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Malaria

FEDERAL SECURITY AGENCY
Public Health Service
Communicable Disease Center
Atlanta, Ga.

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Contents

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The United States and Malaria

The United States is doing its part toward achievement of one ultimate goal of the World Health Organization -- "the eradication of malaria from the world."

Thus spoke Dr. Justin M. Andrews, Deputy Officer in Charge of the Communicable Disease Center, at a meeting in December in Tampa, Fla., of the American Association of Economic Entomology.

"The effort now aimed at the eradication of malaria as an endemic disease in the United States is the culmination of a long series of antimalarial activities -- purposeful and fortuitous -- which have been carried on in this country for about 50 years," Dr. Andrews said.

But the United States, Dr. Andrews pointed out, is not the only area in which malaria eradication programs are being carried on. "The availability of DDT and other residual insecticides since World War II has led to more or less ambitious attempts at the regional extinction of malaria insect carriers," he said.

A leading malariologist, Dr. Andrews is president-elect of the National Malaria Society.

"Endemic malaria is not yet eradicated from this country," Dr. Andrews explained. "When it will be is uncertain and may even be a matter of definition -- but it is of transcendent importance to the Federal, State, and local agencies supporting the eradication program to have available the best considered information on this subject."

Hence, he pointed out, the CDC has asked the National Malaria Society to provide a suitable gauge by which to measure the accomplishments toward eradication.

The CDC, meanwhile, according to Dr. Andrews, (1) is trying to make the reporting of malaria more accurate; (2) is improving laboratory diagnostic facilities in all the States by training technicians in the recognition of parasites; (3) has "malaria detectives" in State health departments to investigate deaths and cases alleged to have been caused by malaria; (4) is operating malaria observation and investigational stations at Helena, Ark.; Newton, Ga.; and Manning, S. C.; (5) has undertaken "a campaign of national and State publicity to inform practicing physicians about the eradication program and to emphasize the practitioner's role in it. Doctors are being urged to diagnose and report malaria on a more scientific basis."

State health departments and the Communicable Disease Center are now at the midpoint of an ambitious 5-year program to wipe out malaria as a major public health problem in the United States.

The printing of this publication has been approved by the Director of the Bureau of the Budget January 19, 1950.

Laboratory Diagnosis of MALARIA

M. M. Brooke, Senior Scientist

In the current effort to eradicate malaria from the United States, epidemiologists and engineers are dependent upon laboratory examinations of blood films for definite proof of the existence of malaria in an area. Among 28,872 blood films examined by the parasitology laboratories of the Communicable Disease Center between July 1948 and June 1949, only four were found positive for malarial parasites. In view of the scarcity of positives and the extreme importance of revealing them, it is appropriate to review some of the factors that contribute to the accurate laboratory diagnosis of malaria.

Whereas the thin blood film is ideal for studying the morphology of malarial parasites, the thick film (figure 1) is far superior as a diagnostic tool. The thick-blood-film procedure is essentially a concentration technique whereby it is possible to find malarial parasites which might be missed in thin films. In addition to revealing more positives, the amount of time spent on the examination of each specimen can be greatly reduced since there is from 10 to 50 times more blood per microscopic field in a thick film than in a thin one. Therefore, whereas it is advisable to examine thin films from 15 to 30 minutes, it is generally sufficient to examine thick films for only 3 to 5 minutes. Likewise, 100 microscopic fields are considered an adequate routine examination of thick films. However, in dealing with suspected cases or epidemiological contacts, it is advisable to study a greater number (at least 150 fields).

The preparation of satisfactory thick blood films is not difficult, but in many laboratories more unsatisfactory blood films are received than almost any other type of specimen. See accompanying illustration, figure 2, page 2, for properly prepared and improperly prepared blood films. In a southern State laboratory that he recently visited, the author was shown a washtub full of unsatisfactory slides received during the past several months. Anyone preparing blood films for the diagnosis of malaria should determine if the specimens meet the needs of the laboratory.*

Giemsa's stain is recognized as superior to Wright's for the staining of malarial parasites (Wilcox, 1942). It gives more uniform results and can be adapted more easily to routine survey work. When a number of blood films are stained together, precautions should be taken to prevent the possibility of blood transferring from one slide to another. The parasitology laboratories of the Communicable Disease Center have evaluated mass staining procedures for malaria and have demonstrated the possibility of false positive diagnoses arising from blood transferred from malarious films to otherwise normal films (Brooke and Donaldson, 1948). Fortunately, the transfer of blood can be virtually eliminated during mass staining procedures by the addition of a small quantity of a surface-active agent (Triton X-30) to the Giemsa solution (Brooke and Donaldson, in press). In addition, the resulting stained blood films are more easily examined, since they

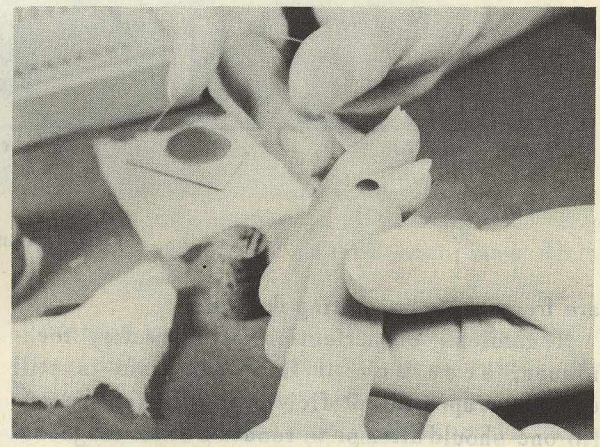

Figure 1. Preparing thick blood film.

**The correct technique is demonstrated in a movie, "The Preparation and Staining of Blood Films," obtainable from the Film Library of the Communicable Disease Center.*

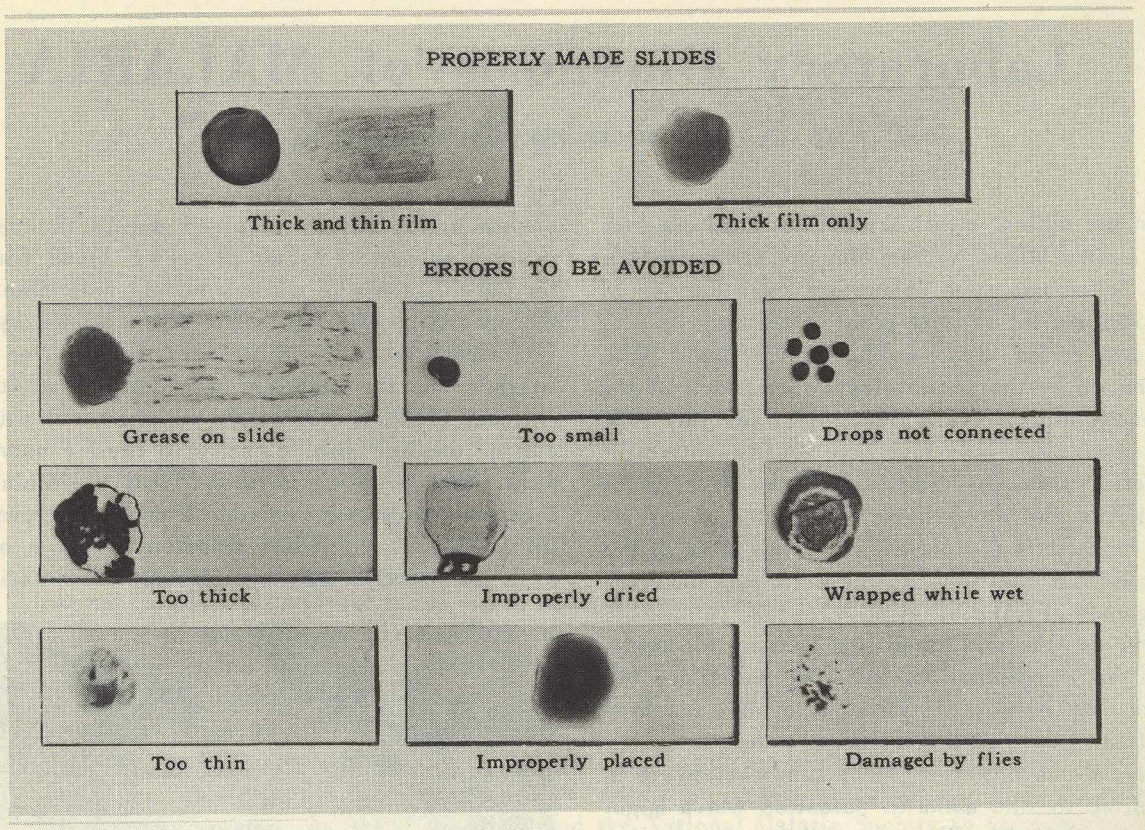

Figure 2.

are freer of contaminating debris.

Regardless of perfection of laboratory techniques, accuracy of final diagnosis is still dependent upon the proficiency of the technician. No one should attempt to render a final diagnosis who has not had adequate training and experience. In this field it is advisable to receive personal instruction in organized training courses. This is particularly true in dealing with thick blood films which may be very confusing without proper guidance. On the other hand, if a person has ample time, sufficient diligence, and reliable illustrations, (e.g. Wilcox, 1942), it is possible to teach oneself to recognize malarial parasites. In either event, after the training period the technician should examine numerous test unknowns before undertaking the examination of survey or clinical blood films.* The grade obtained on the examination of test unknowns will indicate to the technician his relative ability to identify the organisms. In most instances it requires several months of supervised experience before a technician can be relied upon to render correct diagnoses.

Unfortunately, a person loses the ability to find and identify malarial parasites without continued practice. Since, at the present time, positives are encountered rarely in diagnostic laboratories, technicians periodically should review blood films containing the three common species of malaria. Furthermore, arrangements should be made by the laboratory director to have known positive blood films submitted along with routine specimens. Technicians will welcome the opportunity of finding these positives and the director will have greater confidence in the usual negative findings of his laboratory.

During the years of World War II the laboratory

** Loan sets of test slides soon will be available from the Laboratory Services of the Communicable Disease Center.*

diagnosis of malaria reached a high level of proficiency. Numerous military and civilian technicians received intensive training in special courses given by Miss Aimee Wilcox, CDC, and other governmental and private institutions. Recently, practically every major community in this country has had competent technicians capable of diagnosing malaria from thick blood films. It will be difficult to maintain a high level of proficiency, but every effort should be made to do so. Laboratories in the United States currently have the unique opportunity of taking part in eradicating one of the worst scourges mankind has ever known, but if the program is to succeed, laboratories must do everything within their power to assure correct diagnoses.

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A Review of Existing Insect Abatement Legislation

Leslie D. Beadle, Sanitarian (R) and
Nelson H. Rector, Senior Sanitary Engineer (R)

While the Communicable Disease Center and the various State health departments have been conducting extensive malaria-control programs in the Southern States, it frequently has been indicated that there was a definite need for a means whereby the control of mosquitoes and, possibly, also flies, other arthropods, and domestic rodents could be provided in afflicted areas. This problem is being met satisfactorily in several States by the creation of abatement districts which permit local financing of adequate control measures.

Copies of all existing State laws which establish the procedure for creating mosquito abatement districts within States therefore were secured, reviewed, and analyzed. An attempt has been made to enumerate the better features of all existing State laws.

A brief summary of certain features of the various State laws is presented in table 1. It will be noted that 20 States have mosquito abatement laws, and approximately one hundred permanent mosquito-control districts operate under these laws in various parts of the country. It also will be noted that New Jersey and California were the first States to promulgate State-wide laws pertaining to mosquito abatement (1906 and 1915) while Minnesota and Texas passed such laws during the past year.

District Unit. The majority of abatement districts embrace county-wide areas throughout the State, but there are several exceptions: in Alabama, the law pertains only to one county; Massachusetts limits greenhead-fly control projects to localities along the seacoast; the Texas law concerns only counties bordering the Gulf of Mexico; and the Virginia law pertains to counties and towns in the tidewater section of the State. The Minnesota law is unusual in that abatement districts cannot be set up on a county basis, the "governmental unit" being defined as "any city, village, borough, or town."

There is unanimity of opinion among those who have had considerable experience with the operation of insect control districts that all laws should allow any community or county within a State to create an abatement district if there is a problem of sufficient importance. The limiting of abatement districts to municipalities is an undesirable provision because many of the more troublesome

TABLE 1

Features of State Laws Pertaining to Mosquito Abatement and Number of Mosquito Districts in Existence Under Such Laws

State	Year Laws Approved	District Unit	Pest Empowered to Control	Mosquito Control Board	Abatement Plans Approved by	No. of Districts in State (1949)
Ala.	1939	Colbert County	Malaria mosquitoes	No special board	County Court and County Health Dept.	1
Calif.	1915	Territory in 1 or more counties with pop. of 100 or more	Mosquitoes, flies, other insects, & rats	At least 5 members	State Health Dept. approves if State aid is received	41
Conn.	1915	Any locality	Mosquitoes	State Board (5 members)	State Board of Mosquito Control	-
Del.	1933	Any locality	Mosquitoes	No special board	State Highway Dept.	-
Fla.	1929	Any county	Mosquitoes	County Commissioners in counties over 65,000; or 4 members (3 appointed & State health officer in smaller counties)	State Health Dept.	13
Ill.	1927	Territory in 1 or more counties with pop. of 300 or more	Mosquitoes, flies, & other insects	5 members	–	6
Maine	1933	Any locality	Mosquitoes	No special board	State Dept. of Health	-
Mass.	1929	Greenhead fly control limited to localities along seacoast	Mosquitoes & greenhead flies	Data not available	State Reclamation Board	3
Minn.	1949	Any city, town, or village	Mosquitoes, other insects, & arachnids (ticks, mites, & spiders)	4 members (3 appointed & State Commissioner of Agric.)	State Dept. of Agric. & State Dept. of Conservation	0
Miss.	1928	One or more counties	Mosquitoes	4 members (3 appointed & State health officer)	County Board of Supervisors & State Health Dept.	0
N. J.	1906	Any county	Mosquitoes	8 members (6 appointed & Director of State Exp. Sta. & State Dir. of Health)	State Agric. Exp. Sta.	14

(Table 1 continued on next page.)

(Table 1, continued from page 4.)

State	Year Laws Approved	District Unit	Pest Empowered to Control	Mosquito Control Board	Abatement Plans Approved by	No. of Districts in State (1949)
N. Y.	1916	Any county (not including N.Y.City)	Mosquitoes, flies, ticks, & other "hominoxious" arthropods	6 members (4 appointed & chairman of Board of Supervisors & 1 member appointed by State health officer)	County Board of Supervisors	1
Ohio	1945	Any county or portion of	Mosquitoes, flies, & other insects	Data not available	State Dept. of Health	1
Oreg.	1939	Any county or portion of with pop. of 100,000 or more	Mosquitoes	6 members (5 appointed & Director of State Exp. Sta.)	State Exp. Sta.	0
Pa.	1935	Any county or portion of	Mosquitoes	5 members	County Commissioners	1
R. I.	1934	Any city or town	Mosquitoes	No special board	State Dept. of Agric. & Conservation	-
Tex.	1949	Counties bordering Gulf of Mexico	Mosquitoes	Advisory Commission of 5 members makes recommendations	County Court	1
Utah	1923	Any city, county, or portion of with pop. of 100 or more	Mosquitoes, flies, & other insects	At least 5 members	–	4
Vt.	1947	Any locality	Mosquitoes	State Mosquito Control Advisory Committee (4 members)	State Commissioner of Agric.	-
Va.	1928	Counties, cities, & towns in tidewater section of State	Mosquitoes	3 members (2 appointed & State health officer or his deputy)	State Health Dept.	12

insect pests breed in very extensive areas, such as salt marshes and flood plains, and frequently these areas lie outside the city limits.

Pest Which a District Is Empowered to Control. Most of the laws authorize the control of all species of mosquitoes; however, Alabama limits control to malaria mosquitoes. Seven of the State laws permit the districts to engage in the control of mosquitoes and other insects, particularly flies. The Minnesota and New York laws provide for the abatement of arachnids (ticks), and in California several districts are empowered to control rats.

It is highly desirable that districts be granted authority to control all species of insects, arachnids, and rodents which affect public health. This provision would permit the smaller districts to maintain a better year-round program since the abatement of certain pests, such as rodents, could be done during the nonmosquito-breeding months. Furthermore, in many sections of the country

annoyance caused by gnats, sand flies, stable flies, and house flies is just as great as, or even greater than, that caused by mosquitoes. In such areas the public demands control of these pests.

Mosquito Control Board. The administrative body for a district is frequently designated as a "Board of Trustees" or "Mosquito Control (Extermination) Commission." Most of the laws limit the board membership to three, four, five, six, or eight members. In California and Utah the board consists of at least five members, but may be larger if incorporated municipalities are included, since one member is appointed from each city---e.g. the board of trustees for the Alameda County Abatement District in California consists of nine members. The State health officer is ex officio member of the board in Florida, in Mississippi, and in New Jersey, and is ex officio chairman of each commission in Virginia. The Director of the Agricultural Experiment Station is ex officio member of the board in New Jersey and Oregon, while the Commissioner of Agriculture serves in this capacity in Minnesota.

The Florida law authorizes the Board of County Commissioners to serve as the governing body for antimosquito districts in counties having more than 65,000 population.

It is believed that more public interest in the district's abatement program would be aroused if the governing board consisted of more than three members. On the other hand a large board tends to be unwieldy. It is our opinion that the board should consist of five or six members.

Duties and Powers of the Board. By the powers conferred under various State laws, the district board may:

1. Take all steps necessary to abate pests within the district.
2. Purchase necessary supplies, equipment, and material needed to control or abate pests.
3. When necessary and proper in furtherance of the objectives of the act, the board may build, construct, maintain, and repair: dikes, levees, cuts, canals, or ditches upon any land within the district.
4. Enter without hindrance any lands within the district for the purpose of inspection to ascertain whether pests are breeding thereon.
5. Sell or lease any land, right-of-way, easement, property, or material acquired by the district.
6. Borrow money for operation of the district and repay in the same or the next fiscal year.
7. Do any and all things necessary or incident to the powers granted and to carry out the objectives specified in the act.

Powers set forth under the California and Utah acts provide for inspection and performance of control work OUTSIDE the district boundaries when such territory is so situated that mosquitoes therefrom may migrate into the district.

The power to perform work outside district boundaries is an excellent provision because the majority of districts are concerned with the control of migratory mosquitoes -- salt marsh and floodwater species -- and these types are noted for flying long distances from their breeding source.

Guiding Agency. Most of the laws provide for State coordination or cooperation. In New Jersey the work of the various commissions is supervised and directed by the Director of the Agricultural Experiment Station. In Florida, Maine, Ohio, and Virginia such supervision is under the State health department. In Massachusetts, mosquito control projects are under the State Reclamation Board (this board of three members includes a representative from the State Department of Public Health and the State Department of Agriculture). In Connecticut, mosquito abatement projects are administered by a Board of Mosquito Control, consisting of: the Director of the State Experiment Station, the Director of the State Water Commission, the Superintendent of the State Board of Fisheries and Game, the Commissioner of Health, and one person appointed by the governor. In Minnesota, Rhode Island, and Vermont mosquito abatement projects are under the State Department of Agriculture. The Delaware law is unique in that mosquito control programs are under the supervision of the State Highway Department. Mosquito abatement districts in Alabama, California, Pennsylvania, Texas, and Utah lack State supervision.

It is believed that each mosquito control district should be under State supervision to provide for coordination of work of the various districts, and in many cases State participation gives tech-

nical advice to districts which they could not otherwise afford.

State Appropriations. In Virginia the State Board of Health contributes annually to the mosquito control commission a sum not more than 25 percent of the gross amount obtained from tax levy and not to exceed $10,000 in any one year. In Delaware, Maine, and Rhode Island, the State Legislature makes an annual appropriation for mosquito abatement. Any town in the last-named State desiring to make use of State funds must match such funds. Legislation passed in Florida in 1949 provides for State aid to organized mosquito control districts and county health units, such funds being administered by the State Board of Health. Districts and county health units must match the State contribution which may not exceed $15,000 per county per year. During recent years the State Legislature of California has made substantial appropriations to the State health department for assistance to local abatement districts and health departments in the control of disease-bearing mosquitoes (vectors of encephalitis and malaria).

Suggestions for Inclusion in State Legislation. Provisions which would be desirable for inclusion in abatement laws are briefly summarized as follows:

1. Each district should be under the technical supervision of an officer of a designated State agency who would approve plans, methods, and cost estimates.

2. The district should have the jurisdiction to control pests other than mosquitoes, such as flies, fleas, ticks, rats, and other vermin which affect the public health.

3. It should be possible to organize any number of adjacent municipal and county governmental units into insect and pest control districts throughout the State.

4. The administrative body (board) for the district should consist of a definite number of members -- such as five or six -- and the board should include at least one member from a local health department. The State health officer should be ex officio member of each board.

5. The board should have the power to make inspections and to perform control work on territory adjacent to the district.

6. The State should render technical assistance by making preliminary surveys, by preparing abatement plans, and by determining cost estimates of same.

7. Provision should be made for the enlargement by annexation or consolidation, and for discontinuance of any insect and pest control district.

It is believed that these provisions would be of considerable help to States without enabling laws for insect and rodent control when they wish to promulgate this type of legislation. Several States have already requested information from the Communicable Disease Center concerning such legislation.

Some Highlights of the 1949 Residual Spray Program

Porter A. Stephens, Sanitary Engineer (R)

GENERAL

In the spring of 1945, when the residual spray activities were inaugurated on what then was designated as an Extended Malaria Control Program, many problems confronted personnel engaged in those activities. Supplies of insecticidal chemicals were limited, suitable new commercial type vehicles were not available, and spray equipment designed specifically for residual spraying did not exist. Hard and fast policies or rules were not established to unify or standardize program-wide operational procedures and

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techniques. Areas applicable for participation were jointly agreed upon by the Public Health Service and the various States, and a minimum DDT application rate was recommended. The Atlanta office did establish facilities to develop, procure, and test new equipment and materials and to correlate over-all program requirements. Each succeeding spray season has seen an increase in efforts by both headquarters and field personnel to accomplish more effective insect control at a reduced cost. These efforts have produced many new and improved facilities. Many are significant from an over-all program standpoint, and a large number of facilities have been developed by individual programs or from ideas originating in the field. During fiscal year 1949 more new or improved materials, equipment, and processes were employed than in any previous year. A few of these are presented herein with no attempt being made to evaluate specific effects on the program.

Chemicals and Experiments To insure procurement of the highest quality chemicals possible, the Engineering, Administrative, and Technical Development Services participated jointly in the preparation of chemical specifications. Schedules for collection and submission of samples were worked out and procedures were adopted for testing chemicals for conformance with specifications.

During the season samples from three shipments of DDT failed to meet some requirements of these specifications and were rejected. All unused portions of these shipments were replaced. In the field of new insecticides and formulations, the Technical Development Services tested and recommended for use on outside surfaces, where fly breeding produced a significant problem, a formulation containing pine rosin as a sticking agent. The rosin formula was employed on five State programs to treat outside premises surfaces and interiors of barns and other outbuildings. The effectiveness of this formulation has not been demonstrated fully.

Experimental projects involving the use of different chemicals and formulations were approved for operations in several States. One such project conducted in Tennessee utilized water-wettable DDT in one section and methoxychlor in another. On a county-wide respray project the Mississippi program employed on inside surfaces a 2½ percent DDT-kerosene solution in one area and a 2½ percent DDT emulsion in another. A 2 percent chlordan-3 percent DDT formulation was applied to outside surfaces in both areas. Selected areas in Arkansas were resprayed with an emulsion containing DDT of low setting point. Other experimental activities included limited application of chlordan and methoxychlor in Arkansas and chlordan in Alabama. Preliminary results of the Mississippi project indicate very little residual effect of chlordan when applied to outside surfaces. The low setting point DDT got no better results with respect to fly control than DDT purchased under applicable specifications.

Time-Motion Studies At no time during the life of the residual-spray malaria control program had there been a special effort to evaluate the amount of time devoted by field personnel to the various items of spray operations until the summer of 1949. The Engineering Services formulated plans for the inauguration of a time-motion study to be conducted in a representative number of States. The primary purpose of the study was to provide a means by which individual States could direct efforts towards conservation of time and increased efficiency. The Malaria Section obtained automotive equipment and several types of spray equipment, and provided a supervisor to direct field activities. Studies were conducted in four States: Alabama, Arkansas, Tennessee, and Texas. Actions of spraying personnel using local equipment during a spray day were timed. In each State program, spraying personnel were given an opportunity to become acquainted with both hand and power constant-pressure spray equipment provided for that purpose. A final summary of the time-motion evaluation has not been completed to date.

As an aid to the various States in the development of efficient local insect-control activities, the equipment used on the time-motion study is available for demonstrational activities. The insecticidal equipment includes a standard posi-

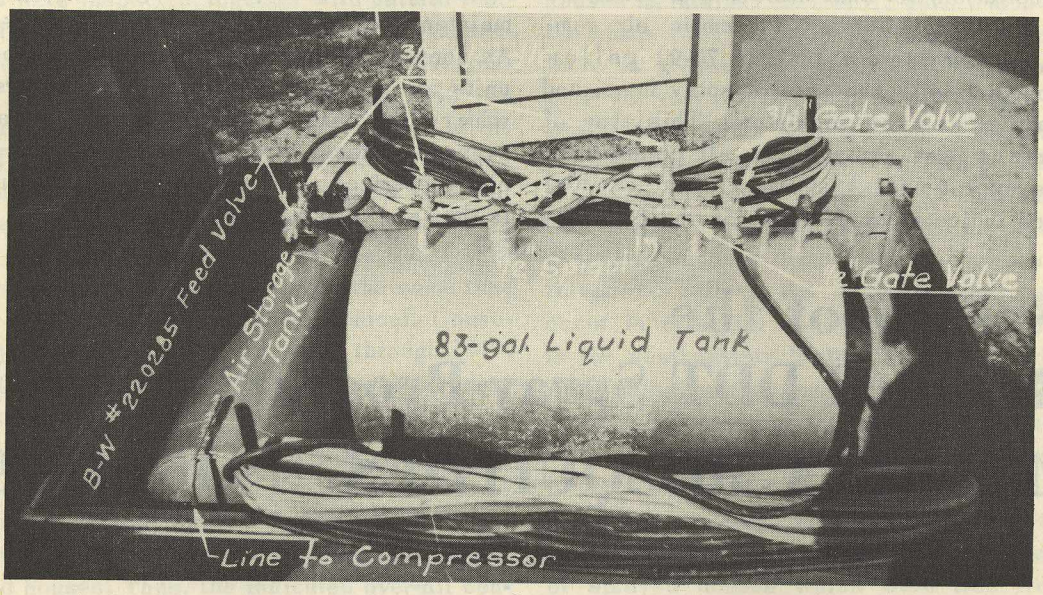
tive displacement-type pump power spray unit; pneumatic-type power spray unit, supplied with air from a modern truck-engine mounted compressor; an exhaust aerosol generator; and various types of the latest hand-spray equipment. Detailed sketches showing the arrangements of equipment have been prepared and will soon be available for distribution.

Insect Abatement The establishment and operation of insect abatement programs within States received increased consideration during the year. Activities in the Florida abatement program were expanded. Revised regulations were prepared in Virginia for presentation to the Legislature to permit State-wide coverage. The Texas State Health Department was successful in securing local abatement legislation covering some sections of the State.

Anticipating a continued downward trend in Federal funds available for residual spray operations, the Engineering Services, in the interest of long-range planning, began preliminary studies and the development of an instrument by which effective vector control might be continued through increased local financing. Copies of all existing insect abatement laws, rules, and regulations were obtained from States where these statutes are in effect. To date a preliminary draft of an insect abatement district code has been prepared. The original draft contains the entire code which may be included in State enabling legislation. A short form will be prepared whereby the essentials only will be included in the enabling legislation, with the State Health Department or other State agency promulgating the rules and regulations.

COMBINED MALARIA AND TYPHUS OPERATIONS

In an effort to reduce operational cost and expand field activities, the Florida CDC program combined residual-spray malaria and typhus-dusting control activities in three rural county programs. In counties where the typhus problem was urban or semiurban and residual spraying was strictly rural, only one activity was conducted at a time. Where both problems were rural, spraying and dusting were conducted simultaneously by the same crew personnel. In one county, crews consisted of three men, and in two counties, two men. In the strictly rural areas, according to available data, the cost of combined operations was considerably less than when the two activities were conducted separately. However, where



Pneumatic power sprayer. (Courtesy of North Carolina State Board of Health).

the typhus dusting was restricted to cities and small towns, the reduction in cost was not significant.

Spray Equipment Since the beginning of the residual spray program, considerable controversy has developed on the question of hand equipment versus power equipment. Each State has adopted whatever type equipment appeared best for that particular area. Originally, power equipment consisted largely of orchard-type positive displacement power units. With the quality of hose available at that time, considerable trouble was experienced due to hoses breaking inside of houses, and this type of equipment soon fell into disrepute. During the 1947 spray season, the Tennessee program developed a pneumatic power spray unit. With reliable hose, satisfactory results have been experienced. Other States developed similar equipment which was used on certain portions of State programs during the 1948 spray season. At the beginning of the 1949 season, the North Carolina program had developed a standard unit (see illustration) for that State which consisted of the truck-engine-driven automatic air compressor, an air storage tank, a 70-90 gallon emulsion tank with two sets of spray hose, and necessary pressure regulators. This type of equipment was provided in all preapproved counties except one. A summary of seasonal activities indicates an increase of about 25 percent in sprayman output over the 1948 season.

A constant-pressure hand-spray can, developed by the Technical Development Services, was field tested during the season. The unit consists two concentric-drawn aluminum tubes welded at top and bottom; a constant-pressure regulator; and hose and wand assembly. From test results, it appears that the unit is practical, and negotiations are under way whereby similar units may be manufactured commercially.

AUTOMOTIVE MAINTENANCE

One of the largest problems encountered in the residual spray program has been that of procurement, operation, and maintenance of automotive equipment. Procurement has been a headquarters problem, but operation and maintenance have been of local importance. Some States have relied on commercial facilities for maintenance and repairs, but most of them have set up shop facilities within the program and have succeeded in developing maintenance techniques with varying degrees of success. Two States in particular, Arkansas and Louisiana, inaugurated preventive maintenance practices during the 1949 season. As soon as the spray season is over, automotive units are brought to the State headquarters shop where they are completely overhauled and all exposed surfaces repainted or coated with a special rubberized paint preparation. The equipment is then stored at a central point.

Results of the Residual DDT Spray Program Against MALARIA MOSQUITOES, 1945 - 1949

F. Earle Lyman, Scientist (R)

The DDT Residual Spray Program for malaria control initiated in 1945 by State departments of health in the southeastern United States in cooperation with the Communicable Disease Center of the Public Health Service has completed 5 years of operational work, during which period over five million house sprayings have been made. In 1949 the number of counties in which operations were carried on reached 344, and the number of individual houses treated was nearly one million.

The reduction of the malaria hazard by the

Residual Spray Program has been measured during the past 5 years in terms of its ability to maintain houses free of *Anopheles quadrimaculatus*. Control operations (in this country) have been directed specifically against those individual malaria mosquitoes which enter houses to bite and are therefore most likely to transmit malaria. The *A. quadrimaculatus* habit of resting and lingering within houses, especially after a blood meal, is well known; and it is this characteristic which results in control through the inside residual spraying of houses. Conclusions as to the effectiveness of the Residual Spray Program are based on data secured from inspections of randomly selected sprayed and unsprayed houses for the presence or absence of *A. quadrimaculatus*.

A 5-year summary of data is given in table 1 covering entomological evaluation of control operations on the Residual Spray Program for 13 southeastern States during the years 1945 through 1949. The data are based on a total of approximately sixty-five thousand inspections of sprayed and unsprayed houses. It should be noted that in 1945, the first year of the program, only sprayed houses were inspected, together with natural resting places such as barns and privies; and inspections of unsprayed houses for comparative purposes were not made until 1946. In 1945 two seasonal applications of DDT were applied at the rate of 100 milligrams per square foot. However, evaluation data indicated that a single seasonal application of 200 milligrams per square foot would be about equally effective from the standpoint of long-lasting residual and at the same time would be operationally more economical. Consequently, in subsequent years, 1946 through 1949, the 200 milligram application rate has been recommended and used in nearly all States.

It may be observed in table 1 that the average percentage of sprayed houses maintained free of *A. quadrimaculatus* for the 5-year period, 1945-1949, was 98.3 as compared to only 83.6 for unsprayed houses. Thus, the indicated over-all control (reduction in houses infested) was approximately 90 percent for the 5-year period. The gradual decrease in effectiveness of the residual during the course of the season is indicated by the average percentage of houses free of *A. quadrimaculatus* for each successive month following the spray application. During the first month after spraying 99.1 percent of sprayed housee were free from *A. quadrimaculatus;* during the second month only 98.7 percent; in the third month 98.1 percent; for the fourth month 97.8 percent; and for the fifth month 96.5 percent. The indicated percentages of control, for successive periods of 0-1, 1-2, 2-3, 3-4, and 4-5 months after spraying were 95, 92, 88, 87, and 79 percent, respectively. Thus, it seems apparent that only a relatively gradual decrease in effective control occurs during the first 4 months after application, but thereafter the decline in effectiveness is accelerated.

Table 2 presents a summary of data on evaluation of the program for the years 1946 through 1949, showing for each year the ratio of the number of sprayed and unsprayed houses in which *A. quadrimaculatus* were found to the total number of sprayed and unsprayed houses inspected, and the indicated percentages of control obtained for the several years. The reason for omitting the year 1945 has already been given.

A comparison of the percentages of sprayed houses maintained free of *A. quadrimaculatus* for the years 1946 through 1949 (table 2) shows that there is a small but significant difference from year to year in these figures. A more marked degree of variation is seen in the comparable percentages for unsprayed houses. Two points appear worthy of emphasis here. One is that the variation from year to year between the percentages of unsprayed houses free from mosquitoes is believed to reflect the annual variations which occur in mosquito abundance from year to year in the southeastern States. In other words, it is indicated that the mosquito crop in 1947, when only 72.0 percent of the unsprayed houses were free of *A. quadrimaculatus*, was considerably larger, for example, than in 1949, when this percentage was 91.4. The other point is that the small but significant variation in the percentages of sprayed houses which were free from mosquitoes indicates the relatively consistent high level of control being achieved by the application of residual DDT spray. That this is true may be further illustrated by examining the indicated percentages of control achieved in the different years; namely, 92.1 percent in 1946; 95.7 percent

Table 1

Five-Year Summary of Entomological Evaluation of Residual Spray Program in 13 Southeastern States, 1945-1949, Based on 64,355 Inspections of Sprayed and Unsprayed Houses. Reduction in Malaria Hazard through Residual DDT Spraying Is Indicated by Comparison of Percentages of Inspected Houses Found Free of "Anopheles quadrimaculatus" in the Afternoon.

SPRAYED HOUSES

Months After Spraying	Number of Houses Inspected						Number of Houses with "A. quad." in p.m.						Percentage of Houses Free of "A. quad." in p.m.					
	1945	1946	1947	1948	1949	Total	1945	1946	1947	1948	1949	Total	1945	1946	1947	1948	1949	Average 1945-1949
0-1	3,916	6,018	1,546	699	1,064	13,243	42	49	12	22	5	130	98.9	99.2	99.2	96.9	99.5	99.1
1-2	4,558	6,739	2,690	1,354	1,871	17,212	79	66	40	24	15	224	98.3	99.0	98.5	98.2	99.2	98.7
2-3	3,557	5,321	2,538	2,093	2,304	15,813	154	50	32	36	28	300	95.7	99.1	98.7	98.2	98.8	98.1
3-4	1,375	2,974	1,578	2,102	1,530	9,559	73	39	20	57	22	211	94.7	98.7	98.7	97.3	98.6	97.8
4-5	723	899	442	1,231	404	3,699	42	16	5	67	2	132	94.2	98.2	98.9	94.6	99.5	96.5
All	14,129	21,951	8,794	7,479	7,173	59,526	390	220	109	206	72	997	97.2	99.0	98.8	97.2	99.0	98.3

UNSPRAYED HOUSES

	Number of Houses Inspected						Number of Houses with "A. quad." in p.m.						Percentage of Houses Free of "A. quad." in p.m.					
	1945	1946	1947	1948	1949	Total	1945	1946	1947	1948	1949	Total	1945	1946	1947	1948	1949	Average 1946-1949
	-	1,639	1,170	1,021	999	4,829	-	208	328	170	85	791	-	87.3	72.0	83.3	91.4	83.6

Table 2

Summary of Entomological Evaluation of Residual Spray Program, 1946-1949.

	1946	1947	1948	1949	Average 1946-49
SPRAYED					
(1) Ratio of: No. Houses with *A. quadrimaculatus* to No. Houses Inspected	1:100	1:80	1:36	1:100	1:75
(2) Percentage of Houses Free of *A. quadrimaculatus*	99.0	98.8	97.2	99.0	98.7
UNSPRAYED					
(3) Ratio of: No. Houses with *A. quadrimaculatus* to No. Houses Inspected	1:8	1:4	1:6	1:12	1:6
(4) Percentage of Houses Free of *A. quadrimaculatus*	87.3	72.0	83.3	91.4	83.6
(5) Indicated Percentage of Control	92.1	95.7	83.2	88.4	92.0

in 1947; 83.2 percent in 1948; and 88.4 percent in 1949; and by the over-all average for this 4-year period of 92.0 percent control. These calculated percentages of control take into consideration the relative difference in mosquito abundance for the different years and they seem to demonstrate, other factors being equal, that effective control may be realized irrespective of seasonal variations in mosquito abundance.

Another way of showing, possibly a little more clearly, the magnitude of variation in annual malaria mosquito populations from year to year is by comparing the annual ratios of the number of unsprayed houses inspected in which mosquitoes were found to the total number of unsprayed houses inspected (table 2). These ratios are as follows: 1949, *1:12*; 1948, *1:6*; 1947, *1:4*; and 1946, *1:8*. Thus, in the year 1947, when mosquitoes are considered to have been most abundant, they were found in one house of every 4 inspected while in the year 1949, when mosquitoes were much less numerous, only one house out of every 12 inspected harbored mosquitoes. Similarly determined ratios for sprayed houses for these same years are worthy of note because they show by comparison the high degree of control realized on the Residual Spray Program. These ratios are as follows: 1949, *1:100*; 1948, *1:36*; 1947, *1:80*; and 1946, *1:100*. The ratio of *1:36* for the year 1948 appears to be a radical departure from the ratios for the other 3 years and is of especial interest to us from an evaluation of control standpoint. The calculated percentage of control realized in 1948 was only 83.2 as compared with the average percentage of 92.0 for the 4-year period, 1946-1949, or the average percentage of 93.9 for the 3 years 1949, 1947, and 1946. This reduction in effective control during 1948 quite possibly is accounted for by the fact that in this year a certain amount of difficulty was experienced through the use of substandard spray formulations in some areas. That this is a plausible explanation is supported by the fact that in each of the years 1947 and 1949 a much higher degree of mosquito control was obtained. It also is worthy of note that in the former year, 1947, mosquito populations were at the highest of any year during the period being reported.

Assuming that the entomological data presented here are a comparable measure of mosquito densities from year to year, it appears that annual differences in the percentages of control (table 2) were of statistical significance and that control operations were most effective in 1947, with 1946 ranking second, 1949 third, and 1948 in the lowest position.

Epidemiological Appraisal of Malaria Morbidity and Mortality in Five Southern States

Griffith E. Quinby, Surgeon

Most authorities believe that, until recently, there generally has been underreporting rather than overreporting of malaria. Dr. Justin M. Andrews, Deputy Officer in Charge of the Communicable Disease Center, has been convinced, since his experience in Georgia in the late 1930's, that where reported malaria is investigated, it tends to disappear.*

In 1946 CDC undertook plans for the eradication of malaria. Reported malaria was one of the important criteria by which the efficacy of the eradication program might be measured. In order to determine the relative accuracy of malaria reporting as an indication of the degree of control being achieved, a program of the epidemiological appraisal of malaria morbidity and mortality was initiated. Originally it was intended that confirmed reports would be used to select the areas in which malaria eradication resources would be concentrated.

The data gathered during the appraisal of reported malaria were used indirectly to ascertain the relative accuracy of CDC's entire communicable disease reporting system. The investigations tended primarily to discourage the spurious reporting of malaria but also confirmed some unreported cases and incorporated them into the vital statistics of the States. The investigations stimulated diagnosticians to utilize thick blood films to confirm clinically reported cases.

Cases of malaria are usually reported weekly by the diagnosing physician to the local health department, which in turn tabulates and forwards these records to the State health department. After being recompiled, the totals are telegraphed to the Public Health Service in Washington. In order to appraise the validity of malaria reporting, it was necessary to obtain the basic epidemiological data from the physician and patient. Since the legal responsibilities of the reporting system are vested in the States, this appraisal program was administered by the State health departments, utilizing principally Communicable Disease Center personnel detailed to the States.

Personnel was available for assignment to only five of the more malarious States. Medical or nurse officers of the Public Health Service assisted State epidemiologists in carrying out this program. In the summer of 1947, a medical officer was assigned to each of the States of Arkansas, Alabama, Georgia, and Mississippi, and a nurse each to South Carolina and Mississippi.

During the latter half of 1947, the States investigated the largest groups of reports which characteristically stemmed from a small number of physicians in a few counties. Fevers of undetermined origin and other ill-defined clinical entities were found ascribed to malaria. The multi-disease card reporting system which did not identify or locate the patients was considered responsible for the vast majority of spurious reports. In Mississippi the institution of a system giving the disease, name of patient, and address eliminated the greater part of the statistics not founded on sound clinical or laboratory criteria.

In both 1947 and 1948, blood surveys were carried out in those counties reporting large numbers of cases. No positive smears were found. Not only were groups of officially reported cases

*Andrews, Justin M. *General Considerations in Planning Malaria Control; Symposium on Human Malaria. Publication of Americation Association for the Advancement of Science, Number 15, 1941.*

investigated but also rumors suggesting malaria.

In January 1948, the appraisal of individual reports was begun in three States. This was done objectively by utilizing a special appraisal form produced with the cooperation of all participating States. Where possible, the reviewer traced the report through the county health department to the diagnosing physician and ultimately to the patient. Attempts were made to obtain the name, address, age, sex, and race of the patient. The case was dated both by report and onset. The source and date of the original attack were noted where known. The reporting physician was interviewed or his records reviewed to determine the method of diagnosis--whether by history, clinical impression, or laboratory means. Wherever available, the blood smears made by the diagnostician were reviewed by the appraiser or referred to the State health department or Public Health Service malaria laboratories for confirmation. Where the physician complained that the public health laboratories would never report his slides positive, he was encouraged to send his positive slides to the school of his graduation for use in teaching. With the consent of the physician, a blood specimen was obtained from the patient.

The quality of the technical standards of the laboratory examination was appraised as ACCEPTABLE, ERRONEOUS, or UNDETERMINED. In a small number of instances, the patient was re-examined clinically by the diagnostician or with his concurrence. Where a differential diagnosis was indicated, the physician was encouraged to use the facilities of the State or other specialized public health laboratories. Thus the appraisals were made by history, clinical examination, and laboratory means.

During 1948 the appraised cases were classified as POSITIVE, DOUBTFUL or IMPROBABLE. Under the POSITIVE category were included all cases with laboratory confirmation by technical standards acceptable to the State health department as well as those presumptively positive cases with consistent clinical histories, clinical findings, and therapeutic response. Under the IMPROBABLE category were included cases which lacked laboratory confirmation, which did not present consistent histories and clinical findings, or which suggested some disease other than malaria. Under the DOUBTFUL category were included all cases the appraiser could assign to neither the POSITIVE nor IMPROBABLE categories, usually because of incomplete data.

Although the aforedescribed classification removed the IMPROBABLE and DOUBTFUL reports from too serious epidemiological consideration, the POSITIVE category was too inclusive. During 1949 this category was separated into a POSITIVE category, to include only reports confirmed by laboratory standards acceptable to the State health department, and into a PRESUMPTIVE category, to include those cases with clinical diagnoses considered valid by the appraiser.

The above methods of appraisal were used to investigate the individual reported cases except where medical relations, incomplete data, or other factors contraindicated or modified the procedures. Where these appraisal procedures revealed the need, special blood surveys were conducted to sample parasitemia in the population. In September 1948, the emphasis of appraisal was shifted in South Carolina from large groups of reports to individual cases. Not until September 1949 did Arkansas initiate individual case appraisals. Prior to that time, they supplemented the laboratory facilities of the reporting physicians, held parasitologic seminars for physicians and their technicians, and performed blood surveys with mobile laboratories to evaluate the larger groups of reports. No positive films have been found by the Arkansas State Hygienic Laboratory among at least 2,000 slides during the course of this study.

The results of the program during the first few months in the fall of 1947 were hardly demonstrable except in the counties accounting for the majority of cases. In Alabama 754 cases were reported from one county and 408 from another. These cases constituted over two-thirds of those reported for the entire State. None were confirmed by examining the smears taken by the physicians. Supplemental blood surveys were negative. Therefore, the State decided to withdraw from its official reports all cases except for an estimated 40 for the first county and 20 for the other. In Arkansas, 368 cases were reported from a sin-

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gle county. These could not be confirmed; but as a result of investigation, reports practically ceased.

Table 1 shows an analysis of the 1,042 cases which were individually appraised from the 4,815 cases reported in these States of Alabama, Georgia, Mississippi, and South Carolina from which individual appraisal forms were received up to October 1, 1949. The appraised cases represent 22 percent of those officially reported. Of 1,042 cases appraised, 180 were in the POSITIVE category, which for the purposes of this summary included only diagnoses confirmed by blood films examined under laboratory standards acceptable to the State health departments; 225 were PRESUMPTIVE and 637 were DOUBTFUL or IMPROBABLE.

TABLE 1

Appraisals of Reported Malaria January 1948 to September 1949, Inclusive

State	Reported Malaria		Appraisal of diagnosis			
	Reports	Appraised	Positive*	Presumptive	Doubtful	Improbable
Ala.	429	196	42	105	35	14
Ga.	158	153	65	10	29	49
Miss.	170	145	55	24	28	38
S. C.	4,058	548	18	86	256	188
Total	4,815	1,042	180	225	348	289

*Confirmed by laboratories approved by State health department.

The methods used in the appraisal of the 1,042 reports were: history alone 770, history and laboratory 165, and laboratory alone 40.

The parasites from blood films confirmed the 180 cases of which 143 were *Plasmodium vivax*, 5 were *P. malariae*, 3 were *P. falciparum*, and species undetermined in 29. Of those same 180 confirmed cases, 115 were believed to have originated outside the United States, and only 59 from within this country (origin of 6 undetermined).

Under the conditions of diminishing endemicity of malaria in this country from 1947 through 1949, the epidemiological follow-up of reported cases is believed to have reduced spurious reporting more than it increased the reporting of undetected or unreported malaria. It is possible that physicians have been discouraged from reporting their clinical diagnoses of malaria. Nevertheless, it is also believed that the epidemiological appraisal program has reduced morbidity reporting to a level reflecting more nearly the actual incidence of malaria. Where spurious reporting has been reduced, greater emphasis should be given to finding nonclinical infections and unreported cases.

The future emphasis of the malaria appraisal program will be concentrated on the more extensive epidemiological investigation in the vicinity of all positive cases, to determine the circumstances of transmission, the extent of the residual focus of infection, and the reasons for survival of the infection. Also, where clinically suspected malaria cannot be confirmed, special laboratory and communicable disease consultant services should be rendered to the reporting physicians to establish the true etiology of the disease.

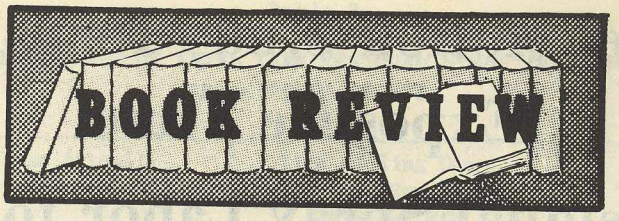
CONCLUSIONS

(1) Two years' epidemiological studies of malaria have further supported the concept that where reported malaria is investigated, it tends to disappear.

(2) Most of the cases reported to the State health departments lacked consistent clinical history or laboratory proof of infection. Few of these could be confirmed by case follow-up.

(3) During 21 months of investigations in 4 States, only 59 reports were confirmed by laboratory standards acceptable to the State health departments and were believed to have had their origin within the United States. Some of these might be scientifically questioned.

(4) Epidemiological appraisal is essential in directing economically the final phases of the malaria eradication program.



The Natural History of Mosquitoes

by Marston Bates, New York: MacMillan, 1949. 379 pp. Price $5.00.

This beautifully written volume is an interesting and orderly presentation of facts concerning the environment and behavior of mosquitoes. Because of the necessity of identifying and controlling species which are dangerous vectors of disease, a large literature has accumulated concerning these and other aspects of mosquito lore, including ecology and physiology. Much of this incidental information is sequestered in specialized scientific journals rarely seen by students of biological theory. Dr. Bates invites their attention to this rich but relatively unexploited source of knowledge about mosquito behavior. He believes this should be especially valuable to those interested in speciation, taxonomy, organic diversity and evolution, and population dynamics.

The content of the book falls into three main categories. Following the introductory section, the first 11 chapters--almost three-fifths of the total text--deal with the environment and functional responses of mosquito adults, eggs, larvae, and pupae. The next three chapters--one-sixth of the text--are an excellent discussion of the relations of mosquitoes to other organisms, especially in the vectoring of pathogens. The third section presents the species problem, information concerning classification and distribution of mosquitoes, techniques in mosquito study, and the strategy of mosquito research as the author views it. The appendix includes a systematic list of mosquito species, a 45-page bibliography, and an index.

Throughout the book, the factual content is enlivened and enriched by the author's comments, interpretations and conclusions, the fruit of his unhindered reflections in the llanos of Columbia.

While avowedly written to catch the eye of "academic biologist," THE NATURAL HISTORY OF MOSQUITOES is highly recommended to medical and other entomologists, parasitologists, malariologists, virologists, epidemiologists, and students of tropical medicine and hygiene. They are certain to find passages of special interest to them--but the reviewer's bet is that they'll read the entire book with interest and appreciation.

Justin M. Andrews,
Scientist Director

Time-Motion Study Items and Exposure Time of Residual Spray Labor to DDT

Porter A. Stephens, Sanitary Engineer (R)

During June and July 1949, a limited time-motion study of spray-crew activities was conducted in Alabama, Arkansas, Tennessee, and Texas. Primarily, the study was designed to record accurately each of the numerous items of work performed by an individual spray-crew member during a complete work day. It is expected that, by critical analysis of accumulated data, a means of increasing operational efficiency may be developed.

The study in the four States included observation and timing of 2 two-man crews using hand spray cans with hand pumps; 9 two-man crews using hand cans charged with air from air reservoirs or compressors; 4 two-man crews using constant pressure spray cans; 1 two-man crew using power spray equipment; and 3 one-man crews using power spray equipment. These crews treated a total of 293 houses, at a total expenditure of 16,512 man-minutes. Each item of normal work performed during a day was timed, beginning with mixing and loading chemicals in the morning, through cleaning equipment after return to the base at night.

Table 1 is a composite summary of the three categories indicated, showing the relation between total time expended, actual spray time, and the time spray crews were in contact with spray material. It may be noted that crewmen in category number 1, which includes only two crews, spent a greater percentage of time spraying than those in category number 2, which includes nine crews. Had an equal number of crews been rated in each category, the percentages could well have been reversed since the first group consisted of well trained crews in one State and group number 2 consisted of crews from three States with variable degrees of training.

Because crews were not familiar with constant pressure spray cans, and because two-man crews were an exception in Tennessee, these categories were omitted from the summary.

In view of the relatively high percentage of time that spray crews were exposed to spray material, as revealed by table 1, it appeared that similar data for the entire residual spray program would provide valuable information for toxicological studies now being conducted. Table 2 was

Table 1

SUMMARY OF TIME-MOTION STUDY ITEMS

Category No.	No. Houses	Total Man-Minutes Time Expended	Total Minutes Spray Time	Percent Total Time	Total Time in Contact with Insecticide	Percent Total Time
1	37	1,887.8	721.2	38.6	1,058.8	56.1
2	141	8,002.1	2,381.0	29.8	3,474.3	43.4
3	33	1,249.0	633.0	51.0	839.0	67.2

Note:

Category 1 — Hand spray cans — hand pumps. (two-man crews)
Category 2 — Hand spray cans — charged from air tank. (two-man crews)
Category 3 — Power spray equipment. (one-man crew)

Table 2

PERCENTAGE OF TOTAL TIME RESIDUAL SPRAY PERSONNEL ARE EXPOSED TO DDT

State	Time Actually Spraying		Time Filling Cans, Cleaning Equipment, Mixing, Etc.		Total Potential Exposure Time	
	Hours Per Day	Percent of Time	Hours Per Day	Percent of Time	Hours Per Day	Percent of Time
Alabama	3.04	38	1.50	19	4.56	57
Arkansas	3.30	41	1.10	14	4.40	55
Florida	3.04	38	1.84	23	4.88	61
Georgia	3.28	41	2.08	26	5.36	67
Kentucky	3.00	38	1.50	19	4.56	57
Louisiana	2.33	30	1.84	22	4.17	52
Mississippi*	6.98	87	-	-	6.98	87
Missouri	2.81	35	2.48	31	5.28	66
North Carolina	6.16	77	0.64	8	6.80	85 (Power)
	4.96	62	1.84	23	6.80	85 (Hand)
Oklahoma	-	-	-	-	3.36	42
South Carolina	2.80	35	1.60	20	4.40	55
Tennessee	3.44	43	0.88	11	4.32	54
Texas	3.15	39	0.50	6	3.60	45
Average		43		15		58

*Hours and percentage shown for Mississippi include travel and contact time in addition to actual spray time, time for filling cans, cleaning equipment, and mixing. A further breakdown is not available.

compiled from data collected during the time-motion study in four States, and from actual or estimated data from the other nine residual-spray States.

It should be noted (footnote) that hours of spray time for Mississippi include travel time. The average travel time for all States covered by the time-motion study was 27 percent of the total time. Applying this percentage to the Mississippi data, actual spray time for that State is 60 percent. The percentage of time actually expended in spraying varies, according to these data, from 30 to 77 percent. In this case, the high percentage of productive time was achieved through the use of power spray equipment. Other factors also were involved. The average spray time for all States is 43 percent. The percentage of the time that crews are shown to be in contact with spray material varies from 42 percent in one State to 85 percent in another State. The average for all States, according to these data, is 58 percent.

From the foregoing, it can be seen that spray crews are in contact with spray material a considerable portion of the day. Constant efforts should be made to impress upon crew members, especially in the training of new employees, the necessity for frequent removal of spray material from hands, face, and other exposed skin surfaces.

ACCOMPLISHMENTS AND COSTS OF THE RESIDUAL SPRAY PROGRAM, F.Y. 1947-1949

by

Porter A. Stephens, Sanitary Engineer (R)

For ready reference the accompanying summary of "Base Line Data of Residual Spray Program Accomplishments and Costs" has been prepared from records submitted to the Malaria Control Office of the Communicable Disease Center. Since fiscal controls currently employed were placed into effect on July 1, 1946, data prior to that period are not included.

The various related items are presented in groups, i.e., numbers 1 and 2 refer to operational areas; numbers 3, 4, and 5, to the houses sprayed, amount of DDT used, and the average number of pounds of DDT per application.

It may be noted that, with the exception of one State, the amount of DDT used per application has increased at a fairly uniform rate. For fiscal year 1949, an appreciable increase in man-hours per application occurred in most States. This increase was due partly to the inclusion of man-hours for supervisory personnel reported on progress reports, under classification 101, as chargeable to actual spray operations. This classification is not included in data for fiscal year 1947-1948.

Column 9 indicates method of financing spray operations; columns 10 and 11 show initial fiscal year allocations and funds available at the end of the fiscal year after interim adjustments. Columns 12 through 15 reflect variations in rate of expenditure throughout the fiscal year. Such variations can readily be expected in seasonal operational programs.

Columns 16, 17, and 18 show funds available for operations from the various sources, with the total amount expended as compiled from the "Quarterly Summary of Local Contribution and Federal Cost." Column 19 shows that CDC costs, when expressed as a percentage of the total cost, have declined each year for most operations. The average cost per application of DDT has shown some increase during 1949 except in a few States. This may be explained as being largely due to purchases of a considerable number of new automotive units, and to conducting complete premises spraying in lieu of residential spraying as was the general practice in previous years.

		1	2	3	4	5	6
		Operations			Pounds DDT		Man-
		No. Counties		No. Spray	Per		Per
State	FY	PA[1]	OP	App.*	App.*	Total	App.*
Alabama	1947	33	21	135,876	0.83	112,911	1.40
	1948	33	33	150,493	1.00	150,326	1.20
	1949	33	31	122,070	1.25	153,595	1.37
Arkansas	1947	53	38	178,836	0.74	133,195	1.27
	1948	53	42	181,562	1.15	209,422	1.50
	1949	53	50	113,825	1.27	143,462	2.10
Florida	1947	39	26	59,619	0.82	48,858	1.71
	1948	39	34	92,994	1.09	100,980	1.40
	1949	39	30	49,335	1.43	70,555	1.77
Georgia	1947	55	52	203,803	0.87	177,457	1.07
	1948	55	53	189,774	0.77	146,685	0.94
	1949	55	39	140,554	0.82	115,892	1.07
Kentucky	1947	4	11	18,427	0.77	14,202	1.88
	1948	4	11	15,916	1.71	27,179	3.21
	1949	4	11	12,726	2.42	30,736	3.93
Louisiana	1947	26	17	71,400	0.80	57,043	1.10
	1948	26	18	62,969	1.29	77,797	1.34
	1949	26	18	50,973	1.22	62,055	1.51
Mississippi	1947	46	18	188,212	0.70	131,380	1.34
	1948	46	19	174,494	1.00	174,279	1.21
	1949	46	22	133,686	1.53	204,780	1.37
Missouri	1947	9	9	71,040	0.56	40,004	1.02
	1948	9	12	80,107	0.80	63,911	1.26
	1949	9	13	43,766	1.23	53,989	1.65
N. Carolina	1947	11	42	58,829	0.70	41,030	1.11
	1948	11	36	58,481	0.90	52,803	1.14
	1949	11	35	87,141	0.94	81,698	0.99
Oklahoma	1947	10	10	35,279	0.99	34,821	1.62
	1948	10	15	37,319	1.08	40,303	1.39
	1949	10	15	26,351	1.27	33,507	1.50
S. Carolina	1947	23	27	127,273	0.67	85,468	1.32
	1948	23	41	189,359	0.93	176,814	1.33
	1949	23	46	177,866	1.11	196,931	1.32
Tennessee	1947	17	12	40,315	1.09	43,959	1.40
	1948	17	13	35,426	1.97	69,662	2.46
	1949	17	13	25,340	1.69	42,858	2.31
Texas	1947	43	32	89,600	0.80	71,610	1.81
	1948	43	33	94,905	1.12	115,652	1.87
	1949	43	38	71,870	1.01	72,225	1.91
All States	1947	369	315	1,278,509	0.78	991,938	1.32
	1948	369	360	1,363,799	1.03	1,405,813	1.36
	1949	369	361	1,055,503	1.20	1,262,283	1.50
Grand Total FY 1947, 1948, 1949				3,697,811	0.99	3,660,034	1.39

*App. = Application

NOTES:

[1] During the first half of fiscal year 1947, 188 counties were preapproved for operations. Since the larger part of the operations took place during the second half of the fiscal year, the counties preapproved for that period are shown.

[2] Fiscal year 1949 man-hours include, in addition to re-

BASE LINE DATA OF

RESIDUAL SPRAY PROGRAM ACCOMPLISHMENTS AND COSTS

7	8	9	10	11	12	13	14	15	16	17	18	19	20
Hours			CDC Allocation		Percent of Allocation Obligated by Quarters				Costs				Avg.
Per Lb. DDT	Total[2]	Method of Financing[3]	Initial[4]	Final[4,5]	1st	2d	3d	4th	CDC[5]	State-Local	Total	% CDC	Cost Per App.*
1.69	190,818	3	$ 383,400	$ 392,400	29.6	22.6	08.2	44.9	$ 413,374	$ 65,620	$ 478,994	86.3	$3.52
1.20	181,283	1	323,300	318,000	29.0	03.7	23.5	53.5	348,936	117,576	466,512	74.8	3.10
1.10	166,725	1	259,200	228,200	21.0	11.1	26.3	41.5	227,995	130,371	358,366	63.6	2.94
1.72	226,620	1	549,300	577,500	44.1	28.5	08.0	21.4	589,155	154,408	743,563	79.2	4.16
1.30	273,173	4	450,000	450,000	41.8	19.4	19.4	17.5	441,385	279,291	720,676	61.2	3.97
1.65	239,471	4	403,200	400,543	37.5	26.0	15.3	22.4	405,524	331,691	737,215	55.0	6.48
2.09	101,825	1	269,400	330,200	39.1	32.0	15.9	12.2	327,668	90,188	417,856	78.4	7.01
1.28	129,980	1	212,250	211,350	49.1	16.0	16.0	24.2	222,541	235,514	458,055	48.6	4.93
1.24	87,293	1	201,200	176,940	49.1	08.4	18.5	23.6	176,201	101,535	277,736	63.4	5.63
1.23	218,941	1	312,500	319,700	36.8	32.7	09.9	21.8	323,436	181,240	504,676	64.1	2.48
1.22	177,781	1	279,400	279,400	28.4	11.1	30.8	30.6	281,922	167,312	449,234	62.8	2.37
1.30	150,580	1	227,100	224,600	37.9	14.7	15.0	33.2	226,414	158,053	384,467	58.9	2.74
2.44	34,585	3	79,900	74,250	29.7	22.0	31.5	18.4	75,420	27,990	103,410	72.9	5.61
1.88	51,144	3	85,700	85,700	14.1	13.8	31.7	53.0	96,508	47,220	143,728	67.1	9.03
1.62	50,048	3	68,900	57,900	30.5	18.5	28.5	21.4	57,237	36,248	93,485	61.2	7.35
1.38	78,751	1	266,400	270,608	44.6	33.9	02.5	17.7	267,078	31,621	298,699	89.4	4.18
1.04	84,587	1	220,000	219,000	30.6	06.8	45.6	21.7	229,246	70,546	299,792	76.5	4.76
1.24	77,017	3	207,800	197,800	23.5	10.9	27.8	38.6	199,309	61,614	260,923	76.4	5.12
1.91	252,592	2	433,400	441,400	32.9	19.9	10.1	37.6	443,585	80,340	523,925	84.7	2.78
1.21	211,589	2	376,500	375,900	28.1	09.0	27.5	33.7	369,587	185,685	555,272	66.6	3.18
0.90	183,006	2	344,700	337,828	09.4	22.4	19.2	49.3	339,000	258,782	597,782	56.7	4.47
1.82	72,227	3	164,500	161,822	28.3	33.3	18.8	19.9	163,999	31,129	195,128	84.0	2.75
1.58	100,573	3	141,500	141,500	32.4	18.0	24.7	24.4	140,729	71,417	212,146	66.3	2.65
1.34	72,162	3	122,700	122,700	18.2	20.1	25.3	35.9[6]	122,064[6]	63,390	185,434	65.8	4.24
1.59	65,560	1	134,700	142,400	35.2	24.9	03.5	37.2	143,525	69,015	212,540	67.5	3.61
1.27	66,907	1	119,250	119,250	37.1	02.0	18.8	38.1	114,488	87,722	202,210	56.6	3.46
1.05	86,630	1	113,600	111,600	18.4	12.2	38.9	29.3	110,312	156,290	266,602	41.4	3.06
1.64	57,116	3	117,900	117,200	29.3	32.8	14.3	23.8	117,474	65,933	183,407	64.1	5.20
1.29	52,026	4,1	110,500	110,500	36.2	17.2	16.4	28.6	108,736	44,670	153,406	70.9	4.11
1.18	39,417	3	94,800	91,800	38.5	11.0	26.4	21.2	89,149	26,051	115,200	77.4	4.37
1.97	167,568	2	301,000	321,200	45.8	26.9	05.0	22.4	321,547	160,303	481,850	66.7	3.79
1.43	252,286	2	259,000	259,365	39.4	18.8	16.9	23.3	255,158	416,701	671,859	38.0	3.55
1.19	235,629	2	245,000	245,000	31.9	17.3	21.6	29.0	244,609	318,709	563,318	43.4	3.17
1.28	56,290	1	166,500	165,600	35.4	22.4	11.4	31.9	170,669	83,651	254,320	67.1	6.31
1.25	87,046	1	170,800	170,950	53.3	10.8	13.7	14.6	157,975	142,521	300,496	52.6	8.48
1.37	58,558	1	144,000	144,000	20.0	22.5	19.4	38.5	144,536	36,994	181,530	79.6	7.16
2.26	162,223	1	368,900	378,159	42.9	25.4	13.2	21.0	380,774	122,140	502,914	75.7	5.61
1.67	192,995	3	338,700	345,278	31.1	20.9	11.7	34.1	337,761	111,514	449,275	75.2	4.73
1.89	137,672	1	277,500	282,110	37.8	24.6	12.2	25.1	281,254	71,310	352,564	79.8	4.91
1.69	1,685,116		3,547,800	3,692,439	38.0	27.4	10.1	25.7	3,737,704	1,163,578	4,901,282	76.3	3.83
1.32	1,861,370		3,086,900	3,086,193	35.0	13.3	22.5	29.8	3,104,972	1,977,689	5,082,661	61.1	3.73
1.25	1,584,208		2,709,700	2,621,021	28.9	18.3	20.5	32.4	2,623,584	1,751,038	4,374,622	60.0	4.14
1.40	5,130,694		$9,344,400	$9,399,653	34.0	19.7	17.7	29.3	$9,466,260	$4,892,305	$14,358,565	65.9	$3.88

sidual spraying man-hours (Classification 111), man-hours for field supervision, warehouse and shop personnel, and entomological evaluation as taken from supervisory man-hour reports (Classification 101).

[3] Code for Method of Financing:
1--CDC and Local Government
2--CDC, Local Government, and State
3--CDC, Local Government, and Fees
4--CDC and Fees

[4] Including travel allocations.

[5] Budget and Fiscal Section report (3 months after close of fiscal year).

[6] In addition to the obligations as reported by the Budget and Fiscal Section, this figure includes $9,720 for a replacement shipment of DDT which was not charged to the allocation.

Preliminary Observations on the Biotic Potential of ANOPHELES QUADRIMACULATUS

R. E. Bellamy, Senior Assistant Scientist

The biotic potential concept implies the maximum rate of increase of an organism. In studying populations of a species some knowledge of its biotic potential is essential for proper interpretation of the fluctuations in the numbers of individuals. Furthermore, the severity of the environmental resistance (i.e. the pressure exerted by such environmental factors as temperature, wind, sunlight, abundance of predators, and limits of food supply and suitable resting places) exerted against the increase of a species becomes evident when the biotic potential and actual numbers of the species are determined. This is according to the simple relation expressed by Chapman (1928):

$$\frac{\text{Biotic Potential}}{\text{Environmental Resistance}} = \text{Actual Population.}$$

Thus, if we encounter two similar species about equally abundant in nature and find that one has two broods annually with 10 offspring per brood and there are equal numbers of each sex, while the other has one brood of 4 offspring each year and again the sexes are equal, we readily see that the environmental resistance against the former species is much greater than is the environmental resistance against the latter. Used thus, environmental resistance is the sum total of factors that militate against the increase of a given species, i.e. factors other than the species' sex ratio and the number of offspring produced.

Rogers, Hubbell, and Byers (1942) utilize as a convenient formula for expressing the biotic potential of a species: $PZ^n(R^{n-1})$, where P is the initial number of reproducing females, Z the number of offspring produced by each female, n the number of generations in the time interval chosen, and R the sex ratio (0.5 if the sexes are produced in equal numbers; 1.0 if the species is composed of parthenogenetic females). When the biotic potential of a form is calculated from this formula the figure obtained is the theoretical number of individuals that would constitute the last generation considered, and any survivors of intervening generations are not taken into account.

While biotic potential is an expression of a theoretical capacity of a species seldom if ever very nearly realized, it is of cardinal importance, as stated earlier, that it be determined for a species whose populations are to be studied. It is a fairly simple matter to supply values for most of the constants in the formula above as applied to the malaria mosquito, *Anopheles quadrimaculatus* Say, but the determination of a value for Z presents certain problems. The constant, Z_1, represents the potential number of offspring each female would produce if all environmental influences were at optimum. One might assume genetic homogeneity in the species and take for Z the largest number of ova any individual female was ever known to deposit (assuming therefore that any failure by a female to deposit that complement of eggs was a reflection of some deterrent influence of the environment). On the other hand one might prefer, as a more appropriate figure for Z, the average number of ova per female determined from the individual

egg laying experiences of a number of females. A female anopheline will take blood, develop a full complement of eggs and deposit them, take a second blood meal and develop and deposit a second complement of eggs, and in some instances repeat this process a number of times. This fact greatly complicates the determination of a value for Z in our formula, especially if we prefer an average figure.

Fortunately, we have available a colonized strain (the National Institutes of Health Q-1 strain) of *A. quadrimaculatus* whose individuals are so thoroughly domesticated that they may be manipulated in the laboratory with great facility. A brief description of certain insectary methods and some of the characteristics of this strain of *quadrimaculatus* should make more understandable the procedures followed in studying its biotic potential. An active colony of about two thousand adults (males and females) may be housed in a screened cage 2 x 3 x 3 feet. Mating occurs in the cage by the time the adults are a few days old, but it is necessary that the males be provided space to perform a mating swarm flight. The dimensions of the colony cage are adequate for mating of the colonized strain and as few as 100 males in a cage may perform an effective mating flight. Freshly emerged adults are quite soft, and few females will attempt to feed (take blood) until about 4 days after emergence. In practice, the female mosquitoes obtain blood from an immobilized rabbit placed in the cage for about an hour every day or several days each week. Every evening a pan of water is placed in the cage and the following morning it is removed with from five thousand to forty thousand ova floating at the water surface. Two or three days later the eggs hatch and the first instar larvae are fed pulverized dog chow sprinkled on the surface of the water. The larvae are distributed to several pans so that there will be no more than five hundred to one thousand per pan and are fed daily. About 3 weeks after oviposition the specimens will have passed through four larval stages and pupation then occurs. The papae are pipetted from the pans to bowls of water. The bowls are then covered by lantern chimneys closed at the top with netting. About 2 days later the adult mosquitoes emerge into the chimneys, and may be transferred to an empty cage to initiate a new subcolony or may be added to an existing colony to strengthen it. Virgin females reared in isolation take blood somewhat more reluctantly than fertile specimens and many refuse to feed; those that feed may develop and deposit a few infertile ova.

The procedures utilized for obtaining biotic potential data on the colonized strain were as follows: an empty cage was stocked with a large number of adults which had emerged in a 48-hour period. On about the 4th day the mosquitoes were permitted to feed on a rabbit. A number of females that had fed were removed from the cage within 2 days after feeding (at least 3 days are required for a female to develop and deposit ova after feeding). Each female was placed in a lantern chimney cage over a finger bowl containing tap water to a depth of 1 to 2 centimeters. Thereafter these specimens were examined daily by the insectary attendant* and were proffered a hand or arm at the open end of the chimney as a source of further blood, should the specimen desire to feed (see figure 1). When ova were present in a bowl they were counted and removed to the water surface in another appropriately labelled bowl.

Figure 1. Feeding individual mosquito specimen on arm.

Acknowledgement is made of the assistance of Biological Aide Robert P. Repass, who carried out by far the greater part of the operations described here.

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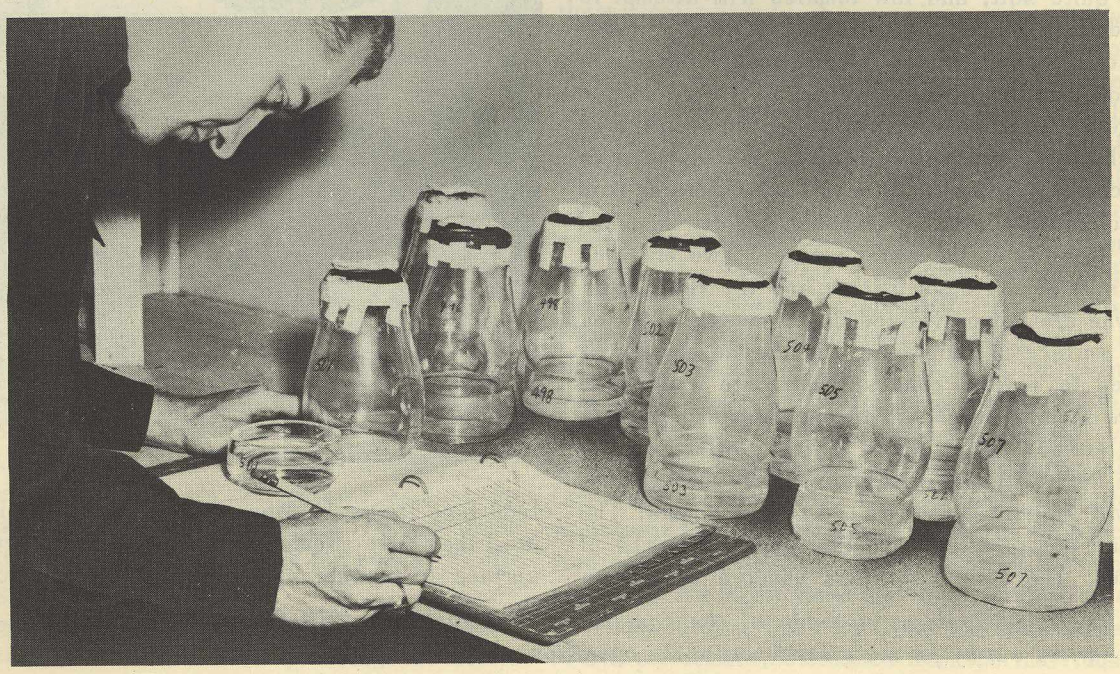
On subsequent days the bowls of ova were re-examined and 1st instar larvae were removed, counted, and recorded as a check on the fertility of the ova. Thus separate records were kept on the number of ova and percentage fertility of successive batches of ova deposited by each female (see figure 2).

Twenty-six colony females were handled in this fashion. Thirteen followed a pattern of depositing ova of high fertility about every 3 to 5 days, taking blood after each oviposition. The total fertility of the ova from these females averaged 93.2 percent, and for the individual females, ranged from 85.3 percent to 97 percent. Of the other 13 females, 7 deposited no ova whatsoever and were probably infertile. Six others deposited few to many ova but in one way or another departed from the pattern of behavior exhibited by the 13 females mentioned above. The fertility of the ova of these six females was generally low, ranging from less than one percent to 79.2 percent. Since the 13 females which deposited ova of high fertility exhibited a similar pattern of behavior, it seems reasonable to assume that the activities of the other specimens may have been seriously prejudiced by environmental factors; i.e. these specimens may have been inadequately fertilized or may have been damaged in handling.

The 13 females of high fertility provided 13,090 ova, an average of 1,007 per female. The fertility of these ova was 93.2 percent. The group of 26 females considered as a unit provided 16,682 ova or an average of 641 per female; total fertility was 85.1 percent. Since 7 of these females did not oviposit, the 16,682 ova were obtained from 19 females, an average of 878 eggs per ovipositing female. Our "champion" female developed 10 distinct complements of ova, totalling 1,621, and deposited them in 14 batches (oviposition occurred on 14 different nights); 1,510 or better than 93 percent of these ova hatched.

We may now supply a value for Z in the biotic potential formula: 1,007, the average oviposition of 13 highly fertile females; 878, the average oviposition of the 19 egg-laying females; or 1,621, the greatest number of ova known to have been deposited by any single specimen. For practical purposes it may be assumed that the species, *A. quadrimaculatus*, is composed of equal numbers of males and females; therefore in

Figure 2. Examining lantern globe isolation cages and making oviposition records.



the formula R becomes 0.5. Actually our experience in the insectary and that reported elsewhere indicates that there are slightly more males than females.

Six is probably a conservative estimate of the average number of annual pedigree generations of *A. quadrimaculatus* in the southeastern coastal plain, although there would probably be broad overlapping between earlier and later generations. Boyd (1927) provided field data which he believed indicated 8 to 10 annual generations of this species in south Georgia and at least 7 in northeastern North Carolina, and Hurlbut (1943) calculated that there might be 9 or 10 annual generations in northern Alabama.

If we wish to accommodate the fertility factor, F, our original formula becomes:

$$P\,(FZ)^n(R^{n-1}).$$

By substituting in the formula the values derived above, the ultimate theoretical one-season progeny of EACH fertile female present in the spring may be calculated. The value for P will be 1 since the offspring from one beginning parent are to be calculated. The number of generations, n, will be 6; R will be 0.5; F will be 0.932; and Z, 1,007; the last two values being those provided by the 13 females of high fertility. Therefore:

$$1 \times (0.932 \times 1{,}007)^6\,(0.5^5) \text{ or}$$

21,356,115,775,836,710 individuals would constitute the theoretical sixth generation population that would be derived in a season from a single female. This calculation assumes, of course, that the environment for all individuals of each generation is optimal. Such a figure as that obtained is an obviously fantastic one and serves to show:

1. The strength of the total restraining influence (i.e. environmental resistance) against
2. The tremendous potential (actually explosive) capacity of the species to increase.

Although reports of fluctuations in actual field populations of *A. quadrimaculatus* indicate some extremely rapid rates of increase over short periods of time, no sustained rate of increase approaching the potential capacity of the species is ever reported.

It should be mentioned that the largest number of ova that we have been able to obtain from any single female *A. quadrimaculatus* collected in the wild is 575. We have isolated 150 adult females collected in the field at different seasons and have handled them in much the same manner as the procedure described for handling isolated specimens of the colony strain. Eighty-eight of these deposited no ova and many others deposited small and irregular batches. The laboratory conditions of confinement to which specimens being tested are subjected are indubitably less disturbing to specimens of the colonized strain than to specimens taken in the field. Also, the action of selective processes operating through many generations of the highly domesticated strain may have provided the colony insect, genetically, an entirely different biological (physiological) reaction system from that of the undomesticated population. Much in our insectary experience would indicate this.

It is interesting that wild-caught specimens of *Anopheles punctipennis* (Say) when isolated in the laboratory exhibit an egg-laying pattern that closely approximates that of the colonized strain of *A. quadrimaculatus*, while specimens of *Anopheles crucians* Weid. behave, in this respect, more like the wild specimens of *A. quadrimaculatus*.

References

1. Boyd, Mark F. 1927. Studies on the bionomics of North American anophelines. 1. The number of annual broods of *A. quadrimaculatus*. Am. J. Hyg., VII, (3):267-275.
2. Chapman, Royal N. 1928. The quantitative analysis of environmental factors. Ecology, IX, (1):111-122.
3. Hurlbut, Herbert S. 1943. The rate of growth of *Anopheles quadrimaculatus* in relation to temperature. J. Parasitol., XXIX, (2): 107-113.
4. Rogers, J. Speed, Theodore H. Hubbell, and C. Francis Byers. 1942. Man and the biological world. 607 pp., New York, N. Y.

PICTORIAL REVIEW

Spraytime

PRODUCTION NO: CDC 5-028, Released 1945
FILMSTRIP: 35 mm., Sound, Black and White, Length: 83 Frames, Time: 14 Minutes
GRAPHIC FORM: Photographs

PURPOSE

To popularize residual spraying with DDT as a malaria control measure, and to show how houses should be prepared before spraying crew arrives, how spraying is performed, and ways in which occupants can cooperate.

AUDIENCE

Public Health Service personnel and groups engaged in mosquito control.

CONTENTS

1. Motivating introduction: relation between malaria mosquitoes and suffering and loss from malaria.
2. Several methods of mosquito eradication with emphasis on residual spraying with DDT.
3. Family cooperation with the spray program by preparing the home for spraying.
4. Quick and thorough spraying of the home.
5. Conclusion: Six months malaria protection with little inconvenience.

COMMENTS

Related filmstrips are "Equipment for Hand Spraying of DDT" and "Power Spraying with DDT."

Identification of Female Anophelines of the United States

PRODUCTION NO: CDC 5-019.0, Released 1946
FILMSTRIP: 35 mm., Sound, Color, Length: 73 Frames, Time: 21 Minutes
GRAPHIC FORM: Titles, Drawings, and Maps

PURPOSE:

To aid in teaching the identification of female anophelines of the United States.

AUDIENCE

Public Health Service personnel engaged in malaria control especially entomologists and epidemiologists.

CONTENTS

1. Malaria control involves identifying the various species of female anophelines in each community.
2. Distinguishing characters for identifying

anopheline species include: wing patterns, and the color of hind tarsi, palps, wing tip scales, knee spots, and halteres.

3. Female anophelines may be placed in four groups according to wing scale patterns.

4. Species are identified within each of the four groups by noting the color of hind tarsi, palps, fringe of scales at the wing tips, knee spots, and halteres.

5. In practice these groups and specific characters are used to identify the thirteen species of anophelines.

6. A review section points out the diagnostic characters of each species but withholds the name until after the student answers.

7. A test section of ten pictures shows various anopheline females of the U. S.

COMMENTS

Related filmstrip is "Identification of U. S. Genera of Mosquito Larvae."

Preparation and Staining of Blood Films

PRODUCTION NO: CDC 4-007, Released 1946

MOTION PICTURE: 16 mm., Sound, Color, Length: 615 Feet, Time: 17 Minutes

GRAPHIC FORM: Photography, Animation, and Slow Motion

PURPOSE

To teach proper methods of making, labeling, and staining blood films for malaria diagnosis.

AUDIENCE

Physicians, medical students, laboratory technicians, parasitologists, malariologists, public health nurses.

CONTENTS

1. Technically perfect blood films can be used with confidence by technicians to discover the dangerous parasites of malaria.

2. Good thick and thin blood films are made with a sharp stylet, with a rolling wrist motion stab into the clean finger tip, with a rotary smearing of blood for the thick film, and quick spread of a droplet at the other end of the slide for a thin smear.

3. Poor technique is often encountered in the making of blood films.

4. Carefully executed procedures are necessary to prepare Giemsa stain stock solution, to prepare buffered water for diluting it, and to stain the films in the final solution.

5. Well prepared and well stained slides are easily recognized.

6. A shorter but less satisfactory staining procedure consists of dehemoglobination followed by Wright's stain.

7. Mass staining techniques can readily be used.

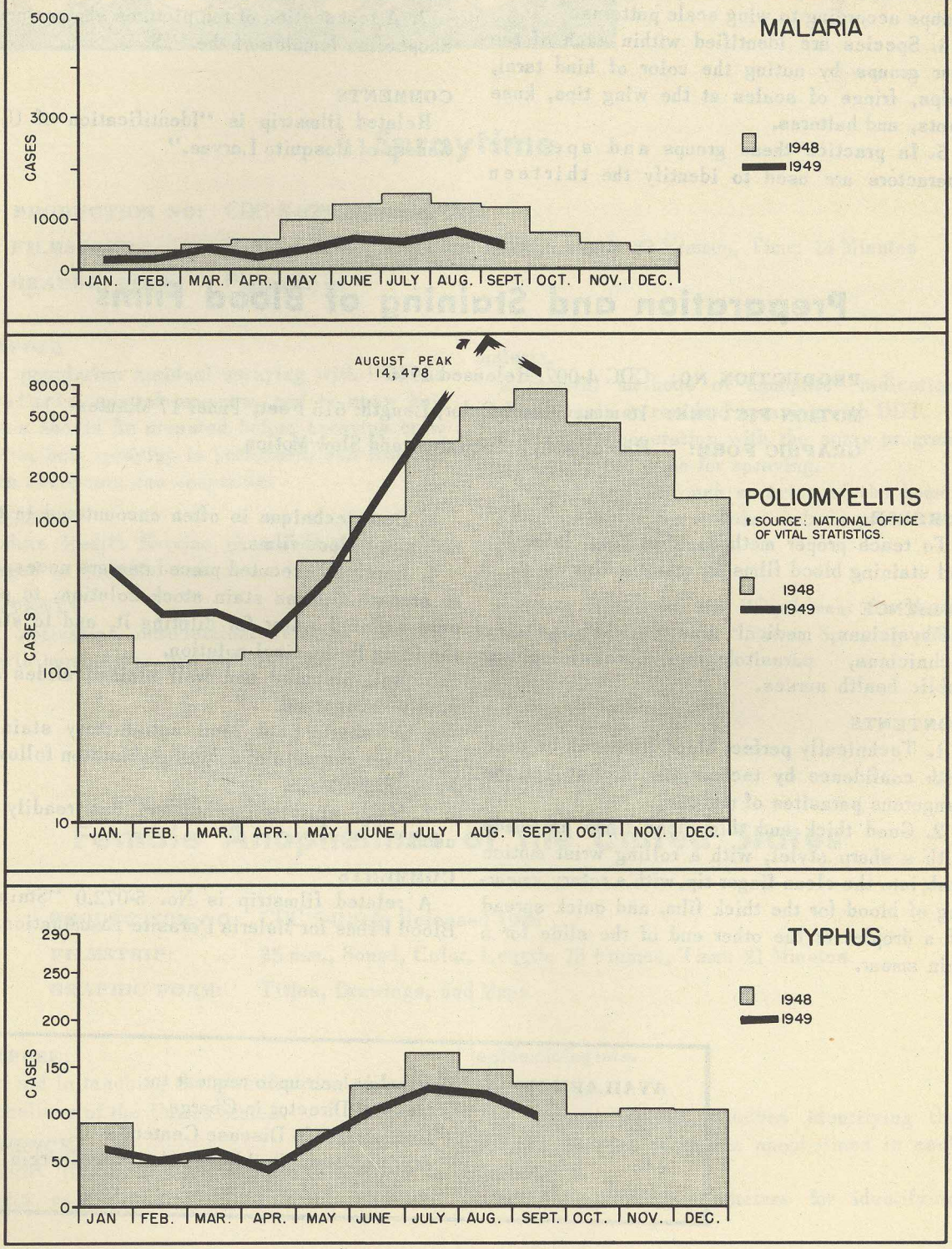
COMMENTS

A related filmstrip is No. 5-072.0 "Staining Blood Films for Malaria Parasite Examination."

AVAILABILITY: Thirty day loan upon request to:
Medical Director in Charge
Communicable Disease Center
605 Volunteer Building, Atlanta 3, Georgia

MORBIDITY TOTALS FOR THE UNITED STATES *
MALARIA, POLIOMYELITIS, TYPHUS

1948 - INCOMPLETE 1949 - AS REPORTED



FSA PHS CDC ATLANTA, GEORGIA

* DATA ARE TENTATIVE AND INCOMPLETE

CENTER HIGHLIGHTS

July-Aug-Sept-1949

Administrative

The CDC Board of Examiners announced examinations for Insect and Rodent Control Aids and Specialists, SP-3 to SP-8 and P-2 to P-6, respectively. Examinations for Draftsmen and for Biological Aids were closed on August 22 and reopened by the Fifth Civil Service Region. An amendment to the Hospital Attendant examination announcement for the U. S. Marine Hospital, Memphis, was issued September 26 to include SP-3 positions. Some 2,010 applications for various examinations were received, making a total of 7,642 applications to date. Six hundred names were placed on the registers during the period. Twelve registers were established during the period covering the positions of Medical Technician, SP-3 to SP-8, and Text Writer, P-3 to P-4, making a total of 218 to date.

A total of 11 supervisory training conferences was held with 20 of the supervisors of Audio-Visual Production Services on the various aspects of their positions. Also, 30-minute orientation conferences were conducted with 38 employees entering on duty during the quarter, and two general orientation courses for new employees were presented.

Below is a list of the 14 manuscripts cleared for presentation and/or publication during the quarter:

Clapp, Richard F.: The activities of the Public Health Service in food handler training.

Fellton, Herman L., Barnes, Ralph C., and Wilson, Clifton A.: New distribution records for the mosquitoes of New England.

Fox, Irving, and Kohler, Charles E.: Distribution and relative abundance of the species of Culicoides in eastern Puerto Rico as shown by light traps.

Goldman, Morris, and Johnson, Sadie A.: Deep-freeze preservation of stool specimens containing intestinal parasites.

Link, Vernon B.: Psittacosis.

Mathis, Willis, and Quarterman, Kenneth D.: Field studies on the use of heavy dosages of DDT and benzene hexachloride as residual mosquito larvicides.

Nelson, Frank W.: Dental service at the CDC.

Nicholson, H. Page: The simuliidae of Minnesota with reference to the taxonomy and biologies.

Price, Edmund R.: Encephalitis as a public health problem.

Serfling, Robert Elton: Quantitative estimation of plankton from small samples of Sedgewick-Rafter-cell mounts of concentrate samples.

Simmons, S. W.: A resume of recent developments on insecticides and rodenticides at the U. S. Public Health Service laboratory, Savannah, Georgia.

Steele, James H.: The role of veterinary public health in the control of communicable diseases of man.

Sumerford, W. T.: The chemistry and toxicology of some organofluorine compounds.

Tetzlaff, Frank: Insect vector control activities of the U. S. Public Health Service.

The proposed plan for converting the present quarterly CDC Bulletin to a monthly publication, effective January 1950, was approved. The monthly Bulletin will feature articles on particular subjects pertaining to communicable diseases for 2 months, with every third Bulletin devoted primarily to abstracts of quarterly reports.

NEW BOOKS IN THE LIBRARY

Approximately 65 books were added to the library during the quarter:

Adkins, Dorothy C.: Construction and analysis of of achievement tests. 1947.

Albright, Fuller: Parathyroid glands and metabolic bone diseases. 1948.

American druggist blue book. 1949.

American library association. Rules for author and title entries. 1949.

American Public Health Association. Standard methods for the examination of dairy products. 9th ed. 1948.

Babbitt, Harold Eaton: Water supply engineering. 4th. ed. 1949.

Bates, Marston: The natural history of mosquitoes. 1949.
Birch, Charles Allen, Editor: Emergencies in medical practice. 1948.
Birkeland, Jorgens Maurice: Microbiology and man. 1949.
Bôcher, Maxime: Introduction to higher algebra. 1949.
Calvin, Melvin: Isotopic carbon. 1949.
Chicago University Press. Manual of style. 11th ed. rev. and enl. 1949.
Coburn, Alvin Frederick: Epidemiology of hemolytic streptococcus. 1949.
Columbia University Statistical Research Group. Selected techniques of statistical analysis for scientific and industrial research. 1947.
Comstock, John Henry: The spider book, revised and edited by W. V. Gertsch. 1948.
Crangle, Charles L.: Planning garbage and refuse facilities for the small community. 1948.
Currie, John Ronald: Manual of public health. 3d ed. 1948.
Dack, Gail Monroe: Food poisoning. 2d ed. 1949.
Davison, Forrest Ramon: Handbook of materia medica, toxicology, and pharmacology. 1949.
DeCourcy, Joseph Luke: Pathology and surgery of thyroid disease. 1949.
Delmonte, John: Technology of adhesives. 1947.
Faunce, Francis: Secretarial efficiency. 1948.
Fisher, Ronald Aylmer: Design of experiments. 1949.
Flesch, Rudolph Franz: The way to write, rev. ed. 1949.
Fowler, Willis Marion: Hematology for students and practitioners. 1949.
Frayne, John G.: Elements of sound recording. 1949.
Hall, Marguerite Franklin: Public health statistics. 2d ed. rev. 1949.
Halsey, George D.: Training employees. 1949.
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Audio-Visual Production

Walter S. Bell, formerly of the Atlanta city school system, entered on duty as Assistant Chief of Audio-Visual Production Services, effective August 1, 1949.

MAJOR PRODUCTIONS RELEASED*

4-077.0 Use of Aircraft for Insect Control --- Part I, Mosquito Control.
4-098.0 Occupational Nursing (a script production only --- for Division of Nursing Resources, Bureau of Medical Services)
5-079.0 Fundamentals of Detergents
5-113.0 Use of Aircraft for Insect Control --- Part I, Mosquito Control
5-122.0 Collection of Adult Flies
5-123.1 The Laboratory Diagnosis of Tuberculosis --- Part I, Preparation of a Culture Medium
5-131.0 How to Measure Deterioration in Dwellings
5-133.0 Fly Density Surveys by the Grill Methods
5-135.0 Oral Hygiene --- Toothbrush Technique
9-030.0 Mosquitoes of the United States
9-031.0 Preventive Maintenance and Rust Control on CDC Vehicles and Equipment
9-032.0 Storage and Handling of Food (For Division of Sanitation)

MAJOR PRODUCTIONS COMPLETED AND AWAITING RELEASE PRINTS, AT END OF THE QUARTER

Audio-Visual Production Services work has been completed on the following motion pictures and filmstrips, and negatives are at commercial laboratories for release prints:

4-089.1 The Laboratory Diagnosis of Tuberculosis --- Part I, Preparation of a Culture Medium
4-089.2 The Laboratory Diagnosis of Tuberculosis --- Part II, Preparation of Sputum Specimens
4-102.0 Preservation of Bacteria by Desiccation *in Vacuo*
5-123.2 The Laboratory Diagnosis of Tuberculosis --- Part II, Preparation of Sputum Specimens
5-134.0 Field Training for Public Health Workers

OTHER PRODUCTIONS COMPLETED AND RELEASED

G 5-030.0 FILM GUIDE --- Life Cycle of a Malaria Parasite

STORY DEVELOPMENT

During the quarter, discussion was continued regarding the production of 11 filmstrips on diabetes for the Division of Chronic Disease. The project supervisor for this series spent a week at Audio-Visual Production Services, going over in detail the preliminary scripts and story boards. The filmstrips will have a dual purpose in that they will provide the public health worker with demonstrations of correct techniques of dealing with diabetic patients and, also, teach new diabetics how to treat themselves. The series begins with a filmstrip entitled "What Is Diabetes" and includes filmstrips on insulin and its use, how to buy the right foods, how to plan meals and prepare them, and other subjects.

PRODUCTION

A new-type microphone especially designed for film recording, was procured for use on motion picture sets and stages. In combination with this action, work was begun on silencing of the cameras. Work on a blimp for the 16 mm. Maurer camera was accomplished, and construction was begun on a blimp for the 35 mm. Mitchell camera. With the completion of the latter, the sound department will be able to do any kind of sound recording on the stage. This is being done at present with 16 mm. but only restrictedly with 35 mm.

UTILIZATION

Film distribution for the quarter (not including redistribution from film libraries holding films on indefinite loan) consisted of 358 motion pictures, 196 filmstrips, and 12 slide series, making a total of 566. One hundred sixty-four copies of the Film Catalog-Utilization Guide were supplied to new users in response to requests. Catalog pages describing new films released during the quarter were distributed in order to keep up to date the 1,000 or more catalogs held by various health and medical activities. Copies of all film guides which have been completed were mailed with corresponding films to improve utilization.

Utilization guides for the two filmstrips, "Identification of Some Common Sucking Lice," and "Identification of U. S. Genera of Mosquito Larvae," were written.

An exhibit, "Epidemiology of Brucellosis," was nearing completion for Veterinary Public Health Services, for display at the American Public Health Association meeting in New York City, October 24, 1949.

**4-000 -- Motion Pictures*
5-000 -- Filmstrips
9-000 -- 2 x 2-inch Slide Series

During the quarter, many professional public health workers visited Audio-Visual Production Services and were given film utilization material, including the Film Catalog-Utilization Guide. Foreign countries represented by the visitors were China, Denmark, England, France, Finland, Guatemala, India, Uruguay, Venezuela, and Yugoslavia.

COOPERATIVE PROJECT WITH THE ARMY ON RAT CONTROL FILMS

At the end of the quarter, work was being completed on the tenth and last script for this series. Shooting was scheduled to start during the third week of October, and planned for completion about the middle of December. This series is one of the most extensive undertakings in the history of the Audio-Visual Production Services, and has required the closest cooperation between Audio-Visual Production Services, Training Services, and the Army. Scripts have been prepared to parallel the manual, "Rat-Borne Disease Prevention and Control," recently published by Training Services. Training Services are responsible for the technical content and accuracy of all the films of the series. In addition to technical advice and scripts, the location is provided for the shooting at Technical Development Services at Savannah, Ga., where the Army has built a number of large stocking and feeding pens for the rats and set up a circus tent to house the 18 sets needed for the production of the films. Mr. Sidney Lanier, who represents Training Services at Savannah, has caught some five hundred rats which he is conditioning for their roles in the films. Movable harborage cages were built on which the only outlet is a long, flexible tube through which the rats must go for food and water. The rats have been required to do this for several weeks. Each set will have several openings to which the rats can be piped, and experiments have indicated that the rats will make themselves at home on the various sets after a few days of training.

The rats have to be conditioned for several weeks to the bright lights and camera noises. This series of films will provide a fairly definitive pictorial coverage of rat habits, characteristics, and control.

Engineering

GENERAL ACTIVITIES

Sanitary Engineer L. B. Hall, Assistant Chief of the Engineering Services, transferred to Johns Hopkins University in September for further training. Engineer (R) John H. Bright was designated as Acting Assistant Chief, and Sanitary Engineer (R) Porter A. Stephens was placed in temporary charge of the Malaria Control Section.

At the request of the Division of Commissioned Officers, a tentative 1 year's training program for junior grade, newly commissioned officers has been established in Atlanta. The schedule agreed upon with the Executive Office and Training Services calls for assignment to State health departments of such officers for approximately 9 months where participation in Communicable Disease Center activities such as malaria and/or typhus and rodent control will be possible. During the off season when such operating programs are not active, arrangements will be made, where feasible, for assignment of these young officers to local health departments on general sanitation activities, including water supplies, sewage disposal, and related sanitation work. The remaining 3 months of the year's training will be spent at the Columbus Field Training Station, where a course in sanitary engineering activities will be offered.

PROGRAM ACTIVITIES AND PROGRESS

Malaria Control. Fiscal year 1950 is the 3d year of the cooperative malaria eradication program, which was begun in fiscal year 1948 as a 5-year effort to eliminate or so reduce malaria transmission in the United States that this disease would become a public health problem of little significance. The program was begun in the presence of declining morbidity rates, and reports during subsequent years reveal that current transmission is negligible in many historically hyperendemic areas. With the decline in malaria morbidity, it has become increasingly apparent that the pattern of control operations should be

changed so that the program will be concentrated around known residual foci of malaria and the remaining proven malaria cases. Another factor influencing such change is the anticipated reduction in Federal funds available for malaria control activities in fiscal year 1951 -- a reduction of approximately 50 percent of fiscal year 1949 funds.

Tentative plans anticipate discontinuation during fiscal year 1951 of control operations in several previously operated States. However, every effort will be made to make available to these States sufficient Federal funds and personnel to maintain surveillance and to encourage a permanent, locally supported malaria prevention program.

Field trips were made during the quarter with representatives of the Epidemiology and Entomology Services to seven States (Alabama, Arkansas, Georgia, Louisiana, Mississippi, South Carolina, and Texas). The proposed operational areas mutually agreed upon with these State officials comprise, as shown on the accompanying map, selected counties in the coastal plains section below the Piedmont region in South Carolina and Georgia; lowland sections in Alabama along the Luxapalila, Warrior, Tombigbee, Alabama, Cahaba, and Conecuh Rivers; the Mississippi and Red River Valleys in Louisiana and Arkansas; the Delta section in Mississippi; and, in Texas, selected counties along east Texas rivers and in the Rio Grande Valley. Only a few coastal counties were selected. At present there are 294 counties preapproved for malaria control operations in 13 southeastern States. In fiscal year 1951 it is tentatively proposed to conduct residual spray operations in approximately 154 counties.

An experimental program involving the use of chlordan as an insecticide has been inaugurated in Mississippi, in Bolivar County and in a part of Sunflower County. County officials had not been satisfied with the concurrent fly control obtained with the first spraying of DDT and did not feel that a second spraying of DDT alone would solve the problem. The experimental use of chlordan on outside surfaces as a 2 percent chlordan-3 percent DDT solution was approved, supplies of the chemical were procured, and spraying operations were inaugurated. Continuous evaluations will be conducted.

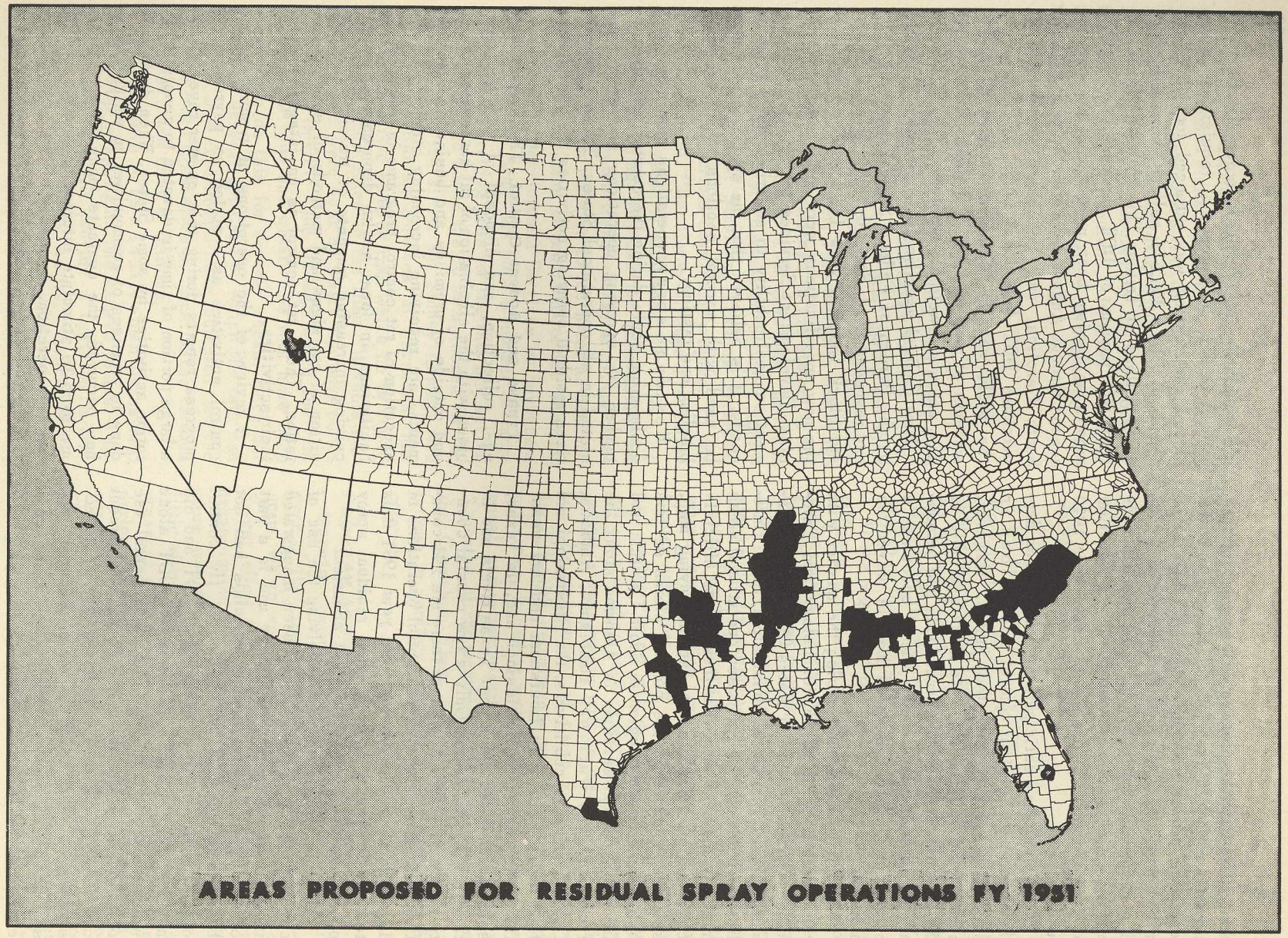
A tabulation of chemicals ordered during the present season indicates that requisitions were placed and testing was arranged for 1,003,300 pounds of DDT, 356,673 gallons of xylene, and 8,760 gallons of Triton. This compares with 1,160,074 pounds of DDT reported on progress reports as having been used during the current season through August 13. Three States (Georgia, South Carolina, and Tennessee) continued to purchase DDT from local funds. In addition to the DDT, several States have reported varying amounts of work done with methoxychlor, chlordan, and water-wettable powders.

New Federal specifications for DDT, approved by the Bureau of Federal Supply, were received and reviewed (Fed. Spec. 0-D-370, Federal Standard Stock Catalog, Sec. IV, Part 5). Copies of the new specifications were furnished the Technical Development Services for review and comment on applicability to malaria control program needs. It is believed that the specifications may be used with special sections added to cover labeling and testing.

Residual spray operations continued on a diminishing scale during the quarter; and by September 30, spraying operations had been completed in all operational States. Table 1 summarizes residual spraying activities for the quarter.

Typhus and Rodent Control. The proper storage, collection, and disposal of garbage, combined with the elimination of rat harborages inside and outside of premises and business establishments, are receiving increasing attention in the execution of rat control programs in urban areas. Sanitarians in local health departments are receiving increasing amounts of training in recognition of rat signs and methods of antirat sanitation. Thus, rat control is an integral part of their activities.

A review of the operations of typhus and rat control activities as reported on payroll-period progress reports during this quarter reveals that a large portion of time is devoted to general sanitation activities by some States. When dusting is done in premises of communities in which typhus has occurred, the contacts made with officials are used to stimulate interest and action in this type of operation. A number of States now have full-time personnel working on the problem of



AREAS PROPOSED FOR RESIDUAL SPRAY OPERATIONS FY 1951

Table 1

SUMMARY OF DDT RESIDUAL SPRAY OPERATIONS
July 1 — September 30, 1949

State	No. Counties	No. House Spray Application	Lb. DDT	Operation Man-Hours			Lb. DDT Per Application	M.H. per Application	M.H. per Lb. DDT
				CDC	Local	Total			
Alabama	10	9,229	6,263*	3,790	9,452	13,242	0.68	1.43	2.11
Arkansas +	48	15,908	27,156	15,860	22,914	38,774	1.71	2.44	1.43
Florida	19	18,840	33,089	5,365	20,686	26,051	1.76	1.38	0.79
Georgia	31	46,406**	39,129	11,764	29,472	41,236	0.84	0.89	1.05
Kentucky	9	1,853	5,377	216	7,380	7,596	2.90	4.10	1.41
Louisiana	-	-	-	4,256	-	4,256	-	-	-
Mississippi +	18	19,194	23,280***	7,020	14,296	21,316	1.21	1.11	0.92
Missouri +	12****	10,375	12,005	1,871	10,521	12,392	1.16	1.19	1.03
North Carolina	30	28,325	30,517	2,759	24,642	27,401	1.08	0.97	0.90
Oklahoma +	14	12,030	18,925	1,184	16,069	17,253	1.57	1.43	0.91
South Carolina	44	69,047	85,245	8,830	69,227	78,057	1.23	1.13	0.92
Tennessee	13	7,241	11,958*****	7,363	-	7,363	1.65	1.02	0.62
Texas +	30	41,926	37,249	18,523	35,686	54,209	0.89	1.29	1.46
Subtotal Cont.U.S.	279	280,374	330,193	88,801	260,345	349,146	1.18	1.25	1.06
Puerto Rico +	-	4,393	723	400	680	1,080	0.16	0.24	1.49
Grand Total	279	284,767	330,916	89,201	261,025	350,226	1.16	1.23	1.06

+ Through October 1, 1949; all others through September 24, 1949.

* Excluding 1,610 pounds resin-based DDT

** Excluding 224 nonresidential premises and related data

*** Excluding 840 pounds chlordan

**** Including Fort Leavenworth (Platte County)

***** Excluding 905 pounds methoxychlor

sanitation as it relates to rat control, advising cities regarding corrections in the garbage program necessary to insure proper antirat sanitation. One State has an employee experienced in the operation of heavy equipment usually used in the sanitary land fill method of garbage disposal. Assistance is given in the planning of garbage collection routes as an integral part of the system. A material saving is frequently realized when the routes are studied and revamped, especially those in smaller towns. The reorganization of the collection system often results in a saving sufficient to initiate the sanitary land fill and also to increase the number of collections.

During the quarter, DDT dusting operations were under way in 81 counties in 11 endemic typhus States. One hundred twenty-two thousand three hundred and twenty-seven premises applications, using 427,457 pounds of DDT dust, were made, an average of 3.5 pounds of dust per premises.

There were 38 ratproofing projects reported in operation during the quarter. Forty-nine man-hours were expended per establishment, on the average, for initial ratproofing. Hours devoted to maintenance varied from 0 in States with programs to 1,675.

Seventy-three counties in 11 States reported rat poisoning activities. Sixty-one thousand six hundred and eighty-nine establishments were reported as using poisoned bait and 14,681 using poison water (1080 and arsenic). The average number of pounds of poisoned bait per establishment was 0.6, and an average of 1.1 pints of poisoned water was used per establishment.

Fly Control. During the quarter all five fly control projects were engaged in active spraying operations and had attained a demonstrable degree of control. In most cases the fly levels of the operating cities were held to approximately one-fourth of those reached in the corresponding check cities. In Troy, N. Y.; Charleston, W. Va.; Muskegon, Mich.; and Topeka, Kans., this favorable ratio was not attained until August and September, when the levels of the check cities rose. For the greater part of the season, the city-wide fly count averages were from 3 to 5, only rarely dropping below these levels. The desired average of 2 was not consistently reached. It would appear that far greater emphasis must be placed on the improvement of garbage handling in the operating cities if fly levels are to be driven lower with present man power and equipment. The present equipment, insecticides, and procedures appear to possess adequate killing power, but the fly breeding potentials of certain sections of each city are extremely high. Plans are under way, in cooperation with the Training Services and Technical Reports Section, to prepare an organized educational and informational program to take place during the spring months of 1950 in order to promote good premises sanitation as a fly control measure.

Arrangements were completed with the National Foundation for Infantile Paralysis for the purchase of refrigerating equipment for the storage of virological specimens. By mid-August, equipment, supplies, and detailed instructions were sent to each project and routine collections of sewage and fly specimens were being made. The average collections per project were 30 sewage samples and 40 fly trappings per week. All collected specimens were treated and refrigerated for future examination.

Pollen collection stations and instructions for their use were sent to three projects (Charleston, Topeka, and Phoenix, Ariz.) to collect pollen count slides for the remainder of the season. By mid-September one station was established near the geographic center of each city. Slides are changed at 24-hour intervals, 7 days per week, and will be held at the project for future examination.

Impounded Water Studies. Two final, one reconnaissance, and three letter malaria survey reports were completed and submitted to the Corps of Engineers during the quarter. Requests were received from the corps for two additional reports. The surveys were made in Texas (3), Idaho, Pennsylvania, and Illinois.

The staff of the Impounded Water Section assisted the Audio-Visual Production Services and the Alabama State Health Department in the preparation of a flimstrip entitled, "Malaria Control on Small Impoundments." Assistance was also rendered the Minneapolis, Minn., Health Department in the formulation of plans for the creation of a mosquito abatement district in that area.

Special Services. In September a request was

received from the Georgia Department of Public Health for assistance in providing an emergency water supply for Clarkdale, Ga., while the filter in that community's water treatment plant was undergoing repairs. After clearance with the Regional Office, arrangements were made for the loan of two mobile water-purification units to Clarkdale. The loan of this equipment afforded an opportunity to observe the operation of the units under emergency conditions, and the Georgia Department of Health agreed to take regular bacteriological samples of the treated water so that the effectiveness of the treatment might be determined.

Entomology

A 5-year summary has been prepared of entomological evaluations of the DDT Residual Spray Program for 13 southeastern States, from June 1945 through August 1949, based on a total of 64,355 inspections of sprayed and unsprayed houses. Data included in this summary for the months June through August 1949 indicate that about the same percentage of houses were maintained free of *Anopheles quadrimaculatus* mosquitoes in 1949 (88.4 percent), as for the past 4 years.

Dr. Richard P. Dow, Entomologist at Thomasville, Ga., was assigned to Iran for a 3-month period beginning in August. He was to continue assistance in malaria control which was initiated by Dr. Andrews, of the Executive Office, and Mr. Hall, of Engineering Services, under a cooperative agreement between the State Department, the Communicable Disease Center, and the Government of Iran.

MALARIA INVESTIGATIONS

Newton, Ga. Routine visits by the nurse were made to residents of the experimental area. In August, 24 persons having symptoms suggestive of malaria were found, and in September, 15 were found. Blood films from all these individuals proved to be negative.

During the quarter, adult female anophelines were collected and prepared for precipitin testing. The mosquitoes are collected from the premises of rural residences, and a total collection at each residence visited is emphasized. This procedure will result in the accumulation of comparative data at those premises examined repeatedly during the season, or in successive years. An analysis of the adult anophelines collected during the 1949 season has been completed. In brief summary, in Baker County, a total of 1,526 female "*quads*" with blood was collected, and 1,136 without blood; similarly, in the *A. crucians* complex, 1,848 females contained blood, and 1,277 did not; in the *A. punctipennis* complex, 8 females contained blood and 2 did not. More than 9,000 mosquitoes were collected in Baker and Early Counties together, in connection with these host preference studies.

Dissections were made of females of the *A. crucians* complex, collected from the premises of rural residences in the experimental area, to determine if malaria infections were present. While the presence of *Anopheles georgianus* in the experimental area is established, it is probable that most of the specimens dissected were *A. crucians*. Of 381 females dissected, 54 (14 percent) were found to harbor small sporozoites or sporozoite-like bodies.

The sporozoites or sporozoite-like structures observed in dissections at this station are smaller than those of human malaria. Further evidence that they do not represent a stage of *Plasmodium* similar to those affecting humans, other mammals, or birds, is the fact that routine stomach dissections, on the series of mosquitoes in which the sporozoite-like bodies were found, failed to reveal the presence of cysts. The possibility that these sporozoite-like bodies might be an intermediate stage of an organism differing from, but related to, *Plasmodium* is not being overlooked.

Plasmodial infections have been found in the southern fence lizard, and observations both in the field and in the laboratory are being made to determine whether or not these offer an explanation for the sporozoite infections in *Anopheles*. Approximately 20 percent of the lizards have been found to be parasitized by a *Plasmodium*.

The National Institutes of Health strain of *A. quadrimaculatus* has been maintained in our colonies through 11 generations, since its acquisition in November 1948, and the 12th generation is now represented by developing larvae. No difficulty in maintaining this strain has been experienced. Attempts to colonize local strains of "*quads*," *A. crucians*, and *A. punctipennis* were continued on a small scale during the quarter.

About September 1 an important project designed to study the chemical components of waters in which "*quads*" breed was inaugurated. Three ponds which are "*quad*"-breeding and three which are non-"*quad*"-breeding have been selected for intensive study. Work was begun on dissolved organic matter, dissolved electrolytes, and dissolved oxygen.

Manning, S. C. In two experiments to determine *Anopheles* dispersal, 1,040 *A. quadrimaculatus* and 586 *A. crucians* were marked with dyes or dusts and released in the stable where they had been collected. Later, about 90 percent of those mosquitoes present on the premises were collected each day over a period of a week and examined for the presence of marked specimens. In one experiment 3.6, 1.6, 1.0, 1.0, and 0.0 percent of the marked *quadrimaculatus* released were recollected after intervals of 3, 4, 5, 6, and 7 days respectively. Only one marked *crucians* was recovered, this collection being made on the 3d day after release. In the second experiment, data for but one day are available. These show that on the 2d day after release, 1.9 percent of "*quads*" and 0.25 percent of *crucians* were recovered.

The number of mosquitoes dissected during the quarter, together with cumulative totals, and the number which were gland-positive, are given in table 1.

In addition to the dissections of *Anopheles* collected from routine stations, 46 *crucians* from light traps, 27 *crucians* from hollow trees, and 6 "*quads*" from hollow trees were dissected, all with negative results.

A summary of data on positive specimens for the season is given in table 2.

Helena, Ark. Efforts were made during September to contact all physicians practicing in Phillips County to explain the functions of the station and to offer them the facilities of the laboratory for malaria diagnosis. Eighteen of the 22 doctors actively practicing were contacted personally. In all but one case, they commented on the decrease or absence of malaria cases in their practice for this year.

Epidemiological work concerned with routine visits to occupied houses yielded blood films from 213 residents who had not been tested previously; all were found to be negative for malaria parasites, although 13 individuals showed symptoms suggestive of malaria.

In the study of feeding habits of *Anopheles*, a total of 1,262 *quadrimaculatus* was collected for precipitin tests in Phillips County. In addition, 1,159 *quadrimaculatus*, 669 *Psorophora confinnis*, and 1,327 *Psorophora discolor* were collected for this purpose at Stuttgart. Results reported to date are shown in table 3.

Dissections were begun in July, 1949. During the quarter, 151 *A. quadrimaculatus*, 7 *A. punctipennis*, and 4 *A. crucians* females were dissected. Glands and guts in all specimens were negative for malaria parasites.

FLY CONTROL

The field operations begun at each of the five fly control-polio investigations cities in the 4th quarter of fiscal year 1949 were continued throughout the 1st quarter, fiscal year 1950. Entomological evaluations at all projects reached maximum proportions during this period, with approximately 500-600 blocks in each city being covered by the grill surveys each week. Fly trapping operations for qualitative determination of fly populations continued at a rate of approximately 12-20 collections per week per city.

In early August, additional collection of flies for virological study was begun. For this work, each section of the city was divided into two to three subsections with two trap collections being made per subsection per week. All flies collected for viological study are inactivated and killed by dry ice, after which they are stored at subzero temperature in the freezer plant until subject to analysis. This virological study is a cooperative undertaking by CDC, National Foundation for Infantile Paralysis, and the Yale School of Preventive Medicine.

In August, a series of nine experimental tests,

TABLE 1 Summary of Dissections of "Anopheles"

Species	Quarterly Total	Cumulative Total-1949
No. *crucians* dissected	4,190	13,928
No. *crucians* with sporozoites	2	10
Percent *crucians* with sporozoites	0.07	0.08
No. *quadrimaculatus* dissected	3,873	5,378
No. *quadrimaculatus* with sporozoites	4	5
Percent *quadrimaculatus* with sporozoites	0.10	0.09
No. *punctipennis* dissected (all negative)	25	172

TABLE 2 Sporozoite-Positive Salivary Glands Found in "Anopheles" During July, August, and September 1949

Date Collected	Species	Estimated No. Sporozoites		Station from Which Collected
June 29	*crucians*	1,000 and over	503	In section previously with highest malaria incidence.
July 6	*crucians*	100-999	E368	In nonmalarious section.
July 20	*quadrimaculatus*	100-999	601	In a previously malarious section.
Aug. 9	*quadrimaculatus*	1,000 and over	601	In a previously malarious section.
Aug. 9	*crucians*	1,000 and over	601	In a previously malarious section.
Aug. 31	*quadrimaculatus*	1,000 and over	486	In section previously with highest malaria incidence.
Sept. 6	*quadrimaculatus*	100-999	571	In a previously malarious section.

TABLE 3 Results of Precipitin Tests Through September 30, 1949, on "A. quadrimaculatus"

Location	Negative	Human	Equine	Bovine	Porcine	Avian	Multiple Reaction
Lake Township (Total 763)	57	2	468	140	77	7	2 E-B 2 B-P 1 P-A 7 E-P
Balance of Phillips County (Total 75)	19	1	5	22	27	1	None
Stuttgart, Ark.	132	9	150	92	19	268	1 E-B

using the relatively new insecticide dieldrin, were begun at the Phoenix, Ariz., project. Preliminary results indicating a relatively high degree of control were obtained.

ECTOPARASITE STUDIES

Data available for analysis on the effectiveness of 10 percent DDT dust were received from 51 counties in 10 States. These include records of ectoparasite identifications from 1,676 rats, and of successful tests of sera from 1,390 rats. Results of complement fixation tests on rat sera show no change in the percentage of rats from nondusted areas which were positive for typhus (11.3 percent), when compared with the same period in 1948 (11 percent). Likewise, the overall results obtained during this quarter fail to show any reduction in the percentage of typhus infection in rats from premises dusted 31 or more days previously (11.5 percent), when compared to nondusted premises (11.3 percent). However, an analysis by States shows that very good results were obtained in all States, with the exception of Texas where no reduction whatever was obtained in dusted premises. The percentage of rats positive for typhus from nondusted premises, and from premises dusted 31 or more days previously was, respectively, 18.8 percent and 20.8 percent for Texas, and 7.7 percent and 1.6 percent for all other States. The reasons for this discrepancy are not readily apparent from the reported data.

Ectoparasite data on the 1,676 rats examined show fairly good control of nonsticktight fleas and mites (*Laelaps nuttalli* and *Echinolaelaps echidninus*) but show little reduction in sticktight fleas and *Liponyssus bacoti*, and no reduction at all in the rat louse.

A study of the data for *Xenopsylla cheopis* by States shows that comparable reduction occurred in the percentage of rats found infested during the first 6 months after dusting, as compared to that of nondusted areas. However, in Texas, an increase in infestation appeared at periods of over 6 months after dusting, and little reduction when all dusting periods are combined.

For comparative purposes with the above mentioned use of 10 percent DDT dust, analyses were run on the available data covering the effectiveness of 5 percent DDT dust, based on records from 26 counties in 6 States. The latter data consist of records of ectoparasite collections from 1,183 rats, and of successful tests of sera from 982 rats. Briefly, when these 5-percent-DDT-dust data are broken down into short monthly dusting periods, they show rather poor control of the three species of nonsticktight rat fleas, even during the first 2 months after dusting. Thus, the percentages of reduction in rat flea population on the 5 percent dusting project compare UNFAVORABLY with those obtained with 10 percent DDT dust (for *cheopis*, 51 percent with 5 percent dust and 84 percent with 10 percent dust).

DYSENTERY VECTOR CONTROL

General. An accelerated sanitation program was started late in July in the city of Thomasville, Ga., in cooperation with municipal officials. By early August 3-times-a-week pick-up of garbage had been established. Because of fly breeding in commercial wastes, as yet impossible to eliminate, it was necessary to use chemical control around two industrial plants. Studies concerned with explaining the daily fluctuation in fly densities were inaugurated. Observations in this area upon fly breeding in household garbage, indicated that fly population potentials from this source alone were far in excess of those populations actually encountered in any of the study towns; the role that environmental resistance and periodic garbage collections play in the curtailment of this fly breeding potential is being investigated.

Epidemiological activity included the collection and examination of some 3,000 human stool cultures from Thomas County and 165 from Moultrie, as well as the making of routine interviews for case finding in the study cities.

Our cooperative studies on the association of eye-gnats with the transmission of acute conjunctivitis continue, and Dr. Dorland Davis of the Microbiological Institute of NIH has established a laboratory at the station.

Fly Attractant Studies. In performing fly density studies, there has been a long recognized need for standard attractants that are available at all seasons and that will compete favorably with normally encountered attractants.

Mixed baits, using seasonally abundant vegetable and fruit attractants, are at best not stand-

ard attractants from season to season, since they vary in composition. Preliminary studies of the time spent in feeding by individual flies throughout the day show a wide range, but actually only a small percentage of the day can be said to be spent in feeding. It was indicated from these and other studies conducted by members of the project staff that some other approach to fly sampling should be investigated. Oviposition studies upon favorable breeding media may be used as a comparison with feeding-attracted flies. Oviposition indices throughout a 24-hour period might give a better sample of the fly population for that period than would be expected from discontinous observations such as grill counts, which only vouch for the fly index obtained upon the sample attractant at the exact time the count was made.

Samples of artificial house fly media were fortified with urea and aged; and then were used for attractant tests. So far, the most attractive oviposition medium was that fortified with 30 grams of urea per 1,600 cubic centimeters of water, and aged for 120 hours before using. This medium was used to collect house fly eggs, which were allowed to hatch and the larvae reared to the 3d instar for counting. The numbers of maggots thus collected in 12 blocks in Thomasville correlated closely with the flies counted in the same blocks by the grill method. Further tests will be made and additional oviposition media tested for other common flies.

SPECIAL STUDIES

Kern County, Calif. In spite of the intensive local control of mosquito vectors of encephalitis, local veterinarians reported the occurrence of 26 clinical horse cases. However, these were not confirmed by laboratory diagnosis.

Some 5,500 female mosquitoes were collected and frozen for virus tests; collections of mites frozen for the same purposes totaled 31,700. In the avian malaria studies, of a total of 441 female *Culex tarsalis* mosquitoes that were dissected, 10 percent were positive either for oocysts, sporozoites, or both.

The first successful colonization of the mite *L. sylviarum* was made in a large breeding colony of hybrid sacred white and ring-necked doves established in a mosquito-proof insectary at Bakersfield. This colony is being used to study experimental transmission of St. Louis and Western equine viruses.

Yakima Valley, Wash. In an attempt to determine why St. Louis encephalitis rates in man, and Western equine rates in man and horses, have decreased to the point of practical disappearance within the last few years, an intensive survey was made during the normal encephalitis season. It was found that, although no measures aimed at mosquito control ever had been carried out in this area, a remarkable reduction in the number of all mosquito species had occurred in most localities. This may be due to the increasing use of DDT in agricultural spray practice. It was noted that water collections in the vicinity of orchards were in all cases NEGATIVE for mosquito larvae; those in hop-growing areas where DDT was not used, and in pastures, were commonly infested. Also, house flies were observed only in small numbers, even on dairy farms. The use of DDT increased from 0 in 1942, to 2,612,000 pounds in 1948. Apples, pears, peaches, and cherries are treated from 2 to 3 times per season with DDT in various forms, principally 25 percent dust, at about 50 pounds per acre. Other important truck and food crops are sprayed or dusted with varying amounts.

Epidemiology

Dr. Alexander D. Langmuir was appointed Chief of Epidemiology Services, on August 1, 1949, succeeding Dr. Seward E. Miller, Acting Chief. For three years before accepting his new position he had served as associate professor of epidemiology at The Johns Hopkins University School of Hygiene and Public Health at Baltimore, Md. He received his Bachelor of Arts degree from Harvard College, his medical degree from the Cornell University Medical College, and his Master of Public Health degree from Johns Hopkins University.

MALARIA INVESTIGATIONS

Beginning in July 1949, the State of South

Carolina introduced a new individual-case morbidity reporting system. This has resulted in a marked decrease in the number of reported cases of malaria. Only 126 cases of malaria were reported during the quarter compared to 1,800 reported in a similar period the previous year. Of these 126 reports, 40 percent were submitted by one physician and 21 percent by another. Diagnosis of these cases has been entirely on clinical grounds, and repeated efforts to confirm some of these diagnoses microscopically have not met with success.

In the State of Mississippi the bounty of $5 for malaria laboratory confirmations, which was instituted in July 1948, was increased to $10 on July 1, 1949. During the quarter, payments were made by the State on only two cases.

Texas continued to dominate the malaria reporting picture, with 982 reports of the 1,488 cases noted during the quarter from the 13 "traditionally malarious States." It is believed, however, that these reports do not reflect the true incidence of malaria because, according to a report of the Director of the Texas State Health Department Laboratory, only two positive smears had been found at the central and district State laboratories from September 19, 1948, to July, 1949. The initiation of a malaria appraisal program in Texas, beginning October 1, 1949, will be watched with interest.

Table 1 summarizes the results of the appraisal program in Mississippi and South Carolina, the two States in which regular investigation of individually reported cases was conducted during the quarter. Of a total 114 individual cases appraised, only 9 could be classified as positive on the basis of laboratory confirmation. In only 3 of these 9 did the investigation suggest the possibility of the infection's having been acquired indigenously.

With the evident rapid disappearance of cases of malaria which can be confirmed by laboratory tests, plans were initiated during the quarter to change the emphasis of the malaria appraisal program. Instead of merely seeking to confirm or disprove the diagnosis of malaria, in the future an effort will be made to collect more detailed clinical and epidemiological information on the individual cases appraised and to secure blood serum and other specimens for additional diagnostic studies. Thus the field representatives will be serving as aides in the diagnosis in a variety of febrile communicable diseases. Insofar as time permits the field representatives will participate also in other appropriate communicable disease control programs under the direction of the State epidemiologist. Of particular interest will be the appraisal of reported cases of typhus fever with attempts to collect blood specimens for confirmation by complement fixation test.

LEPROSY INVESTIGATIONS

On August 18, Medical Director L. F. Badger reported for duty and took charge of the Leprosy Control Program.

Field activities during the quarter were limited largely to the follow-up of contacts of known cases as well as cases who have left Carville, either as arrested cases or as absconders. The absconded cases have been urged to be examined frequently at the U. S. Marine Hospital where some of them have received treatment. In a few instances, absconded cases have returned to Carville.

TABLE 1

Record of Malaria Appraisal
July, August, September, 1949

State	Cases Reported	Cases Appraised	Cases Appraised As			
			Positive	Presumptive	Doubtful	Improbable
Mississippi	46	39	3	13	3	20
South Carolina	132	75	6	57	12	0
Total	178	114	9	70	15	20

Plans for future field work include placement of medical epidemiologists and epidemiological nurses in appropriate locations in the four States, Florida, Louisiana, Texas, and California. The field program will attempt to develop appropriate facilities for diagnosis, treatment, and follow-up of cases and contacts and for the initiation of epidemiological investigations.

Q FEVER

Beginning July 1, 1949, the Q Fever program was transferred from Veterinary Public Health Services to Epidemiology Services. This program is a cooperative one with the California State Department of Health, under Dr. Edwin Lennette.

TYPHUS INVESTIGATIONS

Plans were completed during the quarter for the discontinuation of the typhus investigations program at Thomasville, Ga., as of December 1, 1949, with a spot recheck to be made in the summer of 1950.

POLIOMYELITIS STUDIES

During the quarter many modifications were made in the plan of evaluation of the effect of fly control on the occurrence of poliomyelitis in the five-city program. Emphasis was directed toward developing more reliable methods of measuring fly densities. Additional personnel were appointed in Charleston, W. Va., and Topeka, Kans., to make Scudder grill counts independently of control operations, in predetermined blocks, which represent a stratified random sample of the city. Analysis of these data is still in progress.

Laboratory

In July the Plague Suppressive Laboratories at San Francisco were transferred to Laboratory Services as the Western CDC Laboratory, with Medical Director C. R. Eskey as Medical Officer in Charge, and Senior Surgeon V. B. Link in charge of the Plague and Rodent Control Unit.

Exclusive of services rendered as a part of cooperative surveys, more than 16,000 items were furnished in answer to upwards of 4,000 requests for aid. Among these services, 33 percent of the 12,000 reference diagnosis specimens came directly from State and local public health departments.

Field survey specimens examined during the quarter totalled more than 25,000 items.

CONSULTATION SERVICES

Dr. E. J. Tiffany was called to active duty as Senior Surgeon (R) on September 1, in charge of Consultation Services. In addition to making public health laboratory surveys and program reviews, Dr. Tiffany will bear the chief responsibility for the presentation of refresher training courses away from Atlanta.

During this quarter a laboratory survey and program review was made for the State of Washington, and a follow-up review was made in Kentucky.

A 5-day course of lectures in bacteriology and parasitology was given at Portland, Ore., in July, under the auspices of the Oregon State Board of Health.

At the request of the Texas State Department of Health, a similar 3-day course of refresher training lectures was given at Austin, Tex. Abstracts of the lectures was reproduced and distributed to registrants for these courses--120 in Oregon and 80 in Texas.

Diagnostic consultation services were supplied in Arizona (parasitology); in Georgia, Louisiana, Kentucky, Arkansas, and Colorado (virus).

A short refresher course in helminthology was given in Florida, while special lectures in bacteriology were given in Columbus, Ga., and for the Emory University School of Medicine, Atlanta, Ga.

TRAINING

Regularly scheduled courses were held in "Serological Diagnosis of Rickettsial Diseases," "Laboratory Diagnosis of Mycotic Diseases," "Laboratory Diagnosis of Tuberculosis," and "Laboratory Diagnosis of Parasitic Diseases."

EXTENSION SERVICE

Specimens, keys, and charts were sent each month to 295 laboratories. The shipments

included *Endamoeba histolytica* cysts, *Endololimax nana* cysts, hookworm ova, and *Strongyloides* larvae; *Trypanosoma cruzi* and *Leishmania donovani; Pediculus humanus*, and *Callitroga macellaria.*

Loan sets of parasitological material and keys were sent to five laboratories in Georgia, West Virginia, Arkansas, and Connecticut.

EVALUATION PROGRAM

The Parasitological Evaluation Program to evaluate proficiency in the diagnosis of amebiasis began in July, with monthly shipments of 10 specimens to 38 States and 4 Territorial health department laboratories.

Three referees designated by the American Society of Tropical Medicine serve as consultants to examine all specimens when these are shipped to laboratories in the following States and Territories: Alaska, Arizona, Arkansas, California, Canal Zone, Connecticut, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Jersey, New York, North Carolina, North Dakota, Ohio, Oregon, Puerto Rico, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin.

PARASITOLOGICAL STUDIES

Titrations of *E. histolytica* antigens were begun to determine the effect of long-time storage on their reactivity.

A modification of the Heidenhain's iron-hematoxylin procedure for tissues has been developed, which yields critical and precise results without need for destaining. Work is continuing to adapt the method for fecal smears.

A comparison of the effectiveness of concentration techniques for intestinal parasites was begun, using formalin-preserved and unpreserved stool specimens containing a variety of eggs and cysts. During this quarter the Ritchie ether sedimentation method has been compared with the Faust Zinc Sulphate flotation procedure.

A taxonomic study of biting midges in the genus *Culicoides* has been continued.

Stock cultures of intestinal protozoa have been maintained with and without the continuous use of penicillin and streptomycin in the medium. Although the bacterial flora apparently was altered by use of these antibiotics, no consistent change was effected in the growth characteristics of the various protozoa in the treated series. When the protozoa were transferred to regular media, they resumed all their old characteristics. With the use of antibiotics it has been possible to maintain *Endamoeba coli* and *Dientamoeba fragilis* as stock cultures for over 2 months; these organisms are ordinarily difficult to maintain in culture.

The deep-freeze preservation of parasites in stool specimens was not a satisfactory method for subsequent recovery of parasites by the usual diagnostic techniques.

From the collecting laboratory in Puerto Rico studies on the effects of light and temperature on hatching of miracidia of *Schistosoma mansoni* have been completed and are being prepared for publication.

VIRUS AND RICKETTSIA STUDIES

A virucidal factor for Newcastle disease virus was found in large amounts in the normal sera of man, monkey, rabbit, and guinea pig; this factor was absent in sera from ferrets, hamsters, chickens, and mice. The factor is probably associated quantitatively with one of the four components of complement. Both complement and the neutralizing factor of normal sera can be preserved for more than a year at -10° C. or in the dry-ice refrigerator; both activities are completely lost after storage at 4° C.

The neutralization test in mice for evidence of antibodies against encephalitic viruses is under study; parallel tests using inactivated and normal sera are being made to determine if the values now considered positive for the encephalitis viruses should be changed.

Experiments are under way to develop a complement fixation test for the identification of the different type strains of the myositis virus, now called the Coxsackie virus (Dalldorf and Sickles). Fifty different isolates of this virus are available, and thus far four types can be recognized.

A pathological comparison of brains from naturally occurring animal cases of encephalitis has been started to determine any basis for differentiation of the Eastern and Western strains. It has

been shown that differentiation cannot be made on the basis of the type of infiltrating cell.

A colony of mites, *Liponyssus sylviarum*, has been established for use in future experiments on transmission of equine encephalomyelitis. To date, three complete generations of mites have developed and the colony is thriving. Another colony, *L. bursa*, has been established.

Complement fixation tests on human sera against lymphocytic choriomeningitis antigen totalled 19 specimens, of which 2 from Arizona, 1 from Louisiana, and 1 from Ohio were positive.

Neutralization tests using adult mice were run against Eastern equine encephalomyelitis, Western equine encephalomyelitis, and St. Louis encephalitis viruses. Among the human sera, 33 specimens were tested against E.E.E., of which a single specimen from Georgia and 1 of 6 sera from Louisiana were positive; of 64 specimens tested against W.E.E., 5 of 18 from Colorado were positive; of 52 sera tested against St. Louis virus, 1 of 15 from Colorado and a single serum from Louisiana were positive.

Animal sera tested against these viruses showed 21 of 82 tests against E.E.E. positive. Only 1 of 11 horse and mule sera from Arkansas, 9 of 11 horse sera from Georgia, and 11 of 15 horse sera from Louisiana were positive. A single serum from 8 horse and mule specimens from Arkansas was positive against W.E.E.

For the isolation of poliomyelitis virus 24 human specimens were submitted from Southern States: 1 of 3 spinal cord specimens and 3 of 5 fecal specimens from Alabama showed poliomyelitis when inoculated into monkeys; 1 of 3 fecal specimens from Kentucky, 4 of 5 fecal specimens from Oklahoma, and a single fecal specimen from Tennessee were positive when tested in monkeys.

By inoculation into a monkey, sewage from a main sewer in an Oklahoma town was shown to contain poliomyelitis.

Human material, inoculated into baby mice for isolation of the Coxsackie virus, resulted in recovery of virus from feces and from mouth washings. These tests used specimens from Alabama, Delaware, Florida, Louisiana, and Oklahoma.

Arthropods collected in Georgia, Kansas, and Louisiana were inoculated into mice for recovery of virus, but none of 273 lots gave positive results.

BACTERIOLOGICAL STUDIES

Arrangements were made at Grady Hospital, Atlanta, for a long-time survey of diphtheria carrier rates and bacteriological studies of diphtheria cases. This study should yield important information on the prevalence of different types of diphtheria bacilli and their relationship to morbidity and fatality rates, to the rate and duration of transitory infection, and to reinfection in healthy carriers. The investigation will also lend itself to a study of the effects of antibiotics and to some aspects of diphtheria allergy.

The preparation of antigens for the diagnosis of *Streptobacillus moniliformis* was initiated, and antisera for this organism have been prepared.

A laboratory manual for "Laboratory Diagnosis of Bacterial Diseases" has been completed. The sections deal with diphtheria, *Neisseria*, *Brucella*, *Staphylococcus*, and *Clostridium*.

Work on the filmstrip, "Preservation of Bacteria by Desiccation *in Vacuo*," was completed.

Streptococcus cultures tend to degenerate when maintained *in vitro* in the laboratory and to yield antigens with little or no "M" substance essential for typing. Tests have been started to determine the best methods for regaining streptococcus cultures rich in this M antigen from degenerated strains.

During the quarter, 35 shipments of streptococcus grouping and typing sera totalling 521 milliliters were made. It is proposed to develop a stock of lyophilized cultures of representative strains for all the *Streptococcus* groups and for all group A types.

The battery of antigens used in the Rickettsial laboratory includes murine typhus, Q fever, Rocky Mountain spotted fever, and rickettsialpox. No true case of rickettsialpox has yet been encountered. It has been found that rickettsialpox antigen reflects the presence of Rocky Mountain spotted fever earlier than the specific RMSF antigen. Table 1 presents a summary of the results of tests on 484 human sera submitted for diagnosis.

All of 34 cow sera received from Alaska were negative when tested for Q fever antibodies.

Table 1

Summary of tests on 484 human sera submitted for diagnosis:

Name of Test	Number of Sera	Number Positive	Percent Positive
Weil-Felix	447	148	30.1
Typhus (C.F.)	459	33	13.9
Q Fever (C.F.)	484	4*	1.2
R.M.S.F. (C.F.)	461	56	12.1
Rickettsialpox (C.F.)	457	70	18.6

* *Two of the positive Q fever sera came from Maryland and two from Arizona.*

A total of 4,888 rodent sera from typhus surveys and control studies contained 12.1 percent of positives for murine typhus.

Complement fixation tests for the lymphogranuloma-psittacosis group, using lygranum antigen, were run on 137 specimens from 26 States, and 17.5 percent of the specimens were positive.

None of the 14 sera from six States were positive when tested for evidence of histoplasmosis.

Sera were received from 39 States and from Norway and the Panama Canal Zone to be examined for antibodies against *E. histolytica*, *Trichinella*, and *Echinococcus*. The majority of the specimens were received directly from physicians. Among these specimens, 351 of the 1,120 sera tested for amebiasis were positive; 6 of 156 sera were positive for trichinosis; 3 of 53 sera were positive for echinococcosis.

During the quarter 3,500 milliliters of *Salmonella* sera and 3,000 milliliters of *Shigella* antisera were prepared. In addition, O sera were prepared for the most commonly encountered somatic groups of *E. coli*. Cultures representative of the remaining 85 recognized O groups of *E. Coli* were received for future use in serum production.

Production of antisera for the *Klebsiella* group was begun.

Cultures from two outbreaks of food poisoning in man were identified as Arizona paracolon bacteria. In one of these outbreaks the vehicle of infection apparently was home-made ice cream, while in the other it was a drink mixed by a person who had been ill with diarrhea 3 days previously and who still was carrying the bacteria.

A new Salmonella type, *S. duval*, was identified. It is represented by two cultures from apparently normal dogs in Florida.

A total of 107 cultures of *S. typhosa* were identified and their bacteriophage types determined.

Some lots of histoplasmin have been standardized and are available for distribution in answer to requests.

CLINICAL PATHOLOGY

New projects include an evaluation of methods for determining nonprotein nitrogen substances in blood and urine, with particular reference to urea and creatinine; an evaluation of methods for determining glucose in peripheral blood; and an evaluation of micromethods in blood chemistry.

WESTERN CDC LABORATORY

During the quarter plague was demonstrated for the first time in Thomas County, Kans., and Bernalillo County, N. Mex. The latter area was only 10 miles from a human case reported during July.

Plague was demonstrated in five fleas taken from a pocket gopher, *Thomomys fossor*, trapped in Park County, Colo. This was the first time this laboratory has been able to implicate pocket gophers as being involved in the transmission of plague. However, infected fleas were found on a pocket gopher in California several years ago.

The seven field units operated by this laboratory collected material in 31 counties of Kansas, Montana, Nebraska, New Mexico, and Wyoming, and the laboratory examined additional specimens collected by other units operating in Washington, Colorado, and Utah. During this period plague infection was demonstrated in 15 instances.

Two human cases of bubonic plague were reported in New Mexico August 3, 1949. Neither case resided in an area where domestic rats are found, nor did either case give a history of direct contact with any wild rodent. It may be assumed, however, that the transmitting agents were wild rodent fleas, since both individuals lived on farms and had been in the field. One case was a 10-year-old boy who resided on a ranch near Cerro, Taos County, while the other was a man 37 years old who worked on a farm near Placitas,

Sandoval County. Both patients were very ill, but recovered. One, the older, was first treated with penicillin, then with chloromycetin; the other was treated with streptomycin and sulfadiazine.

Macroscopic autopsy examinations were made of 3,958 rats trapped in San Francisco, and the fleas from these rats as well as fleas taken from rats in Bremerton, Seattle, and Tacoma, Wash., were inoculated to determine whether or not they were infected with plague. No evidence of plague infection was found.

This laboratory continued to conduct those bacteriological examinations, which require animal inoculations, for the U. S. Marine Hospital at San Francisco. It also made all bacteriological tests of water specimens for the Federal Security Agency Region X.

Technical Development*

TOXICOLOGY

(Note: The following information is the result of work in progress and the conclusions reached may not be final. For this reason, the contents should not be published or referred to in articles for publication without permission. Reference in this report to any commercial materials or equipment does not in any way constitute a recommendation of such materials or equipment by the U. S. Public Health Service.)

Toxicity of Dieldrin.** Twenty-five percent concentrate, 5 percent solutions, and 2.50, 1.25, and 0.62 percent emulsions have been tested using rats and rabbits as experimental animals. Doses were applied to the clipped skin of the shoulder area at the rate of 400, 80, 40, 20, and 10 milligrams of technical dieldrin per kilogram of body weight. The volume of solution or emulsion applied at a single dose was in all cases equivalent to a dose of 112 cubic centimeters for an average (150-pound) man. Rabbits were killed by all formulations used, but all rats have gained weight when treated 50 times with 0.62 percent emulsions, and some rats have survived and gained weight when treated 50 times with 1.25 and 2.50 percent emulsions. Convulsive states were observed in animals which subsequently died. Autopsy did not reveal the mechanism of death, but tissues of treated animals contained significant amounts of insecticide as shown by bioassay.

A part of the dairies where experimental fly larviciding was carried out suffered injury to chickens. Some young chickens (up to 2 pounds) died following typical convulsive seizures. Adult chickens were not affected even when kept permanently in the same pen where the younger victims were exposed only a short time. There was a suggestion of different susceptibility in different breeds as well as in different ages of chickens. On bioassay, tissues of chickens which died showed significant amounts of insecticide.

Toxicity of Aldrin*.** Chickens were also injured by field tests of aldrin used as a fly larvicide. Young chickens died following typical convulsions while adults showed no injury. Other findings were similar to those with dieldrin under similar circumstances.

Rodenticide Studies. In laboratory investigations, 11 of 27 Norway rats sublethally poisoned 2 months earlier, by voluntarily eating 5 milligrams per kilogram of ANTU in bait, refused ANTU baits while only 1 of 15 control rats refused ANTU when offered it for the first time. Fifty percent of previously sublethally poisoned rats which took ANTU survived while only 21 percent of controls survived the consumption of ANTU. The results indicated marked bait refusal and less marked drug tolerance in previously sublethally poisoned rats.

Field studies with rats that had survived ANTU poisoning demonstrated marked bait refusal but there was no evidence of tolerance.

Compound 42 has given good results against rats under actual field conditions in a poultry

** Abstracted from Technical Development Summary of Activities No. 19, July, August, September, 1949.*

*** Recently established common name for the experimental insecticide formerly known as compound 497.*

**** Recently established common name for the experimental insecticide formerly known as compound 118.*

abattoir, a cat and dog hospital, a pastry bakery, three grocery stores, and an airport hangar. Twenty-three rats were killed in the abattoir by compound 42 after 1080 had been used for 63 days, and 10 in the bakery after 1080 had been used for 42 days.

Three- to 4-month old chickens survived 14 doses of compound 42 over a period of 18 days and never showed symptoms. The food contained compound 42 at 5 and 10 times the rate now used in rat bait. Two chickens fed only on rat bait containing 10 times the proportion of compound of 42 died in 13 and 26 days, respectively, but starved chickens allowed to eat this same bait for 1 day showed no symptoms. The pathology of compound 42 poisoning in chickens has been observed and described.

EQUIPMENT DEVELOPMENT

"Package Unit" Aircraft Insecticide Spraying System. Formal approval has been received from Civil Aeronautics Administration to use the CO_2 package unit spraying system in the Piper Cub J-3 airplane. Changes which have been made on the unit subsequent to the last report include lengthening of the sight gage to 24 inches, and increasing to ½ inch diameter the size of pipe connecting the two tanks at the bottom.

Reciprocal Solution Agitator. A mechanical agitator, capable of holding up to sixteen 500-milliliter, pear-shaped separatory funnels, has been constructed for use by the Chemistry Section to speed up milk sample analyses for DDT content determinations

Rat-Rearing Equipment. A sanitary-type rat-rearing cage and rack have been designed to eliminate filth pockets and permit frequent disposal of animal excreta. A watering device connected to the premises water supply system eliminates the need for hand-filled water bottles. Also included is an improved feed container. These improvements will eliminate 50 percent of the man-hours required in the watering and cleaning activities in caring for 3,000 to 4,000 rats.

Ratproofing Studies. A miniature grain storage bin with inflated rubber sidewalls has not suffered any damage from rat gnawing after 105 days' exposure to rats, up to 100, housed in a ratproof room 20 feet square. A second bin of the same type, filled with dry corn on the cob, has been located on a rat-infested farm for 87 days with no damage occurring.

INSECTICIDE STUDIES

Investigational Work on Adult Mosquitoes. Deposits of 50 and 100 milligrams per square foot of benzene hexachloride (BHC) (95 percent gamma isomer content) compared favorably with deposits of 50 and 100 milligrams of DDT per square foot up to 39 weeks after spray application in 60-minute exposures of adult *A. quadrimaculatus*. Deposits of 100 and 200 milligrams of dieldrin per square foot have continued to give kills superior to DDT with 30- and 60-minute exposures up to 29 weeks after application.

Investigational Work on Adult Flies *(Musca domestica).* When poplar panels were held in the laboratory, deposits of 200 milligrams DDT per square foot* -- from 5 percent emulsions containing 2 percent rosin -- after 30 weeks failed to show better residual effectiveness than similar DDT deposits without rosin. DDT deposits from 2½ percent emulsion containing 1 percent rosin showed slightly higher effectiveness after 30 weeks than equal deposits without rosin.

Laboratory tests on protected plywood surfaces over a 26-week period showed that deposits from methoxychlor rosin formulation with Triton X-100 were superior to those containing Triton X-155 as the emulsifier. Rosin (2 percent) in technical methoxychlor emulsions containing emulsifier did not extend the residual effectiveness of deposits and showed a slight masking action. One percent rosin in water-wettable methoxychlor appeared to prolong the residual effectiveness of the deposits.

Up to 6 weeks after spray application, deposits of 50 milligrams per square foot of BHC (95 percent gamma isomer) have produced 100 percent mortality at 15- and 30-minute exposures. Deposits of 12.5 and 25 milligrams per square foot lost effectiveness rapidly.

On the basis of 24-hour mortality data, deposits of 50 milligrams per square foot or less of dieldrin show inferior residual effectiveness in

** The usual rate of application of insecticides is 200 milligrams per square foot. Thus the rate will not be given hereafter except when it varies from this amount.*

comparison with 200 milligrams per square foot of DDT 11 to 14 weeks after spraying. There is evidence that 48-hour mortality figures might show a higher mortality, particularly at lower dosages. Deposits of 75 milligrams per square foot or more continued producing essentially 100 percent mortality during the first 5 weeks, 100-milligram deposits continuing 29 weeks.

An insecticidal smoke bomb containing 20 percent DDT and one with 15 percent DDT and 5 percent chlordan gave 100 percent kills of flies in 2 hours. After 2 weeks, less than 20 percent of flies released in treated rooms were knocked down in 4-hour exposures. Glass and plywood panels were exposed in rooms to bomb discharges. No residue was detected chemically on the glass panels, and less than 5 percent of flies exposed for 30 minutes to plywood panels were killed 1 week after treatment.

Thirty-minute exposures of flies *(M. domestica, Callitroga macellaria,* and *Phaenicia pallescens)* showed that DDT deposits containing rosin and Triton X-100 retained effectiveness after 20 weeks of outside weathering. Similar weathered deposits with Triton X-155 failed after 15 weeks. Deposits of DDT from homogenized 5 percent DDT spray with 2 percent rosin, gave complete kills of house flies and blow flies after 44 weeks of weathering, but after 48 weeks, effectiveness dropped markedly. Deposits of dieldrin from emulsions with and without rosin and containing either Triton X-100 or Triton X-155 gave satisfactory results at dosages of 50 milligrams per square foot for at least 8 weeks of weathering. On the basis of 24-hour kills, deposits of 25 and 12.5 milligrams per square foot containing rosin were effective for 4 weeks. After 8 weeks, similar tests showed that considerable effectiveness had been lost. Inclusion of rosin in dieldrin formulations apparently extended residual effectiveness.

Tests of field strains of house flies collected at monthly intervals (March-August) from six Texas towns where treatment by the Pharr, Tex., Section has been discontinued, showed in August slight to moderate tendencies toward reversion to normal susceptibility. Comparison of Edinburg and Mission field strains with strains from these towns reared in the insectary since May, show reversion in resistance in those strains from both towns, which were held in the insectary without exposure to DDT. Two local resistant strains, the "Savannah Wild" strain collected from a group of farms where DDT was used occasionally, and the "Savannah Resistant" strain, collected from two commercial dairies where DDT was routinely applied, were held and reared free from DDT. The "Savannah Wild" strain showed a gradual loss of resistance through eight generations; the "Savannah Resistant" strain showed marked loss of resistance in the F_4 generation, and returned to normal susceptibility in the F_6 generation.

Flies from F_7 generation held in cages with various proportions of the colony cage treated with DDT, methoxychlor, or a combination showed knock-down susceptibility similar to those of the F_6 generation. Reciprocal tests with F_7 flies showed that flies exposed to DDT over several generations acquired knock-down resistance to methoxychlor as well as DDT, but that flies similarly exposed to methoxychlor develop knock-down resistance to DDT to a less degree than to methoxychlor.

A second series of tests using 45 and 5 percent surface coverages with DDT deposits, 45 percent coverage with methoxychlor, 45 percent coverage with 100 milligrams DDT-100 milligrams methoxychlor per square foot, and a check colony with no treatment has been carried through the F_5 generation to date. In addition, flies of each generation were exposed in standard exposure chambers to deposits of the above insecticide combinations. Results showed that resistance to insecticide deposits was built up faster in the second series of tests except in colonies with combined deposits of DDT and methoxychlor. Resistance was produced more rapidly in colonies with 45 percent of the interior treated with DDT than in those with only 5 percent treated.

Flies were confined to treated vertical surfaces in petri-dish exposure chambers until such time as 100 percent knock-down was obtained. Exposure periods of 35 to 45 minutes were required at 70° F., 40 to 60 minutes at 80° F., and 60 to 75 minutes at 90° F.

Adult house flies were held in Peet-Grady chambers previously treated with deposits of

chlordan and dieldrin for periods ranging from 15 minutes to 4 hours. Results of tests with dieldrin showed that 50 percent or more mortality was obtained within 24 hours after exposure of flies for 2-, 3-, and 4-hour periods over an interval of 4, 5, and 6 weeks, respectively, after spray application. Tests with chlordan showed faster effectiveness during the first 2 weeks after spray application. The general results with aging deposits resembled those obtained with dieldrin. Limited tests with DDT showed very little fumigant activity.

Callitroga macellaria and *Phaenicia pallescens* were held in cages with samples of ground rat liver containing a known amount of 5 percent dieldrin solution in Wesson Oil added. Results indicated that 0.2 to 1.0 milligram or more of dieldrin in 2-gram samples of liver would produce close to 100 percent mortality of both male and female *P. pallescens*. Fifty percent mortalities of *C. macellaria* and *P. pallescens* were obtained with dosages of 0.05 to 0.1 and 0.02 milligram, respectively.

Investigational Work on Mosquito and House Fly Larvicides. Of 12 synthetic chemicals tested for insecticidal properties in 5 percent solutions of cyclohexanone, one, 1(*p*-chlorophenyl)-2,2,2-trichloroethanol* gave a 54 percent kill of mosquito larvae *(A. quadrimaculatus)* after a 35-minute exposure, DDT producing 96 percent mortality. In 18-hour exposures, two compounds, 1(*p*-chlorophenyl)-2,2,2-trichloroethyl-p-chlorobenzoate and 1(*p*-chlorophenyl)-2,2,2-trichloroethyl-o-chlorobenzoate, gave 70 and 75 percent mortalities, respectively, DDT producing an 89 percent mortality.

Tests with DDT, BHC, and toxaphene applied to house fly cultures at dosages of 125, 62.5, and 25 milligrams per square foot showed that the susceptibility of larvae to DDT varied with age and that DDT was ineffective at this treatment level. BHC (95 percent gamma isomer) and toxaphene gave satisfactory kills of all stages of larvae but were not effective against pupae.

Attempts were made to rear house fly larvae in new 5-gallon garbage cans, treated by pouring 5 milliliters of 5 percent dieldrin xylene solution in the bottom (300 milligrams per square foot). No pupae were recovered from any treated can up to 6 weeks after treatment, whether cans were held in sunlight or shade, covered or uncovered.

Investigational Work on Mites. Several miscellaneous organic compounds were synthesized, and tested against several species of insects; one of these compounds, namely, 1,4-naphthoquinone, was found to be quite active in killing two species of mites, *Echinolaelaps echidninus* and *Liponyssus bacoti*.

Investigational Work on Fleas. Culture methods were developed for rearing the oriental rat flea, *Xenopsylla cheopis*, and the cat flea, *Ctenocephalides felis*. Some 2,500 fleas were fed on rats held in small cages in 24-inch cubical culture boxes, over sterile pine shavings. The shavings were laid on 16-mesh galvanized screen over sterile sand and finely ground rat feces. After a 3-week period for egg laying under insectary conditions and after removing rats and wire screen containing shavings, pupae were collected. The fine sand remaining was sifted, and pupae and larvae were collected on suitable screens. Larvae were returned to culture box to develop further and pupate. Usually, five siftings of sand were necessary to obtain all pupae. Pupae were placed in glass containers so that daily collections of emerged fleas of known age could be obtained for test purposes.

A testing technique, using 5 percent DDT dusts, was devised for DDT-resistance studies on *X. cheopis* and *C. felis*. Insecticidal dust deposits were obtained by using a round-topped bell jar 15 inches high, 8¼ inches in diameter, as a dusting chamber. An airblast through a piece of copper tubing dispersed a measured sample of dust from a test tube suspended inside the bell jar. Ten minutes were allowed for the dust to settle on six poster-board disks 48 millimeters in diameter on the floor of the dusting chamber. Uniform deposits were obtained by this method. The fleas were tested and held in a 3-liter culture flask. A metal disk was centered at the bottom. On this was placed

** A short series of esters of 1(p-chlorophenyl)-2,2,2-trichloroethanol was prepared from selected acids by reacting the secondary alcohol with the corresponding acid chloride.*

the dusted disk. One end of the 12-inch glass tube was placed on the treated disk. Approximately one hundred fleas dropped into the tube were held on the treated disk for the desired exposure period, after which the tube was removed, allowing fleas to leave the treated surface. The cardboard and metal disks were removed and the fleas were held for 24 hours, after which the mortality counts are made. Tests with this method showed that females are slightly more susceptible than males, and that mortalities are not affected by a blood meal.

DISINSECTIZATION OF AIRCRAFT

Comparative Effectiveness of Various Aerosol Formulations. Formulations containing 2 percent pyrethrum extract were compared with 5 percent pyrethrum extract formula S-37 to determine whether cost could be reduced without sacrifice of effectiveness by reducing the amount of pyrethrum. Formula S-43, which contained 1 percent of Sovacide 544G, and more VanDyk 264, than did formula S-37, was shown to be essentially as effective against house flies as formula S-27, though it contained 3 percent less pyrethrum.

CONTROL METHODS AND EVALUATION

Field Investigations on House Fly Control. House flies at dairies near Savannah, Ga., were found to be moderately to strongly resistant to DDT. In field tests at these locations, satisfactory control of flies was not obtained with residual applications at rates of 200 milligrams per square foot of technical DDT, technical DDT with rosin added as an adhesive, technical methoxychlor, methoxychlor-wettable powder, or a 50-50 combination of technical DDT and technical methoxychlor. A 60-40 combination of DDT and chlordan, at the rate of 200 milligrams of combined toxicants per square foot, gave satisfactory control for 6 weeks. Technical chlordan emulsion at 100 milligrams per square foot gave fairly good results for 8 to 10 weeks; at 200 milligrams per square foot, excellent control was obtained for 10 weeks with observations continuing. Dieldrin, at 12.5 and 25 milligrams per square foot, gave excellent control for 11 weeks with observations continuing; at 5 milligrams per square foot, the results were variable. Lindane* gave effective control for only 2 to 3 weeks when applied at the rate of 25 milligrams per square foot; at 50 milligrams per square foot, effective control was obtained for 4 to 8 weeks.

Evaluations were continued on the residual effectiveness of outdoor surfaces which were treated with test insecticides in April 1949. Results were based on the 24-hour mortality of adult female laboratory-reared house flies exposed to the treated surfaces in wall cages. Dieldrin, at 200 milligrams per square foot, continued to give best results 22 weeks after treatment. At a dosage of 100 milligrams per square foot with rosin added as an adhesive, this compound gave good results through 21 weeks.

In small land-locked ponds, the application of residual larvicides gave effective control against mosquito larvae, both anophelines and culicines, for the following periods: DDT at 3 pounds per acre -- 13 to 23 weeks; DDT with rosin at 3 pounds of DDT per acre -- 10 to 24 weeks; technical BHC (10 percent gamma isomer) at 1 pound per acre -- 3 to 8 weeks; dieldrin at 1 pound per acre -- 21 weeks; dieldrin at 0.5 pound per acre -- 5 to 7 weeks; dieldrin at 0.25 pound per acre -- 8 to 11 weeks; and toxaphene at 1 pound per acre -- 4 to 6 weeks. Observations on many of these tests are still in progress.

In preflood treatments, effective control of anopheline and culicine larvae was obtained for the following periods after the ponds flooded: DDT at 1 pound per acre -- 3 to 4 weeks; DDT at 3 pounds per acre -- 5 to 15 weeks; DDT with rosin, at the rate of 3 pounds of DDT per acre -- 9 to 14 weeks; dieldrin at 3 pounds per acre -- 15 weeks; toxaphene at 3 pounds per acre -- 4 to 5 weeks; and DDD at 3 pounds per acre -- 14 to 15 weeks. Observations are continuing on many of these tests also.

All materials included in these tests were destructive to fish and other aquatic organisms, except the technical BHC at 1 pound per acre.

In a limited number of field tests against soil infestations of cat fleas, 5 or 10 percent DDT dusts gave effective kills of the adult cat fleas existing at the time of treatment, but were inef-

** Lindane is benzene hexachloride containing at least 99 percent gamma isomer.*

fective against adults which emerged later in the treated areas. Repeat applications were effective against these newly emerged adults. The DDT was apparently ineffective against the immature stages of the fleas in the soil. A 5 percent chlordan dust gave indication of being effective in a single-treatment control of cat flea infestations out of doors.

PHARR, TEX., SECTION

Environmental Sanitation Studies. A sanitary land fill continues to give good fly control at Mission. A mechanical break-down for 2 weeks during peak fly breeding demonstrated the ease with which fly control is lost and the rapidity with which it can be regained when using this method of disposal. Reasonable control, though erratic, was maintained at Edinburg using a modified sanitary land fill supplemented by use of insecticides. Pharr continued to maintain excessively high fly populations by indiscriminate dumping of wastes.

Chemical Fly Control Investigations. Dieldrin was tested as an outdoor residual fly spray at 100 milligrams per square foot dosage in Penitas and Elsa. A concentrate containing 12½ percent dieldrin and 10 percent rosin as an adhesive was diluted 1 part to 4 parts of water and applied with hand sprayers as a 2½-2 percent dieldrin-rosin mix. In both treated towns a marked reduction in the fly population was noted subsequent to treatment. Low fly population levels have been maintained in the two towns for 3 months and 2 months, respectively.

House fly larviciding tests on vegetable wastes were continued, using 200, 100, 50, and 25 milligrams of dieldrin and aldrin, while additional tests were made with chlordan and BHC at 200 and 100 milligram dosages. All sprays and dusts were applied at percentages that resulted in a constant of 40 cubic centimeters of spray material or 4 grams of dust being applied for each square foot of surface treated. Emulsions and water-wettable powder suspensions of dieldrin and aldrin produced good kills (90 percent or better) at 50 milligrams per square foot and above. Water-wettable powder suspensions of dieldrin and aldrin produced good kills at 25 milligrams per square foot but the emulsifiable concentrate emulsions at 25 milligrams produced erratic kills. Chlordan emulsifiable concentrate and dust gave good kills at 100 and 200 milligrams per square foot. BHC as a 5 percent gamma isomer dust at 200 milligrams gave good kills, but BHC as 10 percent water-wettable powder suspensions failed to produce satisfactory kills at 100 and 200 milligrams per square foot.

Training

James H. Crawford, Sanitary Engineer (R), Assistant Chief of Training Services, who has completed his graduate studies at Georgia Institute of Technology, Atlanta, is filling the position formerly held by R. J. Hammerstrom.

FIELD TRAINING

Cincinnati, Ohio. A schedule was completed for an advanced training course to be held November 7-18 for State chemists primarily concerned with water pollution investigations. A tentative schedule was prepared for a 2-week advanced training course for industrial chemists and engineers on water pollution control. This course will be presented in cooperation with the Ohio River Valley Sanitation Commission.

Special training schedules were prepared for four foreign visitors who were interested in water and sewage, stream sanitation, and training activities. In addition, there were six visitors from points in the United States who were interested in training activities.

Columbus, Ga. The sanitary engineering course which began June 20 was completed September 10. Certificates were issued to 14 trainees who attended this course. A field training course for sanitarians began at this station September 19, with 19 trainees enrolled.

A representative of the station attended the annual meeting of the National Association of Sanitarians, which was held in California August 13-20. He presented a talk on "The Activities of U. S. Public Health Service in Food Handler Training."

Denver, Colo. On July 20, the facilities of the Rocky Mountain Training Center were used by the

State Health Department, City and County of Denver Health Department, and the Tri-County Health Department for a 1-day seminar on sanitation of poultry and rabbit establishments.

A 4-day milk seminar was held August 2-6 for Colorado Health Department personnel. Approximately 40 persons attended.

The 12-week fall course in environmental sanitation began on September 19. There are six trainees in this group.

Topeka, Kans. A 3-month environmental sanitation course for sanitarians began August 22. Ten men are enrolled for the course. Eight additional trainees will attend that portion of the course concerned with milk sanitation.

Forty-one persons attended the milk and food sanitation short course conducted at Sylvan Lake, S. Dak., July 18-22.

A food establishment short course was held at Chicago, Ill., during the period September 19-29, with 105 persons in attendance. This group included personnel from health departments, the U. S. Public Health Service, the U. S. Naval Hospital, and private companies from the States of Illinois, Indiana, and Minnesota.

The Topeka Field Training Center was requested to participate in an "In-Service Training Program" to be held in Chicago, November 1, 2, and 3, 1949. This school is to be held for railroad dining car superintendents and inspectors.

Arrangements were made for a program in milk sanitation to be conducted at Madison, Wis., April 10-15, 1950. This course will be sponsored by the Wisconsin State Milk and Food Sanitarians Association. The Topeka Field Training Center will furnish demonstration equipment for water supplies, dairy farms, and short-time high-temperature pasteurization; projection equipment, reference literature, and educational visual aids.

Troy, N. Y. The Staff of this center conducted an 8-week field training course during July and August for graduate sanitarians at the University of Massachusetts, Amherst, Mass. Ten persons completed the course. The fifth 12-week field training course for sanitary inspectors at Troy, N. Y., began September 19 with eight persons enrolled.

Preliminary arrangements have been made to conduct a course for swimming pool operators.

During the period September 19-21, a representative of this center attended the annual conference of the New York State milk sanitarians at Syracuse, N. Y., at which time he addressed the group. He discussed future sanitation training activities in New York State.

HEADQUARTERS TRAINING

Insect and Rodent Control. Two 2-week training programs in insect and rodent control especially designed for foreign public health workers were conducted during the quarter. The first week of each course was concerned with insect control, with about 2 days devoted to flies, 2 days to mosquitoes, and 1 day to other insects of public health importance. The last week of each of these 2-week courses was concerned with rat-borne disease prevention and control. The course conducted July 11-22 was attended by 10 foreign public health trainees, while the one conducted July 25-29 was attended by six foreign public health trainees.

On August 15-19, a 2-week insect and rodent control course, especially designed for sanitary engineers from the Columbus Field Training Station, was conducted. This course was quite similar to the 2-week courses mentioned above except that there was more emphasis on control methods applicable to situations within the continental United States. This course was attended by 18 trainees from the Columbus Field Training Station as a part of their 3 months' comprehensive field training course in sanitary engineering.

The ninth field training program in rat-borne disease prevention and control was begun September 19 and will be completed October 14. Twenty-two men are enrolled for the course.

A Training Services representative assisted personnel of the California Department of Public Health in conducting three 1-week fly control courses in July. The first of these courses was attended by 18 members of the Bureau of Vector Control, California State Health Department; the second was attended by 18 members of local health departments in northern California; and the third was attended by 20 persons from local health departments in southern California.

Training Services personnel assisted the Texas State Health Department in conducting a

4-day field training program in fly control during September 26-29. This course was attended by 27 trainees, including sanitarians, State health department personnel, and Texas CDC representatives.

A 3-day field training program in insect and rodent control was presented for public health personnel in the State of Kentucky on August 9-11. This course was attended by a total of 46 people, most of whom were employees of the Kentucky State Health Department or of local health departments in the State. Five of those in attendance were from the Indiana State Board of Health.

Representatives from Training Services participated in a 2-week rat control class held in Kansas City, September 12-23, which was sponsored by the Office of Midwestern CDC Activities.

Training Public Health Personnel from Foreign Countries. Special observation and training courses were arranged for 37 public health visitors from 18 foreign countries during the quarter. The visitors came from Brazil, China, Denmark, England, Finland, France, Guatemala, India, Iran, Italy, Liberia, Peru, Philippines, Poland, Thailand, Turkey, Uruguay, and Yugoslavia.

Housing Sanitation. A 5-week course in "Appraisal Method for Measuring the Quality of Housing" was conducted during the period July 18-August 19.

Training Services personnel participated in a 1-day housing symposium under the auspices of the Syracuse Regional Health Department of the New York State Health Department. Participation was provided in a 1-day housing symposium on housing hygiene in Austin, Tex. The housing session was designed to acquaint the State regional engineers and selected city health officers with recent legislation and with the latest thinking on housing hygiene.

On August 25, a Training Services representative visited the Texas State Health Department, Austin, Tex., to arrange for assistance in field training for insect and fly control and housing sanitation.

Orientation. On September 27, an orientation program was arranged for a group of eight members of the Syphilis Study Commission of the World Health Organization. This program included a tour of the Communicable Disease Center.

Approximately 25 new employees attended two orientation courses, each continuing for 2 days.

OTHER HEADQUARTERS ACTIVITIES

Conferences. The Chief of Training Services participated in the sanitation seminar at Blue Ridge, N. C., during the week of August 24. Approximately 300 sanitarians from the six States in Public Health Service Region II assembled for panels and discussions during the week. Environmental sanitation techniques were the keynote, and consideration of field training of sanitation workers was highlighted by a panel directed by the Region II Medical Director of the U. S. Public Health Service, and the State Health Commissioner of each of the States. An opportunity was given the Chief of Training Services to participate in this discussion.

An agreement was negotiated during the quarter through the New York State Health Department between the Syracuse City Health Department and Training Services for the establishment of a regional housing training center. Mr. Emil Tiboni, formerly stationed at Atlanta, was transferred to Syracuse, N. Y., during August. His office is situated in the City Hall, where he has been placed in charge of the operating program in the city so that it can be utilized in giving training in housing evaluation techniques. It is planned to offer training at the Syracuse Housing Center to interested persons from health departments and housing authorities coming from the entire northeastern section of the United States.

Training Materials. In August, copies in quantity of the new publication entitled "Rat-Borne Disease Prevention and Control" became available for distribution. The general goal of the distribution is to get copies of the manual into the hands of all Federal, State, and local public health workers who are engaged in rat control work. Accordingly, each Public Health Service Regional Office was requested to correspond with the States in their regions advising them of the availability of the manual and requesting the submission of lists of public health people in their State involved in rat control programs. By the end of the quarter, copies of the manual had been distributed to all Federal public health personnel engaged in rat control work, to every State health officer, and to State and local public

pleted during the summer months, and the film soon will be ready for release.

Studies were completed on the use of various diluents for rabies virus. It was found that tryptose phosphate broth can be used in place of serum-saline. Further studies are being pursued on this problem to determine what diluent can be used most advantageously.

In studies on the complement fixation test of canine rabies, it was demonstrated that dog serum is not always anticomplementary; in fact, a substantial amount of complement was found in most sera. For successful use, it is necessary to inactivate the complement that is present. Further studies are being pursued on the complement fixation test in rabies. A dosage study on rabies vaccine was begun to determine the amount of vaccine to use for maximum protection. Attempts were made to purify rabies virus, which attempts were not successful. The virus was either destroyed or it disappeared in the physical and chemical methods employed. Further tests are being made to determine at what point the virus is destroyed. In tests on the ultraviolet irradiation, it was found that virus and brain tissues were not affected until after 25 to 30 seconds of the irradiation. There are many problems to solve in connection with ultraviolet-treated canine vaccine.

In the field operations for rabies control, Dr. George L. Humphrey was assigned to the California Department of Health to assist in organizing rabies control activities, especially in Southern California. During August and September of the first quarter, all his efforts were directed toward determining the size of the problem and the number of animal species and human cases reported in the enzootic area.

In Texas, rabies programs were put into effect in El Paso and cities of the upper and lower Rio Grande Valley. The death of a 3-year-old girl from rabies during June stimulated public interest in the control and eradication of the disease in El Paso. By the end of July more than 10,000 dogs had been vaccinated in El Paso. With continued efforts they plan to double that number by the end of the year. In Austin 8,000 dogs were vaccinated without any paralysis. In addition, 51 dogs received postrabies vaccination successfully. These animals must be restricted for 6 months. There have been no cases of rabies in the past 45 days. The sanitarians throughout the State have given excellent cooperation in promoting rabies control. Their work has been outstanding in the success of rabies control in small communities. Additional rabies programs have been carried on at Fort Worth, Dallas, and San Antonio, and it is believed that with the control of rabies in these centers of population the problem in Texas will diminish except for rabies in foxes of east Texas.

In Indiana, most of the efforts of the veterinary program were devoted to developing rabies and stray-dog control in the endemic area. Dr. John Scruggs was appointed to the Governor's Committee to make legislative recommendations for the control of animal diseases which are important to public health and agriculture.

In Florida, the incidence of rabies has dropped dramatically in the past quarter, compared to 1948. If the present trend continues in Florida, rabies will soon be eradicated except for the wild animal problems in the northern part of the State.

In Colorado, only one case was reported in 1949 (in the spring). Many communities have taken steps to make rabies vaccination a prerequisite to licensure of dogs.

In Iowa, plans were made to inaugurate rabies control programs in Polk County and Des Moines. A veterinary public health program has been inaugurated in the State under the direction of Dr. Stanley L. Hendricks, of the Iowa Department of Public Health. Dr. Hendricks will be in attendance at the University of Minnesota School of Public Health this year.

The incidence of rabies for the first quarter throughout the United States was lower than in 1948. This is a continuation of a trend that has been in effect for the past 3 years, except in certain areas where the disease has flared up. The most serious rabies problem remaining is the control of the disease in wild animals. This requires the services of trained hunters and is expensive.

Q FEVER

The experiments on the transmission of *Coxiella burneti* have not revealed any evidence

as to what may be the natural mode of infection of Q fever. Dr. Stoenner has exposed the teats of cows for a period of 60 days without being able to produce any infection. In addition, experiments were tried in infecting lactating cows by the instillation of infectious yolk-sac material into conjunctival sac. An equal quantity of sterile normal yolk-sac suspension was injected intradermally in the left caudal fold to control possible nonspecific protein reaction. Calves were found to be susceptible through intradermal inoculation, although the results were not consistent. The calves had a febrile reaction of 3 days' duration. In some cases this was confused by the presence of complement-fixing antibodies in addition to the organisms being demonstrated in guinea pigs.

RADIOBIOLOGY DEFENSE

Drs. Stoenner and Fagan both attended the radiobiology defense course given by the Navy at Treasure Island, Calif. The course covered (1) an introduction to nuclear physics and topics related to atomic bomb development and production, (2) an introduction to radioactivity and radioactive isotopes, (their production and decay); (3) the characteristics and use of the atom bomb; (4) organized defense against the atom bomb; (5) biological effects of radiation; (6) principles of monitoring; (7) construction and application of monitoring instruments; and (8) related topics. Drs. Stoenner and Fagan both thought the greatest value of the course was in giving accurate information in order to dispel hysteria and curtail the imaginative stories about the long-range effect of atomic energy.

MEAT INSPECTION

Dr. Martin Baum has developed a model meat-inspection program for a State health department in which the authority is centered in the State Health Department. Under the regulations, no individual plants are approved by the State, but, following satisfactory compliance, the entire local meat-inspection unit is approved. At the present time, such participation is of a voluntary nature. As anticipated, such a program stimulated interjurisdiction competition in obtaining approval, since meat from one approved agency was acceptable to another without additional inspection. The approval of agencies, rather than of individual establishments, encourages the better plants to bring the nonconforming plants into compliance. The substandard operations deprive the good ones of approval, with the subsequent benefits of free movement of their products.

Under the plan, no local service will be approved unless a licensed veterinarian is employed by the service on a full- or part-time basis, contingent upon the volume of slaughter. Ante-mortem and post-mortem examination of all animals processed under the supervision of the service is required before approval, and all pathology must be recorded and made available to the State department of public health. Sanitation alone is not adequate to certify for meat inspection approval.

CREEPING ERUPTION, SALMONELLOSIS

In Florida, studies in veterinary public health have continued to give most of their attention to creeping eruption and salmonellosis. About 50 percent of all the dogs and cats examined were found to be infected with either *Ancylostoma caninum* or *A. braziliense*. The disease has a high incidence in nearly all parts of the State. In the Salmonella studies, it has been found that many kennels and other places where animals are kept have infection rates ranging from 8.8 to 59.0 percent. One hundred eight isolations were made from 620 samples collected. Sixteen different types were identified, while a number of others had not been definitely identified to this date. Experiments are being inaugurated to determine the effect of various therapeutic agents on canine salmonellosis. The Brucella ring test is being used by the Florida State Board of Health in making routine milk surveys. It has aroused considerable interest in brucellosis eradication.

POULTRY INSPECTION

In Texas, the veterinary public health program has been concerned not only with rabies activities, but also with the development of poultry inspection. One of the larger producers of poultry believes that this is the safest and most satisfactory way to insure its quality and flavor. In an interview with him, it was pointed out that in New York-dressed poultry the viscera are re-

tained in the bird, resulting in absorption of the fecal odors from the intestinal content into the flesh. New York-dressed birds are shipped in iced barrels to market. As the ice melts, the weight of the birds on top squeezes the fecal content of the birds on the bottom of the barrel into the melting ice. The resultant mixture then contaminates the birds leaving a distinctly undesirable flavor which is referred to as "barn yard flavor." The producer believed that this unsanitary procedure soon would disappear in the United States because of demand for drawn, quick-frozen poultry. It is believed by the poultry industry that if the public can be educated to the use of ready-to-eat eviscerated birds the unsanitary plants and unsanitary practices which exist in the United States could be improved.

HISTOPLASMOSIS

In the investigation of histoplasmosis of animals, it has been found that the cervical skin test in cattle is the most desirable. On one farm in southern Kansas, reactors continued to persist in cattle over a period of 2 years. No other evidence of disease has been identified in any animals from this farm. Studies in dogs are being continued in the eastern Kansas and western Missouri areas. Two papers on histoplasmosis in dogs are now in preparation.

ENCEPHALOMYELITIS

During the first quarter Veterinary Public Health Services assisted Laboratory Services in investigating outbreaks of equine encephalomyelitis in Colorado, Louisiana, and Arkansas. The outbreaks in Louisiana and Arkansas were both thought to be caused by Eastern equine encephalomyelitis virus. It is recommended that all animals be immunized in these areas annually in order to prevent the enlargement of any reservoirs of the disease.

The Washington State Department of Health inaugurated a veterinary public health program in September 1949. Dr. Monroe Holmes, Senior Assistant Veterinarian, was assigned to assist in the program development. A study of animal diseases in the Columbia River Basin has begun, with all interested State agencies cooperating.

RECENT CDC MALARIA PUBLICATIONS

A list of recent publications by CDC personnel relating to the subject of malaria will be published in the February CDC Bulletin.

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