federal agencies but with State and local health organizations, private physicians and laboratories, universities and scientific associations.

BIBLIOGRAPHY

Still in preparation; will consist of chronologic list of publications by Malaria Control in War Areas and Communicable Disease Center to date.

Bibliographic List of Publications Prepared by MCWA-CDC Personnel - 1942 - 1946

1943

Bradley, G. H. 1943. Density of Anopheles quadrimaculatus and the Prevalence of Malaria.
Proc. New Jersey Mosq. Ext. Assoc., 20-22.

Bradley, G. H. 1943. Determination of Densities of Populations of Anopheles quadrimaculatus on the Wing.
Proc. New Jersey Mosq. Ext. Assoc., 22-27.

Bradley, G. H. and Hanson, H. G. 1943. Entomological Services in the Regulation of the Larvicide Program.
J. Nat. Malaria Soc., 2(2):21-28.

Bradley, G. H. and Travis, B. V. 1943. Time-Saving Methods for Handling Mosquito Light Trap Collections.
J. Econ. Ent., 36(1):51-53.

Eyles, D. E. 1943. Accidental Transportation of Mosquitoes by Automobile.
J. Econ. Ent., 36(2):354.

Eyles, D. E. and Bishop, L. K. 1943. An Experiment on the Range of Dispersion of Anopheles quadrimaculatus.
Am. J. Hyg., 37(3):239-245.

Eyles, D. E. 1943. Method for Catching, Marking, and Re-examining Large Numbers of Anopheles quadrimaculatus Say.
J. Nat. Malaria Soc., 2(2):85-91.

Eyles, D. E. 1943. The Measurement of a Population of Anopheles quadrimaculatus Say.
J. Nat. Malaria Soc., 2(2):71-83.

Eyles, D. E. and Bishop, L. K. 1943. The Microclimate of diurnal Resting Places of Anopheles quadrimaculatus in the Vicinity of Reelfoot Lake.
Pub. Health Rep., 58(6):217-230.

Fellton, H. L. 1943. World-wide Mosquito Control: Larvicides and their Application.
Mosq. News, 3(3):96-104.

Pratt, H. D. 1943. Identification of first stage Larvae of Puerto Rican Anopheles. Pub. Health Rep., 58:1715-1717.

Rector, N. H. 1943. Anti-malaria Ditching by Dynamite. J. Nat. Malaria Soc., 2(2):11-20

Rector, N. H. 1943. Selection of Anti-Mosquito Methods to fit Specific Malaria Control Programs. J. Nat. Malaria Soc., 3(3):221-226.

Stubbs, T. H. and Derryberry, M. 1943. Community Education for Malaria Control. J. Nat. Malaria Soc., 2(2):57-60.

illiams, L. L., Jr. 1943. Density of Anopheles quadrimaculatus as Related to Prevalence of Malaria. Proc. New Jersey Mosq. Ext. Assoc., 17-20.

Williams, L. L., Jr. 1943. Malaria Control in War Areas. Proc. New Jersey Mosq. Ext. Assoc., 43-51.

Williams, L. L., Jr. 1943. Malaria - Public Health and Economic Aspects. Chem. Eng. News, 21: 1148.

944

Barnes, R. C. and Fellton, H. L. 1944. Anopheles quadrimaculatus in Northeastern United States. Proc. New Jersey Mosq. Ext. Assoc., 31: 48-52.

Bradley, G. H., Fritz, R. F., and Perry, L. E. 1944. Additional Mosquito Records for the Southeastern States. J. Econ. Ent., 37(1):109.

Bradley, G. H. 1944. Entomological Phases of Malaria Control Programs. J. Nat. Malaria Soc., 3(4):249-253.

Bradley, G. H. 1944. Entomological Services on the Program for Malaria Control in War Areas of the U. S. Public Health Service. J. Nat. Malaria Soc., 37(4):457-477.

Bradley, G. H. 1944. Malaria Control in War Areas in the United States in 1943 by the U. S. Public Health Service. I. Entomological Phases. Proc. New Jersey Mosq. Ext. Assoc., 129-133.

Dorer, R. E., Bickley, W. E., and Nicholson, H. P. 1944. An Annotated List of Mosquitoes of Virginia.
Mosq. News, 4: 48-50.

Ellis, J. M. 1944. Notes on the Collection and Oviposition of Anopheles walkeri.
J. Tenn. Acad. Sci., 19(1):29-30.

Eyles, D. E. 1944. A Critical Review of the Literature Relating to the Flight and Dispersion Habits of Anopheline Mosquitoes.
Pub. Health Bull. 287.

Eyles, D. E. 1944. A Guide and Key to the Aquatic Plants of the Southeastern United States.
Pub. Health Bull. 286.

Fellton, H. L. 1944. The Breeding of the Salt-Marsh Mosquito in Midwestern States.
J. Econ. Ent., 37(2):245-247.

Fellton, H. L. and Barnes, R. C. 1944. The Plan of Operation for the Northeastern Division of the Malaria Control in War Areas Office of the U. S. Public Health Service.
Proc. New Jersey Mosq. Ext. Assoc., 31: 45-47.

Fellton, H. L. 1944. Simple Field and Laboratory Tests of Larvicides.
Mosq. News, 4(2):50-54.

Freeborn, S. B. 1944. Problems Created by Returning Malaria Carriers.
Pub. Health Rep., 59(11):357-363.

Freeborn, S. B. 1944. The Malaria Control Program of the U. S. Public Health Service.
J. Econ. Ent., 37(4):467-469.

Freeborn, S. B. 1944. The Malaria Control Program of the U. S. Public Health Service Among Civilians in Extra-Military Areas.
J. Nat. Malaria Soc., 3(1):19-23.

Hollis, M. D. 1944. Engineering Aspects of Mosquito Control.
Civil Eng., 14(11):467-470.

Hollis, M. D. 1944. Modern Malaria Control.
Am. J. Pub. Health, 34: 5.

Irons, J. V., Bohls, S. W., Thurman D. C., Jr., and McGregor, T. 1944. Probable Role of the Cat Flea, Ctenocephalides felis, in Transmission of Murine Typhus. Am.J. Trop. Med., 24(6):359-362.

Murray, W. C. and Knutson, H. 1944. Airplane Dusting with Paris Green for Control of Anopheles quadrimaculatus Say in Water Chestnut Covered Areas of the Potomac River during 1943. Pub. Health Rep., 59(18):573-583.

Pratt, H. D. 1944. Studies on the Comparative Attractiveness of 25-, 50-, and 100-Watt Bulbs for Puerto Rican Anopheles. Mosq. News, 4(1):17-18.

Pritchard, A. E. and Pratt, H. D. 1944. I. A comparison of Light Trap and Animal Bait Trap Anopheline Mosquito Collections in Puerto Rico. II. List of Mosquitoes of Puerto Rico. Pub. Health Rep., 59(7):221-223.

Quinby, G. E., Serfling, R. E., and Neel, J. K. 1944. Distribution and Prevalence of the Mosquitoes of Kentucky. J. Econ. Ent., 37(4):547-550.

Rector, N. H. 1944. Malaria Control in War Areas in the United States in 1943 by the U. S. Public Health Service. II. Engineering Phases. Proc. New Jersey Mosq. Ext. Assoc., 133-138.

Rector, N. H. 1944. The Use of Ditch Lining, Underground Drains and Sanitary Fills for Malaria and Mosquito Control. Proc. Calif. Mosq. Control Assoc., 96-106.

Schoof, H. F. 1944. Adult Observation Stations to Determine Effectiveness of the Control of Anopheles quadrimaculatus. J. Econ. Ent., 38:1,115.

Schoof, H. F. and Ashton, D. F. 1944. Notes and New Distribution Records on the Mosquitoes of North Carolina. J. Elisha Mitchell Scientific Soc., 60(1):1-10.

Stubbs, T. H. 1944. Educational Factors in the Ultimate Control of Malaria. J. Nat. Malaria Soc., 3(4):255-259.

Usinger, R. L. 1944. Entomological Phases of the Recent Dengue Epidemic in Honolulu. Pub. Health Rep., 59(13):423-430.

Usinger, R. L. 1944. The Triatominae of North and Central America and the West Indies and Their Public Health Significance.
Pub. Health Bull. 288.

Wirth, W. W. 1944. Notes on the Occurrence of Anopheles georgianus in Louisiana.
J. Econ. Ent., 37(3):446.

1945

Arnold, E. A., Ferguson, F. F., and Upholt, W. M. 1945. The Experimental Use of DDT Sprays as Mosquito Larvicides.
Supp. 186 to Pub. Health Rep., 66-79.

Barnes, R. C. 1945. Anopheles walkeri in Diurnal Shelters in Massachusetts.
J. Econ. Ent., 38(1):114.

Bickley, W. E. 1945. The Anal Gills of Mosquito Larvae.
Mosq. News, 5(1):18.

Boyd, W. S. 1945. Educational Activities as Related to the Returning Malaria Carrier Problem.
J. Nat. Malaria Soc., 4(2):147-150.

Boyd, W. S. 1945 Training and Educational Services on the Malaria Control in War Areas Program.
Proc. New Jersey Mosq. Ext. Assoc., 129-134.

Bradley, G. H. 1945. Entomological Evaluations of Control Work on the Malaria Control in War Areas Program during 1944.
Proc. New Jersey Mosq. Ext. Assoc., 115-119.

Bradley, G. H. 1945. Entomological Problems in Malaria Control.
J. Nat. Malaria Soc., 4(1):1-8.

Bradley, G. H. and Fritz, R. F. 1945. Observations on Seasonal Occurrence and Abundance of Anopheles quadrimaculatus Say.
J. Nat. Malaria Soc., 4(3):251-262.

Bradley, G. H., Hess, A. D., Creighton, J. T., and Adair, H. S. 1945. Report, Subcommittee on Medical Entomology.
Am. Assoc. Econ. Ent., 23-25.

Bradley, G. H. 1945. Review of "Handbook of the Mosquitoes of North America" 2nd Edition.

Chandler, A. C. 1945. Factors Influencing the Uneven Distribution of Aedes aegypti in Texas Cities.
Am. J. Trop. Med., 25(2):145-149.

Davis, D. E. 1945. Control of Rat Fleas (Xenopsylla cheopis) by DDT.
Pub. Health Rep., 60: 485-489.

Davis, D. E. 1945. The Home Range of Some Brazilian Mammals.
J. of Mammalogy, 26(2):119-127.

Dodge, H. R. 1945. Notes on the Morphology of Mosquito Larvae.
Ann. Ent. Soc. of Am., 38(2):163-167.

Eyles, D. E. and Burgess, R. W. 1945. Anopheles walkeri in South Carolina.
J. Econ. Ent., 38(1):115.

Eyles, D. E., Sabrosky, C. W., and Russell, J. C. 1945. Long-Range Dispersal of Anopheles quadrimaculatus.
Pub. Health Rep., 60(43):1265-1273.

Fay, F. W., Simmons, S. W., and Clapp, J. M. 1945. Laboratory Investigations on the Toxicity of DDT Residues to Adults of Anopheles quadrimaculatus.
Supp. 186 to Pub. Health Rep., 21-34.

Fellton, H. L., Barnes, R. C., and Wilson, C. A. 1945. Malaria Control in a Nonemdemic Area.
J. Nat. Malaria Soc., 4(3):201-208.

Fellton, H. L., Barnes, R. C., Wilson, C. A., and Boyers, M. 1945. Malaria Control in the Northeastern States.
Proc. New Jersey Mosq. Ext. Assoc., 32: 223-230.

Ferguson, F. F., Upholt, W. M., and Arnold, E. H. 1945. Tests with DDT as an Anopheline Larvicide.
Mosq. News, 5(2):51.

Gies, R. W. 1945. Some Economic Aspects of Mosquito and Malaria Control in War-time.
Proc. New Jersey Mosq. Ext. Assoc., 32: 101-103.

Gilbertson, W. E. 1945. Sanitary Aspects of the 1943-1944 Epidemic of Dengue Fever in Honolulu.
Am. J. Pub. Health, 35(3):261-270.

Good, N. E. 1945. A List of the Mosquitoes of the District of Columbia.
Proc. Ent. Soc. Washington, 47(6):168-179.

Harden, P. H. 1945. The Occurrence of Orthopodomyia alba (Baker) at New Orleans, Louisiana.
Mosq. News, 5(4):131.

Henderson, J. M. 1945. Antimalaria Measures for the Protection of Military Personnel in Puerto Rico and Their Applicability to Civilian Malaria Control.
Puerto Rico. J. Pub. Health and Trop. Med., 20: 419-445.

Henderson, J. M. 1945. A Discussion on Caribbean Malaria Control.
J. Nat. Malaria Soc., 4(3):189-200.

Henderson, J. M. 1945. Operational Planning for the Malaria Control in War Areas DDT Residual House Spraying Program.
Proc. New Jersey Mosq. Ext. Assoc., 75-81.

Joyce, C. R. 1945. The Occurrence of Psorophora mexicana (Bellardi) in the United States.
Mosq. News, 5: 86.

Lackey, J. B., and Steinle, M. L. 1945. Effects of DDT Upon Some Aquatic Organisms, Other than Insect Larvae.
Supp. 186 to Pub. Health Rep., 80-89.

Metcalf, R. L., Hess, A. D., Smith, G. E., Jeffery, G. M., and Ludwig, G. W. 1945. Observations on the Use of DDT for the Control of Anopheles quadrimaculatus.
Pub. Health Rep., 60(27):753-774.

Peterson, A. G., and Smith, W. W. 1945. Occurrence and Distribution of the Mosquitoes in the State of Mississippi.
J. Econ. Ent., 38: 378.

Pratt, H. D. 1945. Mansonia indubitans Dyar and Shannon - A New Mosquito Addition to the United States Fauna.
J. Kansas Ent. Soc., 18: 121-129.

Pratt, H. D., Wirth, W. W., and Denning, D. G. 1945. The Occurrence of Culex opisthopus Komp in Puerto Rico and Florida, with a Description of the Larva.
Proc. Ent. Soc. Washington, 47: 245-251.

Price, M. M., and Lyman, F. E. 1945. Second Report on the Control of Anopheles quadrimaculatus Say in the Water-Chestnut Areas of the Potomac River, 1944.
Pub. Health Rep., 60(34):985-994.

Schoof, H. F. 1945. Entomology in Malaria Control.
J. Econ. Ent., 38(5):517-521.

Schoof, H. F., Schell, S. C., and Ashton, D. F. 1945. Survival of Anopheline Larvae and Pupae in Muck.
J. Econ. Ent., 38(1):113-114.

Simmons, S. W. 1945. DDT Investigations at the Henry R. Carter Memorial Laboratory.
Supp. 186 to Pub. Health Rep., 1-2..

Simmons, S. W., and Staff. 1945. Techniques and Apparatus Used in Experimental Studies on DDT as an Insecticide for Mosquitoes.
Supp. 186 to Pub. Health Rep., 3-20.

Simmons, S. W. 1945. Tests of the Effectiveness of DDT in Anopheline Control.
Pub. Health Rep., 60(32):917-927.

Smith, R. L. 1945. Significance of Palpable Spleens in Malarious Areas of Low Endemicity.
J. Nat. Malaria Soc., 4(3):155-164.

Spicer, S. S. 1945. The Spleen Survey as Applied to the Measure of Malaria in the United States - A Review of the Literature.
J. Nat. Malaria Soc., 4(3):165-182.

Stierli, H., Simmons, S. W., and Tarzwell, C. M. 1945. Operational Procedures and Equipment Used in the Practical Application of DDT as a Residual House Spray.
Supp. 186 to Pub. Health Rep., 49-65.

Stubbs, T. H. 1945. Educational Opportunities in Prevention of Malaria.
J. Health and Phys. Educ., 16: 172.

Tarzwell, C. M., and Stierli, H. 1945. The Evaluation of DDT Residual Sprays for the Control of Anopheline Mosquitoes in Dwellings.
Supp. 186 to Pub. Health Rep., 35-48.

Thurman, D. C., Ogden, L. J., and Eyles, D. E. 1945. A United States Record for Culex interrogator Dyar and Knab.
J. Econ. Ent., 38(1):115.

Upholt, W. M., Gaines, T. B., Simmons, S. W., and Arnold, E. H. 1945. The Experimental Use of DDT in the Control of the Yellow Fever Mosquito Aedes aegypti (L).
Supp. 186 to Pub. Health Rep., 90-96.

Upholt, W. M. 1945. Observations on Wartime Biometrics.
Biometrics Bull., 1(4):47-52.

Welch, E. V. 1945. The Finding of Anopheles albimanus Wied. at West Palm Beach, Florida.
Mosq. News, 5: 145.

Wilson, C. A. 1945. Lotus Borer Ecologically Antagonistic Toward Mosquitoes.
Mosq. News, 5(2):50.

Wirth, W. W. 1945. The Occurrence of Culex (Melanoconion) elevator Dyar and Knab in Florida, with Keys to the Melanoconions of the United States (Diptera, Culicidae).
Proc. Ent. Soc. Washington, 47(7):199-210.

Zukel, J. W. 1945. Marking Anopheles Mosquitoes with Fluorescent Compounds.
Science, 102: 157.

1946

Arnold, E. H., Simmons, S. W., and Fawcett, D. G. 1946. Precipitin Technique for Determining Mosquito Blood Meals.
Pub. Health Rep., 61(34):1244-1249.

Barnes, R. C. 1946. The Occurrence of Anopheles quadrimaculatus, Anopheles occidentalis, and Anopheles walkeri in Vermont.
Mosq. News, 6(1):32-33.

Bradley, G. H., and Fritz, R. F. 1946. Entomological Evaluation of DDT Residual Spraying for Malaria Control, 1945.
J. Nat. Malaria Soc., 5(2):141-145.

Bradley, G. H. 1946. The Use of DDT on the Malaria Control in War Areas Program.
Proc. California Mosquito Control Assoc.

Brooke, M. M., and Proske, H. O. 1946. Precipitin Test for Determining Natural Insect Predators of Immature Mosquitoes.
J. Nat. Malaria Soc., 5(1):45-56.

Dodge, H. R. 1946. Identification of Culex Males Under Low Magnification.
Ann. Ent. Soc. Am., 39(1):140-142.

Good, N. E. 1946. Mosquito Surveys and Inspections in the District of Columbia Area. Mosq. News, 6(2):76-77.

Hatchett, S. P. 1946. Chlorine as a Possible Ovicide for Aedes aegypti Eggs. Pub. Health Rep., 61(19):683-685.

Hollis, M. D. 1946. Post-war Malaria Control in Continental United States. J. Nat. Malaria Soc., 6(2):95-98.

Porter, J. E. 1946. The Larva of Uranotaenia syntheta. Am. Mid. Nat., 35: 535-537.

Pratt, H. D. 1946. The Larva of Psorophora (Janthinosoma) coffini Dyar and Knab (Diptera, Culicidae), and a Key to the Psorophora Larvae of the United States and the Greater Antilles. Proc. Ent. Soc. Washington, 48: 209-214.

Rees, D. M. and Harmston, F. C. 1946. Observations on the Habits of Anopheles freeborni in Northern Utah and Southern Idaho (Diptera, Culicidae). Mosq. News, 6(2):73-75.

Sabrosky, C. W. 1946. Correction on the Nomenclature of Human Plasmodium. Science, 104(2704):401-402.

Sabrosky, C. W., Reider, R. F., and McDaniel, G. E. 1946. A High Rate of Natural Plasmodium Infection in Anopheles crucians. Science, 104(2698):

Shlaifer, A. and Harding, D. E. 1946. The Mosquitoes of Tennessee. J. Tenn. Acad. Sci., 21(3):241-256.

Simmons, S. W. 1946. Investigations at the Henry R. Carter Memorial Laboratory of the U. S. Public Health Service. J. Econ. Ent., 39(1):15-17.

Simmons, S. W. 1946. Progress in the Development of Malaria Control Techniques. J. Nat. Malaria Soc., 5(2):157-163.

Thompson, G. A. 1946. Effect of DDT Residual Deposits on Scorpions. J. Econ. Ent., 39(4):537.

Wiley, J. S. 1946. Recent Developments in Murine Typhus Fever Control. J.A.P.H., 36(9):974-983.

Wilson, C. A., Barnes, R. C., and Fellton, H. L. 1946. A List of the Mosquitoes of Pennsylvania with Notes on Their Distribution and Abundance. Mosq. News, 6(2):78-84.

In Press or In Manuscript.

Andrews, J. M. and Link, V. B. (in press) The Murine Typhus Fever Problem.

Bacon, V. W. Typhus Fever Control in San Antonio.

Basham, E. H., Mulrennan, J. A., and Obermuller, A. J. The Biology and Distribution of Megarhinus Robineau.

Baker, W. C. and Schwartz, L. G. (in press) Preliminary Studies on the Control of Blowflies with DDT.

Baker, W. C., Scudder, H. I., and Guy, E. L. (in press) The Control of Houseflies by DDT Sprays.

Barnes, R. C., Fellton, H. L., and Wilson, C. A. An Annotated List of the Mosquitoes of New York.

Bickley, W. E. Entomological Work of the Virginia Malaria Control in War Areas Program

Boyd, W. S., Stubbs, T. H., and Weinstein, P. O. The Tropical Disease Education Program of the U. S. Public Health Service.

Bonnet, D. D. The Hybridization of Aedes aegypti and Aedes albopictus.

Bradley, G. H. and Goodwin, M. H. Anopheles Techniques.

Bradley, G. H. and Fritz, R. F. Entomological Evaluations of Results of Residual DDT Spraying During 1946.

Bradley, G. H. Mosquito Control Operations of the Office of Malaria Control in War Areas.

Bradley, G. H. Results of the 1945 Malaria Control in War Areas DDT Residual House Spraying Program.

Bradley, G. H. and Knutson, H. Training of Entomologists for Professional Public Health Work.

Bradley, G. H. and Wiley, J. S. The Control of Murine Typhus in the United States.

Clapp, J. M., Fay, R. W., and Simmons, S. W. The Comparative Residual Toxicity to Anopheles quadrimaculatus of DDT when Applied on Different Surfaces.

Davis, D. E. Notes on Commensal Rats in Lavaca Co., Texas