FEDERAL SECURITY AGENCY
Public Health Service

COMMUNICABLE DISEASE CENTER

1948 - 1949 ACTIVITIES

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FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
ATLANTA, GEORGIA

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Preface

This report deals with the major activities of the Communicable Disease Center during the fiscal year 1949. Information presented was abstracted from reports prepared by the headquarters units, Regional CDC representatives, and CDC activities directors in States where cooperative operational programs are conducted.

In the interest of clarity of presentation, and as an aid to those unfamiliar with the Center's operations, the report is divided into three parts: (1) organization and objectives; (2) headquarters organization activities; and (3) field organization activities.

Though this edition covers the same general field as previous CDC Activities Reports, this year the material has been organized and presented as an integrated account of the undertakings and accomplishments of the Center as a whole rather than on the basis of activities of the respective component units. It is believed that this topical approach offers a more useful summation of the Center's contributions to the over-all program of communicable disease control.

In the preparation of this report there has been conscious effort to omit details and record only composite end results that contribute toward improved health for all of the people through more effective control of communicable diseases.

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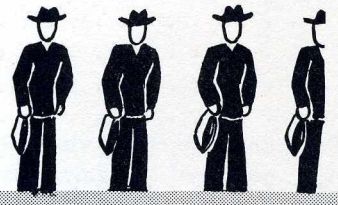
Personnel
Fiscal Year 1949

Civil Service	1,699
Commissioned	175
Total	1,874

Each symbol represents 100 people.

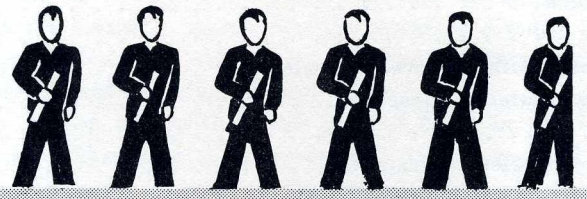
PROFESSIONAL
18.8%

Civil Service 9.4%
Commissioned 9.4%



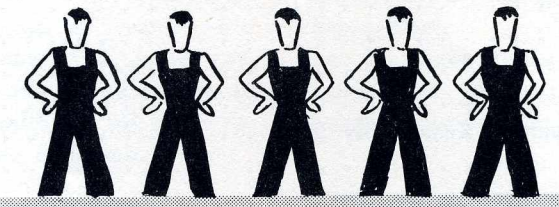
350

SUBPROFESSIONAL
30.5%



571

CRAFTS, CUSTODIAL,
AND PROTECTIVE
27%



507

FISCAL, CLERICAL,
AND ADMINISTRATIVE
22%

413

UNCLASSIFIED
1.7%

33

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Organization and Objectives

Experience has demonstrated the effectiveness of attacking communicable disease problems through teams of specially trained scientists under the supervision of a single organizational unit. The Communicable Disease Center has operated as such a unit since July 1, 1946, particularly in directing a coordinated attack against malaria, murine typhus, diarrheal diseases, plague, rabies, encephalitis, and more recently, certain aspects of poliomyelitis.

Organizationally, the Center is a Division of the Bureau of States Services of the Public Health Service, Federal Security Agency, with headquarters and major installations in Atlanta, Ga. The accompanying chart shows the internal organization of the Center from the functional standpoint. As new problems are encountered, as diseases assume larger or lesser importance, and as responsibilities of the Center are redefined, the organizational structure is revised and redirected. Insofar as practicable, research, investigative, and operational personnel and units are relieved of the burdens of administrative and management details which are relegated to an administrative unit.

Although headquarters of the Center is in Atlanta and most of its facilities are located there, activities are carried on in all sections of the continental United States, and various types of installations are maintained in different parts of the country. One coordinate headquarters unit, Technical Development, is located near Savannah, Ga. Other installations outside of Atlanta include three malaria observation stations (Manning, S. C.; Newton, Ga.; Helena, Ark.), eight field training centers (Albany, Ga.; Atlanta, Ga.; Cincinnati, Ohio; Columbus, Ga.; Denver, Colo.; Savannah, Ga.; Topeka, Kans.; Troy, N. Y.), five experimental fly control projects (Charleston, W. Va.; Muskegon, Mich.; Phoenix, Ariz.; Topeka, Kans.; Troy, N. Y.), plague investigations laboratory in San Francisco, Calif., laboratory facilities in Montgomery, Ala., and special field study projects in Pharr, Tex., and Thomasville, Ga.

The paramount objective of the Center is to assist the States in the control of communicable diseases within the respective States. To this end, the Center, utilizing its staff of trained specialists, transmutes scientific facts about communicable diseases into practical control methods, tests these methods through demonstrations in the field, and trains State and local health personnel in the techniques of applying them in actual control operations. Thus, the Center undertakes field investigations, carries on laboratory studies and research projects, cooperates with the States in operational programs, conducts training courses, produces specialized training aids for all categories of public health personnel in the communicable disease control field, and carries on a continuous program of evaluating control techniques and methods.

In implementing this program of multiple assistance to States, emphasis is on helping the States bring their respective communicable disease control facilities and personnel up to the level where they can do the job unaided. Center personnel assigned to States to assist in investigations, control operations, evaluation work, and in training, supplement rather than supplant State and local personnel.

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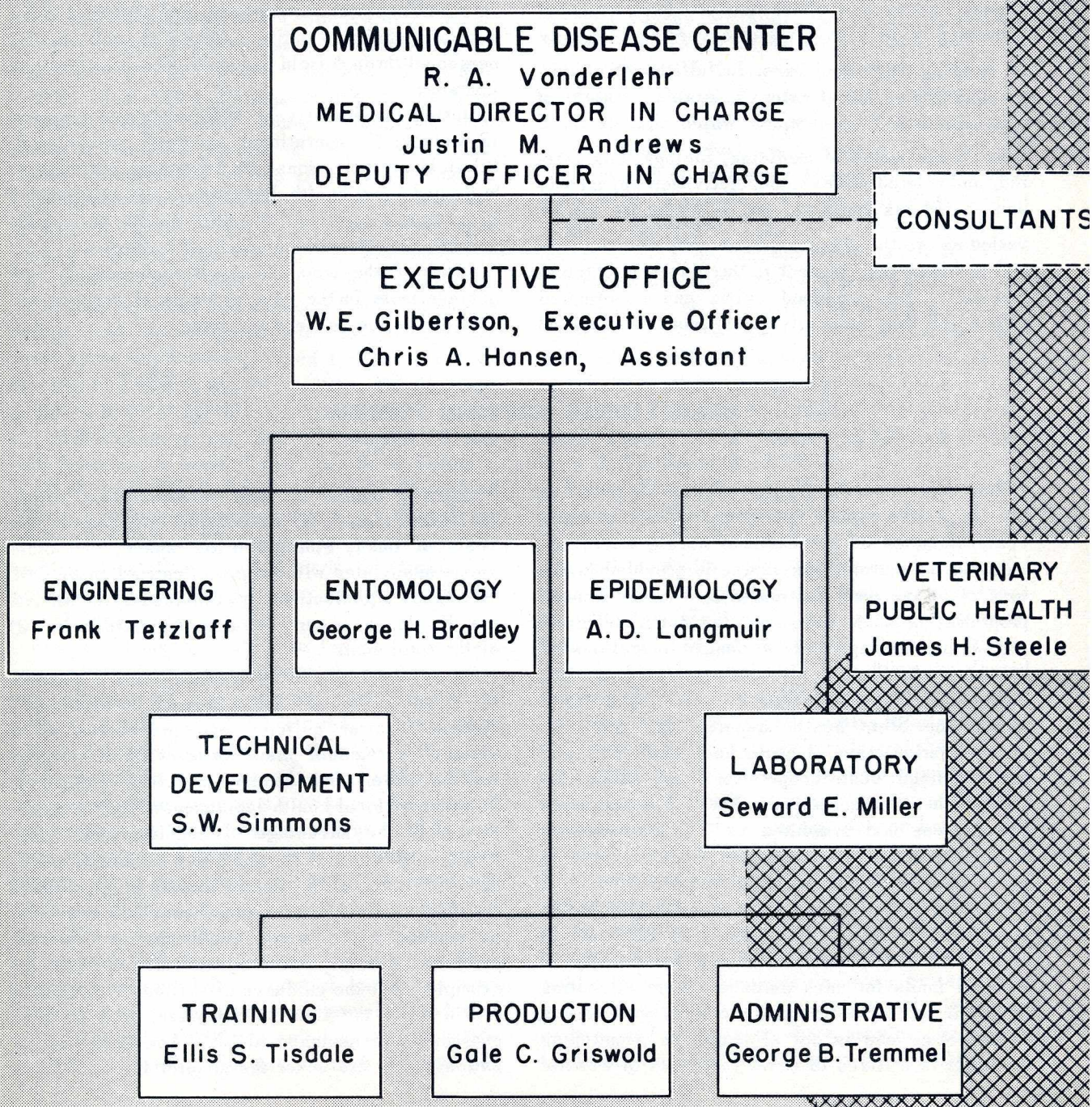
HEADQUARTERS ORGANIZATION



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Headquarters Organization Activities

The Communicable Disease Center exists to help the States in the control of communicable diseases, particularly where the problems involved transcend State boundaries or exceed the capacity of existing State facilities. In fulfillment of this responsibility, the Center maintains a staff of specialists and technicians which operate as a team in the fields of medicine, biology, engineering, and related professions. Activities engaged in and procedures employed are as numerous and as varied as are the diseases dealt with and the control problems they present in the respective States. Basically, the combined skills and coordinated efforts of this team of specialists are directed toward the assembling of scientific facts about communicable diseases, translating these facts into practical control methods, and teaching these control techniques to State and local public health personnel through field demonstrations and training courses.

During the fiscal year 1949 activities engaged in include: (1) operational control programs; (2) field investigations; (3) laboratory services to State and local health departments; (4) specialized and general training for public health personnel; and (5) disaster and epidemic aid to States.

Some of the more important undertakings and achievements in the several fields of activity are recorded in the succeeding pages.

OPERATIONAL CONTROL PROGRAMS

Since the Center's primary mission is to assist the respective States in the control of communicable diseases on the basis of needs, where circumstances warrant, assistance is provided in the form of active participation in operational control programs. In such instances, the actual administration and management of control operations is vested in the State health departments. Organizations known as CDC Activities are established within the State health departments, under the general jurisdiction of State health officers, and predetermined control operations are carried on through these organizations. The Center, pursuant to congressional mandates and agreements with State health officers, allocates Federal funds to each CDC Activities organization on the basis of the extent of the communicable disease problem in the particular State, the capacity of the State to cope with the problem, and the availability of Federal funds for such purposes. This allocation or credit is not, however, a monetary grant-in-aid to the State and is not allocated on a matching basis. It is utilized to cover the costs of Federal personnel, equipment, and supplies used within the State by the CDC Activities organization. The costs of labor, storage, office space, and other items associated with programs carried on by CDC Activities organizations are provided by localities, usually in an amount equal to approximately half of the total cost.

This cooperative Federal-State formula permits the development and utilization of communicable disease control policies and procedures on a national or regional basis while at the same time leaving actual administrative direction of the work in State and local health departments. This arrangement has the advantage of enabling each State health officer to draw upon the combined skills and knowledge of the Center's staff of specialists and still maintain that degree of autonomy essential in dealing with diverse conditions and special problems. The respective State health officers, for example, have the guidance of skilled investigators provided by the Center; but when such Federal personnel are assigned to CDC Activities organizations, they are under the general jurisdiction of

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the State health officer, being part of the CDC Activities organization which is a part of the State health department.

This formula worked smoothly and effectively during 1949 in operational programs, particularly in malaria, murine typhus, and rabies control operations.

MALARIA CONTROL

The cooperative Federal-State program for the eradication of malaria by controlling the principal malaria vector, *Anopheles quadrimaculatus*, through DDT residual spraying was continued in 13 Southeastern States. Reported cases of malaria for the calendar year 1948 totaled 9,868, an appreciable decline from 1947. Incomplete reports for 1949 (January through July) record 2,781 cases, indicating a continued decline in malaria and a continued effectiveness of the DDT spray program. Examination of blood films from malaria surveys in South Carolina (22,291), Arkansas (4,289), Mississippi (1,993), and Georgia (299) disclosed only four positive, all of them from South Carolina.

Residual spraying was conducted in 361 counties during 1949 as compared with 347 counties in 1948. Spray applications totaled 1,060,000 in 1949 as compared with 1,365,000 in 1948. The increase in the number of operational counties was due to the substitution of selected spraying for countywide spraying in some States, and to an increase in local participation which rose from 39 percent of total expenditures in 1948 to 41 percent in 1949. The decrease in the number of spray applications, about 12 percent, primarily is attributable to the adoption of a single spray cycle in all States except one.

Several changes relating to the spray program were effected during the year. A sticking agent was added to DDT formulations used in outdoor spraying. Field tests disclosed that regular formulations deteriorated rather rapidly when exposed to outdoor weather conditions. It was found that the addition of white rosin as a sticking agent retarded deterioration and this formulation was used in outdoor applications during 1949. In view of complaints about the nonuniformity of commercially purchased DDT concentrate used in some instances in 1948, local preparation of concentrate was resumed in 1949. A new formula for the preapproval of counties for malaria control operations was developed. It provides for preapproval of counties on the following basis: (1) approval of all counties having a malaria death rate of 5 or more per 100,000 population during the period 1938-42, and, in addition, a rate of 1 or more malaria deaths per 100,000 population during the 4-year period 1943-46; and (2) approval of all counties having an annual malaria death rate of 4 or more per 100,000 population during the period 1943-46. This formula, applicable in the fiscal year 1950, was adopted by some States in 1949.

The effectiveness of the DDT residual spray program in decreasing the malaria transmission hazard is determined by the extent to which sprayed houses are kept free of *A. quadrimaculatus*, chief vector of malaria, as compared with the incidence of the same species of mosquito in unsprayed houses. Entomological inspections of houses, sprayed and unsprayed, during the 4-year period 1945-48 show an average of 98.1 percent of sprayed houses were kept free of malaria mosquitoes for 5 months, whereas only 80.8 percent of unsprayed houses inspected were free of malaria mosquitoes. Thus, on the basis of some 56,000 inspections, a reduction of approximately 90 percent of the malaria mosquito population is obtained by spraying houses with DDT. Data from the same inspections indicate a gradual lessening of toxicity of the DDT residual spray with age.

Table 1 summarizes results of entomological inspections of 56,200 houses, selected at random, made during the period 1945-48.

From the beginning, there has been public acclaim of the concurrent control of pestiferous insects, notably house flies, resulting from the malarial mosquito control program. Initially, fly control was so pronounced that many citizens thought of the residual spray program as a fly control rather than as a malaria control activity. Although certain strains of flies have manifested degrees of resistance to DDT in a number of areas that have been sprayed frequently, relatively good fly control continues as a byproduct of the malarial spray program. Field investigations disclosed that expansion of spray coverage to include entire premises rather than just houses or houses and privies increases the degree of fly control, and this treatment has been adopted in most jurisdictions. However, complaints of lack of effectiveness in fly control were registered in increasing numbers during 1948, and in 1949 developed into annoying public relations problems in some States. In a move to evaluate these complaints and adjust procedures and techniques, where possible, to relieve the situation, standardized testing procedures were

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Table 1

MALARIA ERADICATION PROGRAM, 1945 - 48

Number of Sprayed and Unsprayed Houses Inspected, and Percentage of Houses Free of "Anopheles quadrimaculatus" in Afternoon

SPRAYED HOUSES							
Months After Spraying	1948 No. Houses Inspected	1948 No. Houses with "A. quad." in p.m.	Percent of Houses Free of "A. quad." in p.m.				Average Percent of Houses Free of "A. quad." in p.m.
			1948	1947	1946	1945	
0-1	699	22(3.1%)	96.9	99.2	99.2	98.9	99.3
1-2	1,354	24(1.8%)	98.2	98.5	99.0	98.3	98.5
2-3	2,093	36(1.8%)	98.2	98.7	99.1	95.7	97.9
3-4	2,102	57(2.7%)	97.3	98.7	98.7	94.7	97.4
4-5	1,231	67(5.4%)	94.6	98.9	98.2	94.2	96.5
Total Houses	7,479	206(2.8%)	7,479	8,794	21,951	14,129	
Percent (Average)			97.2	98.8	99.0	97.2	98.1
UNSPRAYED HOUSES							
Year							
1948	1,021	170	83.3				
1947	1,170	328	72.0				
1946	1,639	208	87.3				80.8

Table 2

EFFECT OF PREMISES SPRAYING* VERSUS HOUSE-PRIVY SPRAYING** ALONE IN REDUCING FLY DENSITIES IN HOUSES, 1948

MONTHS AFTER SPRAYING	PERCENTAGE OF HOUSES HAVING INDICATED FLY DENSITIES										TOTAL HOUSES SPRAYED	
	0 Flies		1-10 Flies		11-50 Flies		51-100 Flies		101+ Flies			
	Premises	House-Privy	Premises	House-Privy	Premises	House-Privy	Premises	House-Privy	Premises	House-Privy	Premises	House-Privy
0-1	39.47%		53.85%		6.41%		0%		0%		78	
		27.67%		49.92%		19.09%		1.57%		1.75%		571
1-2	37.33%		50.34%		12.33%		0%		0%		300	
		31.13%		52.92%		13.65%		1.23%		1.07%		1,304
2-3	33.33%		52.82%		13.20%		0.65%		0%		462	
		29.37%		51.56%		16.95%		1.51%		0.61%		2,118
3-4	20.67%		63.38%		15.28%		0.67%		0%		445	
		23.90%		55.05%		18.16%		2.04%		0.85%		2,104
4-5	10.32%		64.37%		25.57%		0.74%		0%		407	
		16.73%		61.98%		18.68%		2.00%		0.61%		1,794
Averages	28.28%		56.95%		14.36%		0.41%		0%		1,692 (Total)	
		25.76%		54.29%		17.30%		1.67%		0.98%		7,891 (Total)

*Tennessee and Mississippi.

**Alabama, Arkansas, Florida, Kentucky, Louisiana, Missouri, and Oklahoma.

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evolved and testing kits sent into the field for obtaining fly control evaluation data. Registers of complaints were established and instructions issued to insure uniform use of the field testing kit in investigating complaints. This work yielded considerable data which are yet to be analyzed.

Table 2 portrays data on fly counts made inside of 9,583 houses, 1,692 of which were houses where all buildings on premises were sprayed (premises spraying) and 7,891 in houses on premises where only the house and privy were sprayed (house-privy spraying). As indicated, in States where house-privy spraying was carried on, the percentage of houses with inside fly counts above 50 was roughly three times that of States where entire premises were sprayed. Actually, during the first 2-month postspray period in premises-sprayed States, no fly counts of above 50 were recorded; whereas during the same period in house-privy sprayed States, counts in this density group were registered. The 51-100 flies group is considered to be the break between high and low densities.

Table 3 summarizes data showing the over-all percentages of houses in the various fly density groups, based on inside fly counts made in 7,891 sprayed and 1,278 unsprayed houses. In accordance with other findings, the table reflects receding DDT toxicity and a gradual building up of fly populations as the age of the DDT deposit increases. These data also indicate striking results in fly control by DDT residual spraying, since only 3 percent of sprayed houses show counts of more than 50 flies, whereas in unsprayed houses 14 percent appear in the 50-flies density group.

Table 3

FLY INSPECTIONS ON EXTENDED MALARIA PROGRAM, 1948

Percentage of Sprayed and Unsprayed Houses in Various Fly Density Groups Based on Inside House Inspections

MONTHS AFTER SPRAYING	FLY DENSITY GROUP					TOTAL HOUSES INSPECTED
	0	1-10	11-50	51-100	100	
	SPRAYED HOUSES					
0-1	28	50	19	1	2	571
1-2	31	53	14	1	1	1,304
2-3	29	52	17	1	1	2,118
3-4	24	55	18	2	1	2,104
4-5	16	62	19	2	1	1,794
AVERAGE	25	55	17	2	1	7,891
	UNSPRAYED HOUSES					
	13	42	31	7	7	1,278

Since malaria is a mosquito-borne disease and improperly constructed and managed water impoundments constitute mosquito breeding sources, malaria control operations encompass inspection of existing impoundments and preconstruction surveys of proposed impoundments when requested by the sponsoring agency. Preconstruction surveys usually are conducted in collaboration with State health departments and in cooperation with the Corps of Engineers, Department of the Army, or other public or private agency responsible for impoundment projects. In the preparation of survey reports, proposed sites are inspected and the mosquito breeding potential studied. Data thus accumulated are analyzed against the malaria history of the area involved and recommendations submitted to the appropriate authority. Mosquito control programs pertaining to impoundments are planned so as to offer the least possible interference with the primary purpose of the existing or proposed impoundment. This planning is carried on in collaboration with the Corps of Engineers, Bureau of Reclamation, U. S. Fish and Wildlife Service, State health departments, and/or other public or private agencies concerned. In most jurisdictions, a permit from the State health department is a prerequisite for the construction of private ponds and like impoundments; and such permits are issued contingent upon adherence to plans and procedures that conform to approved health protective regulations.

During the fiscal year 1949, surveys of 29 major proposed impoundments were made and submitted to the Corps of Engineers. Numerous other smaller projects were surveyed and recommendations entered.

TYPHUS CONTROL

Cooperative programs for the control of murine typhus were conducted in endemic areas along the same lines as in previous years, principally in nine Southeastern States. Control operations, consisting of DDT dusting for the control of rat ectoparasites, antirat sanitation, rat poisoning, and ratproofing of buildings, were supported by the Center through State and local health departments. Consultative and general advisory services were extended other agencies in other areas where ectoparasite control, rat poisoning, and ratproofing were practiced as a health protective measure.

Preapproval for participation in Federal allocations, as in past years, was based on the number of human typhus cases. Counties that reported 50

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or more cases during the five calendar years preceding the beginning of the fiscal year, or 10 or more cases during the single season preceding the fiscal year were approved for control operations. This formula resulted in the preapproval of 135 counties for the fiscal year 1949. However, control operations in some degree were carried on in 203 counties.

The number of typhus cases continued the decline begun in 1945, as indicated in figure 1. The number of officially reported cases at the end of December 1948 was 1,175, as compared with 5,338 for the calendar year 1944. The number of cases reported for the period January–June 1949 was 406 compared with 411 for the same period in 1948. It has been noted, however, that the winter of fiscal year 1949 was exceptionally mild, and experience indicates that such conditions favor an increase in the populations of the oriental rat flea (chief vector of typhus) which normally precedes a rise in human typhus incidence. The Gulf Coast States, for example, registered high midwinter temperatures during the period 1941-45 and the incidence of human typhus increased markedly during that period. The following winter (1945-46) was cooler and the number of typhus cases declined. Figure 2 portrays the mean temperature and rainfall in the Gulf Coast States for the period 1931-47.

DDT Dusting: DDT dusting (10 percent DDT was used in most instances) operations were carried on in 106 of the 135 preapproved counties between January 1 and June 30, 1949. Premises in other counties were dusted where epidemiological studies indicated foci of typhus. During the fiscal year, dust was applied to 381,775 premises at an average expenditure of 3.4 pounds of dust and 0.5 man-hour per premises. State and local sources provided 39 percent of the total costs of dusting operations.

Ratproofing and Antirat Sanitation. The Center participated to some degree in ratproofing and elimination of rat food and rat harborage programs in 164 communities during 1949. Active ratproofing programs involving 4,244 establishments in 34 communities were conducted jointly, with State and local agencies providing 71 percent of the total

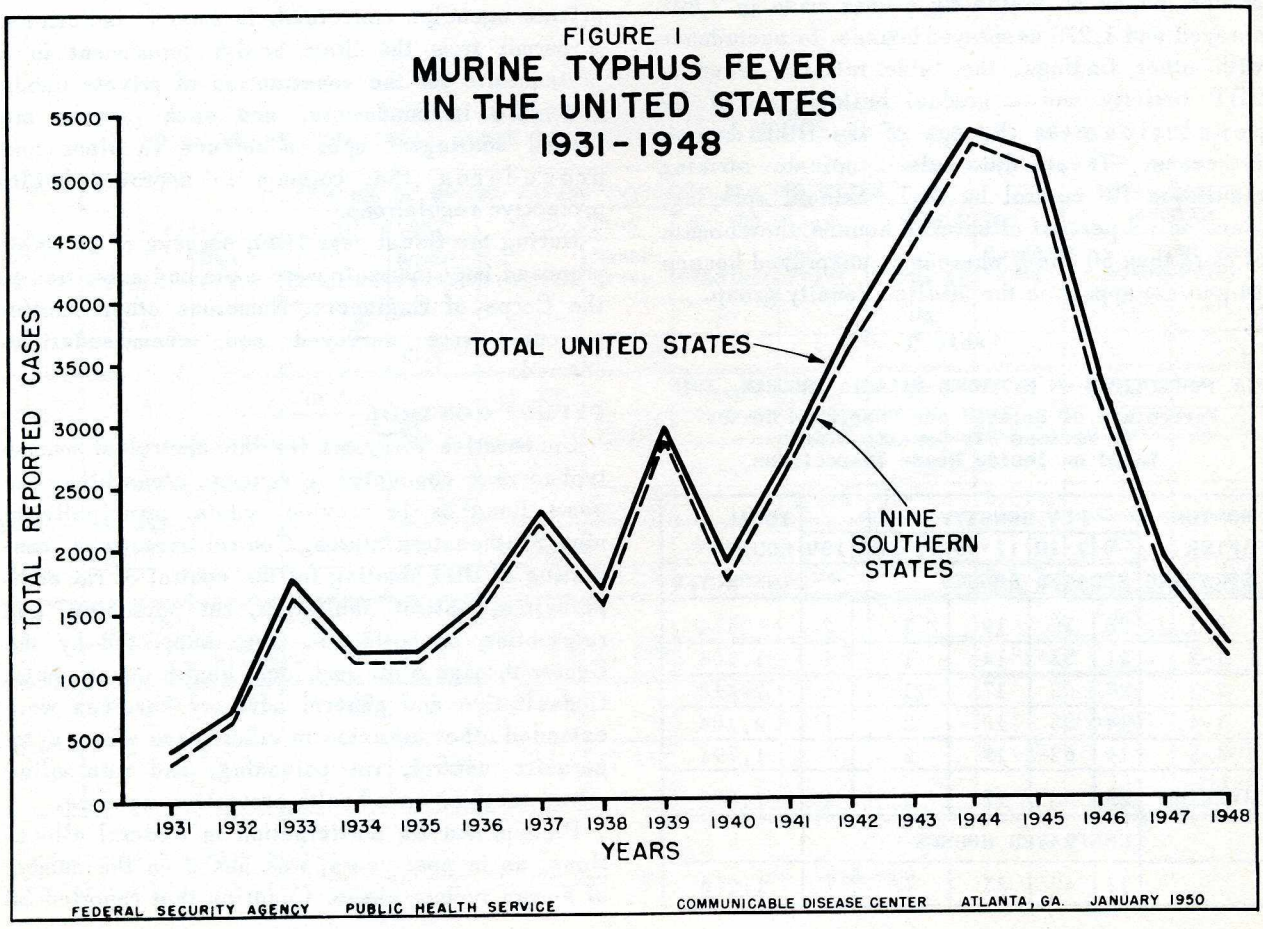

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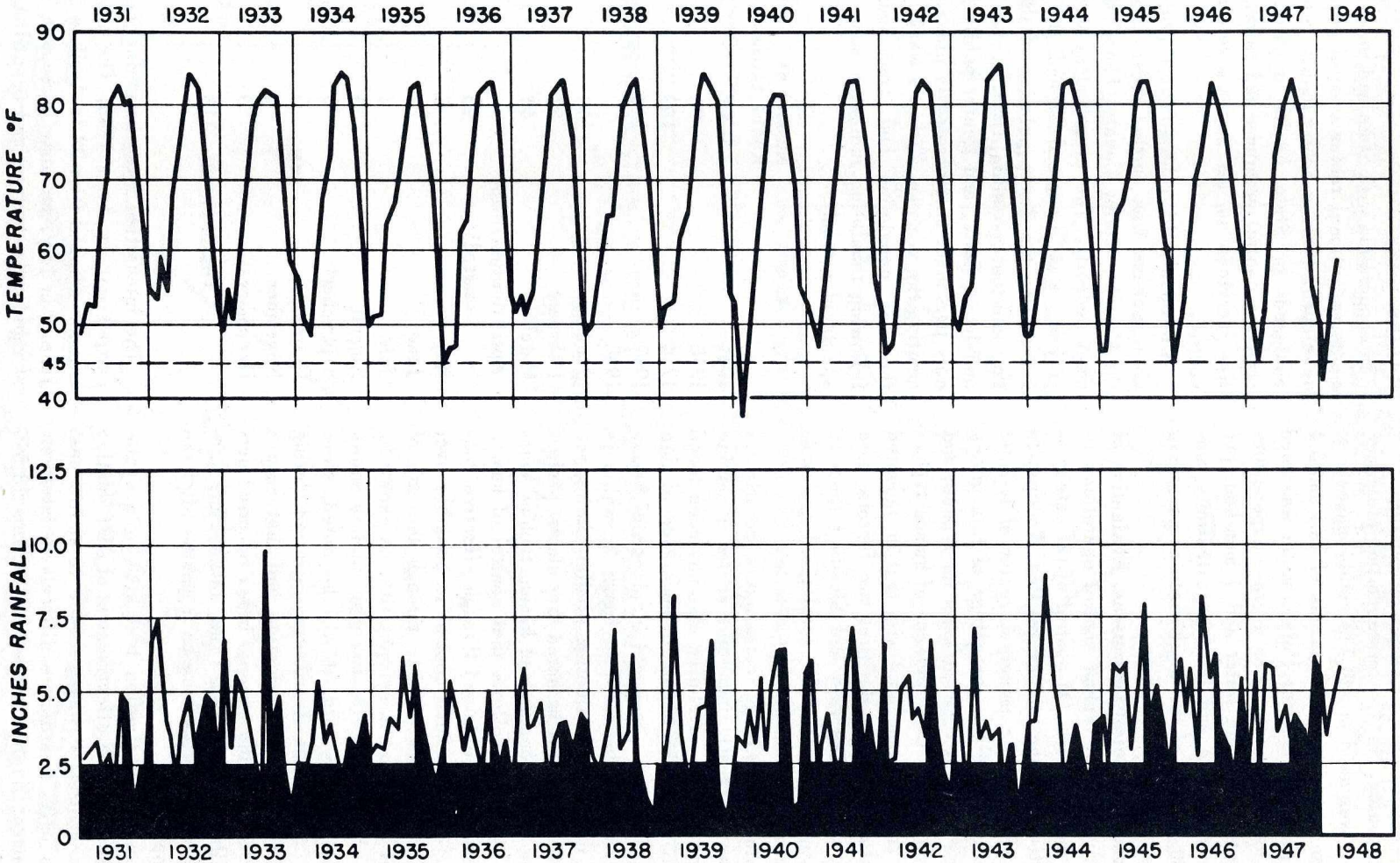
FIGURE 2

MEAN TEMPERATURE AND RAINFALL FROM REPRESENTATIVE STATIONS IN GULF COAST STATES



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costs. An average of 42 man-hours per establishment was expended in ratproofing operations.

Rat Poisoning. In Center-supported programs, poison bait was used in 249,133 establishments at an average expenditure of 7 pounds of bait and 0.4 man-hour per establishment. Poison water was used in 47,205 establishments at an average expenditure of 1.1 pints of poison water and 1 man-hour per establishment. State and local organizations contributed 80 percent of the total costs of poisoning operations.

Evaluation of Control Operations. Evaluation of the effectiveness of typhus control operations is based on three factors: (1) control of rat ectoparasites, particularly the oriental rat flea, *Xenopsylla cheopis,* which is the principal vector of typhus; (2) the reduction in the percentage of rats giving positive complement fixation tests for typhus; and (3) the reduction in the incidence of human typhus in dusted areas as compared with that in undusted areas. Data concerning the first two factors were collected by trapping rats and bleeding them to obtain samples of blood for serological examination and combing them for ectoparasites.

Accumulated knowledge incriminates the oriental rat flea as the really important vector of murine typhus, and a close correlation also has been found to exist between the seasonal abundance of this ectoparasite and the seasonal incidence of human typhus. This is illustrated in figure 3, which is based on data from evaluation studies during the period 1946-48. It will be noted that almost perfect correlation of *X. cheopis* and human typhus abundance is shown. It follows that control of human typhus probably is obtained through effective control of *X. cheopis.* Such control is possible over considerable periods of time through the use of 10 percent DDT dust in pyrophyllite, as shown by data from duration of effectiveness studies shown in figure 4. These data, it will be noted, show excellent control of *X. cheopis* resulted during the first 4 months after dusting and that only a slight increase in the *cheopis* index occurred during the following 2 months. Thus, satisfactory control is indicated for as long as 6 months after the dust is applied.

The complement fixation test also is a useful tool in measuring the effectiveness of DDT dusting in typhus control; however, since it shows past infections only, results are difficult to interpret. In complement fixation tests of sera from 13,565 rats, during 1949, 8.2 percent of rats from dusted areas showed evidence of murine typhus, whereas 14.8 percent from nondusted areas were positive.

RABIES CONTROL

In cooperation with State and local health departments, a national rabies control program is being developed. Trained public health veterinarians are assigned to State health departments to help organize control programs and to render consultative services in all matters relating to rabies control.

A demonstration rabies control project of remarkable success was carried on in cooperation with the Memphis-Shelby County (Tenn.) Health Department recently. The program, essentially a local project, was organized around the objective of immunizing the dog population of the area within the shortest possible time. Local veterinarians and local, State, and Center public health veterinary personnel collaborated in planning and implementing the program. Within a week, 70 percent of the dog population had been immunized. The following tabulation indicates some of the rather spectacular results:

Year	Number of Rabid Animals	Antirabic Treatments
1944	42	41
1945	93	131
1946	103	135
1947	113	115
1948		
January	13	15
February	24	33
March	41	57
April (immunization started)	28	34
May	5	12
June	2	6
July	2	8
August	0	0
September	0	0
October	0	0
November	0	0
December	0	0
Totals (1948)	115	165

The intensified mass immunization program was carried out in April 1948. The number of rabid animals dropped from 28 in April to 5 in May, 2 in June, 2 in July, and none in August. The incidence of rabid animals remained 0 until April 10, 1949, when one case was encountered on the outskirts of Memphis.

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FIGURE 3

CORRELATION OF MURINE TYPHUS SEASONAL INCIDENCE IN HUMANS WITH *XENOPSYLLA CHEOPIS* INDEX AND PERCENT INFESTATION OF RATS

UNDUSTED AREAS OF NINE SOUTHEASTERN STATES 1946-1947-1948

3-MONTH MOVING AVERAGE

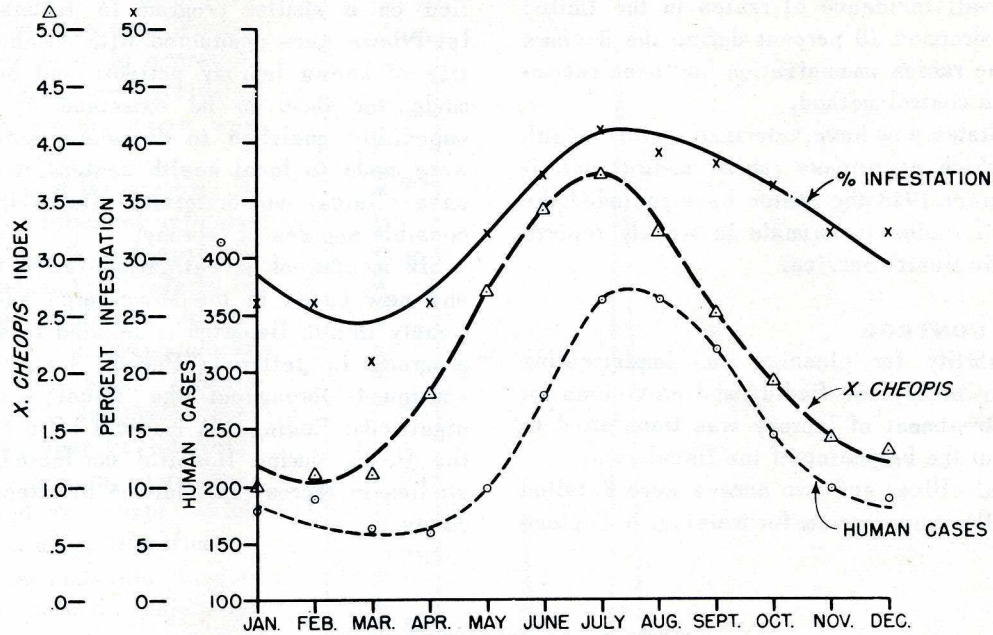

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FIGURE 4

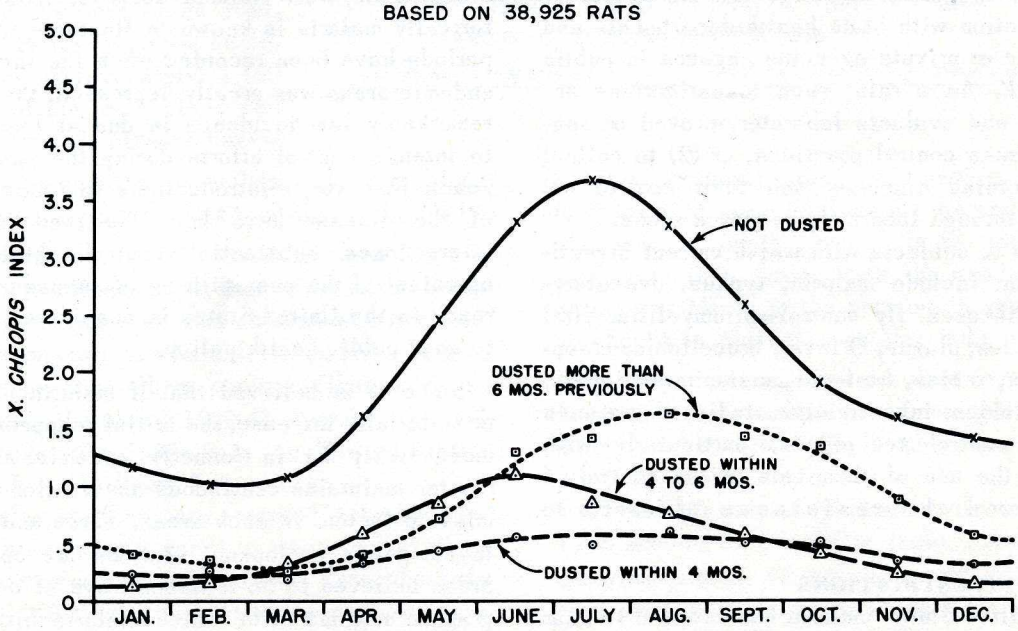
DURATION OF CONTROL OF THE RAT FLEA, *XENOPSYLLA CHEOPIS* BY DDT DUST

AVERAGE NUMBER OF *X. CHEOPIS* PER RAT

NINE SOUTHERN STATES - 1946 THROUGH 1948

3-MONTH MOVING AVERAGE

BASED ON 38,925 RATS



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Thus, an actual demonstration in the field confirms the earlier findings of the laboratory in Montgomery, Ala., that mass dog immunization is effective in controlling rabies.

The over-all incidence of rabies in the United States has dropped 20 percent during the 3 years since canine rabies immunization has been recommended as a control method.

Sixteen States now have veterinary public health programs which encompass rabies control activities, and since 1948 the States have included the incidence of rabies in animals in weekly reports to the Public Health Service.

LEPROSY CONTROL

Responsibility for planning and implementing a program of early case finding and provisions for outpatient treatment of leprosy was transferred to the Center at the beginning of the fiscal year.

A medical officer and two nurses were detailed to the Carville Leprosarium for training. In September a nurse was assigned to the Dade County (Fla.) Health Department to institute a program of case finding in Miami and environs. Another nurse, assigned to the Louisiana Health Department, carried on a similar program in Jefferson Parish. Interviews were conducted with members of families of known leprosy patients and arrangements made for them to be examined by physicians especially qualified to diagnose leprosy. Visits were made to local health centers, venereal disease clinics, and maternity clinics in search of possible sources of leprosy.

Six months of investigation failed to disclose any new cases in the Miami area and the Dade County Health Department decided to suspend the program. In Jefferson Parish, La., the program continued throughout the fiscal year with no significant findings. A medical officer on duty at the U. S. Marine Hospital conducted laboratory studies in leprosy in addition to attending active cases.

FIELD INVESTIGATIONS

Field investigations, unlike operational control programs, are usually Center undertakings and not directly under the administrative aegis of CDC Activities organizations within State health departments. However, many investigations are conducted in collaboration with State health departments and other public or private agencies engaged in public health work. As a rule, such investigations are (1) to test and evaluate laboratory-proved or suggested disease control practices, or (2) to collect data concerning diseases and their control not obtainable through laboratory research alone.

Diseases or subjects with which current investigations deal include malaria, typhus, dysentery-diarrheal diseases, fly control-poliomyelitis, viral encephalitides, plague, Q fever, brucellosis, creeping eruption, rabies, histoplasmosis, insecticides, and rodenticides. Investigative studies cover such items as control techniques, particularly with respect to the use of chemicals in the control of insects and the resistance of insects to insecticides.

MALARIA INVESTIGATIONS

In the United States malaria has receded to near extinction within the past 15 years. Active cases are virtually nonexistent, even in areas where the disease long has been entrenched. During 1949, for example, only four positive findings were recorded in laboratory examinations of some 28,000 blood films from malaria surveys. Although historically malaria is known to fluctuate widely and periods have been recorded when the incidence in endemic areas was greatly depressed, the currently remarkably low incidence is due at least in part to intense control efforts during the past several years. However, reintroductions and reoccurrences of the disease have been observed in regions where once substantial control obtained, and appraisal of the possibilities of subsequent occurrence in the United States is considered essential to good public health policy.

Since it is believed that if malaria does recur or materially increase, the initial reappearance will most likely be in formerly endemic areas, the Center maintains continuous observations of transmission factors in such areas. Three malaria field investigation or lookout stations are operated in areas believed to be representative of the physiographic regions with which malaria hitherto has been associated. Malariologists at these stations

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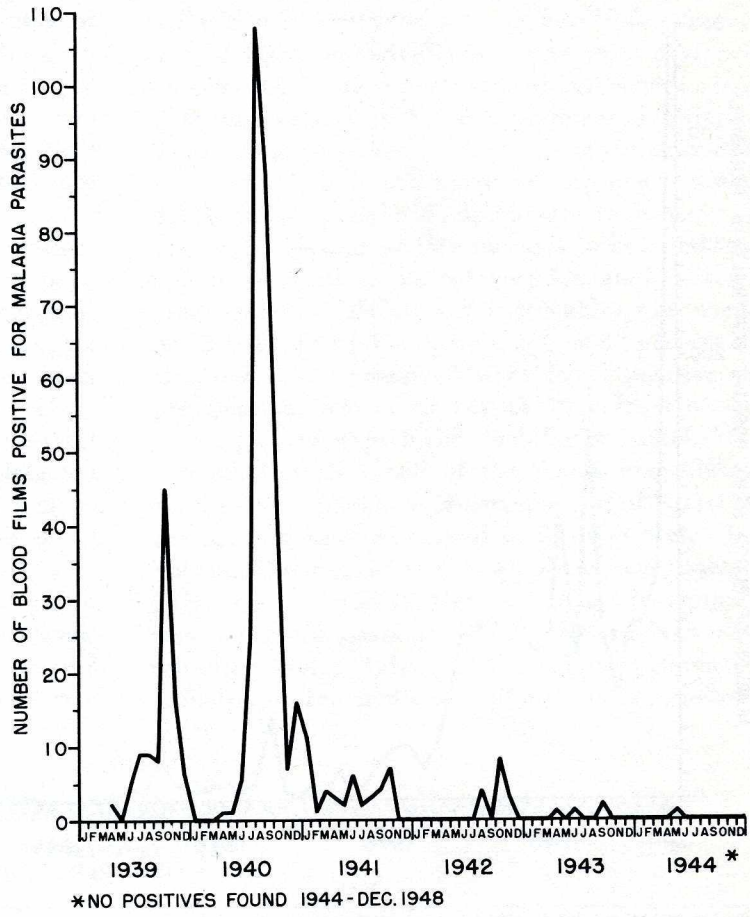
maintain surveillance and make continuous studies of malaria transmission factors. Stations are operated at Manning, S. C.; Newton, Ga.; and Helena, Ark. The South Carolina and Georgia stations have been in operation since 1944 and 1939 respectively. The Arkansas station was activated in 1948.

The mission of the stations is to provide the following information concerning their respective areas: (1) amount of malaria in man; (2) comparable quantitative indices of *A. quadrimaculatus* abundance; (3) blood feeding habits of local *Anopheles* species; and (4) specific interrelationship of vectors, parasites, and intermediate hosts which have particular significance in malaria transmission. In pursuing this common objective, each station conducts studies and utilizes techniques adapted to the analyses and interpretations of peculiar problems encountered.

FIGURE 5
BLOOD FILMS POSITIVE FOR MALARIA PARASITES
GEORGIA MALARIA INVESTIGATIONS STATION
APRIL 1939 - DECEMBER 1948



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Newton, Ga., Station. Surveys for the detection of human malaria have revealed no cases of malaria in the area since 1944. In regular visits by public health nurses to approximately 1,000 residents of the area, blood was collected from all persons having symptoms suggestive of malaria. Routine blood-film surveys were conducted periodically. During the past year, no positives were found in laboratory examinations of 856 blood films. Sixty-one of this number were from persons who exhibited clinical symptoms attributable to malaria, and 42 from persons from whom positive films were obtained during the period 1939-43. Results of blood-film findings from 1939-48 in the Newton station area are shown in figure 5.

Five index stations were operated in the heaviest breeding area (near a pond) to measure variations in *A. quadrimaculatus* populations. Throughout the winter of 1948-49, the mildest in the past 20 years, the three common *Anopheles* species, *quadrimaculatus*, *crucians*, and *punctipennis*, were found in index station collections. At the end of 1949 the abundance of adult "quads" in the index stations was more than three times the number observed during any March in the previous 5 years. Follow-up checks in April through May indicated that this large overwinter survival resulted in an unusually large spring population of mosquitoes, but the summer count was no larger than that of the previous year.

Of 6,114 female anophelines collected during the 1948 season for precipitin tests, 59 percent were *quadrimaculatus*, 40 percent *crucians*, and 0.2 percent *punctipennis*. Approximately four-sevenths of *quadrimaculatus* and three-fifths of *crucians* con-

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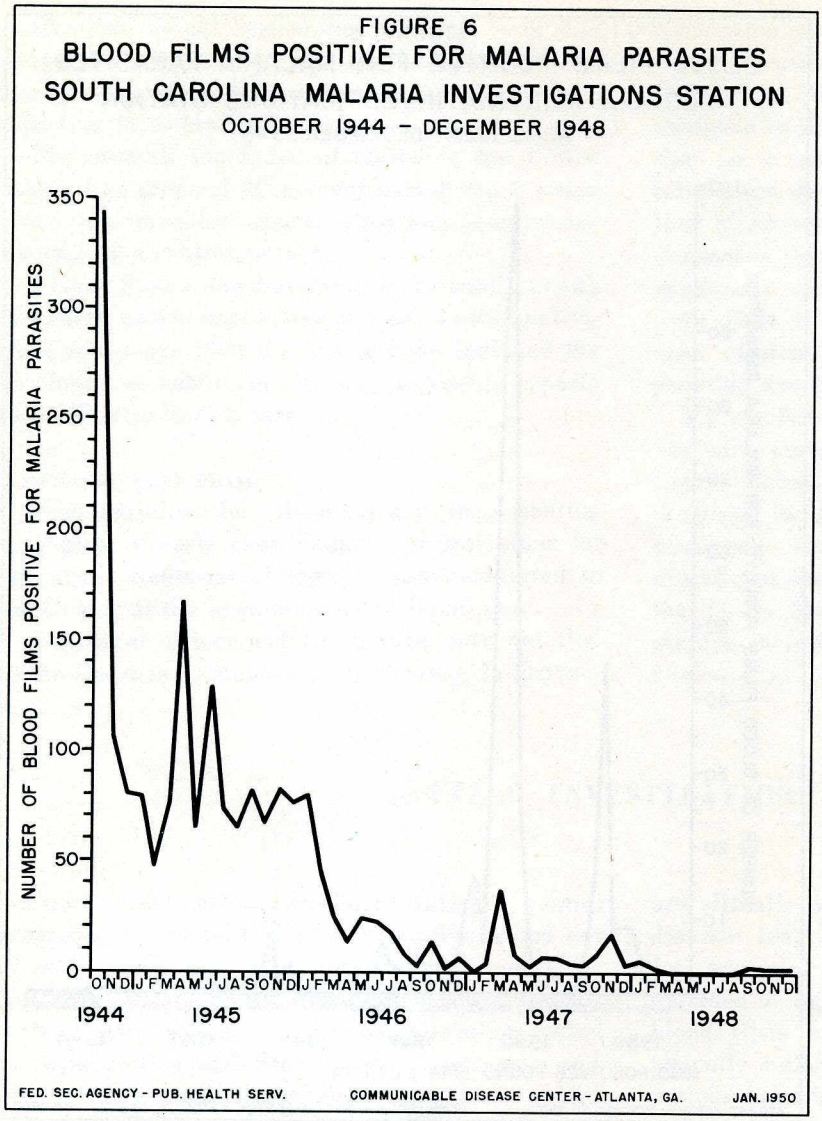

tained unassimilated blood. The proportion of the 1948 sample which contained human blood was about six times as great as that of the 1947 sample. In 1948, 36 out of 3,000 specimens were positive to human antiserum as compared with 7 out of 5,713 in 1947. On the basis of precipitin tests, feeding on humans by *Anopheles* was as prevalent in sprayed as in unsprayed areas.

Investigations designed to contribute to a better understanding of the natural history of malaria were continued. One of these concerned malaria parasites of birds, mammals, and reptiles in the area in connection with a search for a suitable host in malaria occurrence studies. Attention also was devoted to studies of: (1) the potential productivity of the three common *Anopheles*, *quadrimaculatus*, *crucians*, and *punctipennis*; (2) the development of *Anopheles* larvae in relation to aquatic temperature; (3) morphology of *Anopheles* eggs; and (4) the dissection of adult *A. crucians*, examination being made of the stomach salivary glands for the presence of malaria parasites.

Manning, S. C., Station. Observations and studies carried on at this station are centered in a malarious area contiguous to a large artificial water impoundment. Since similar conditions exist and/or may be created by impoundments in a variety of physiographic environments, emphasis is given to the observation of the peculiarities of malaria occurrence when natural environmental conditions have been modified.

During the year, human malaria incidence was appraised monthly by blood-film surveys of approximately 2,000 residents of an experimental area of high malaria prevalence; and quarterly surveys were made of 2,000 residents of an adjacent marginal area. These surveys disclosed four persons with malaria-positive blood films. In three of the four persons, parasitemia was demonstrable for the first time during 1949 observations. Blood-film surveys during the period October 1944–December 1948 revealed infections in 839 persons at some time subsequent to October 1944. Figure 6 summarizes these data on a monthly basis.

A. quadrimaculatus and *crucians* densities in the study area vary from year to year, both in magnitude and seasonal distribution. The population of *quadrimaculatus* was 90 percent smaller in the spring of 1949 than during the same period in 1948, although the reservoir level was high. However, there were slow and small fluctuations in the water level which may have contributed to the lower density. Also dry and cool atmospheric conditions prevailed during March and April 1949. The *crucians* population was smaller by about one-third.

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Results of precipitin tests for 1947 and 1948 indicate that feeding rates parallel those observed at the Newton, Ga., station.

Studies at this station have been directed toward the identification of sporozoites found in wild-caught *Anopheles*. In dissections, high rates of sporozoite-positive salivary glands were found in both *quadrimaculatus* and *crucians*. During the year, 12,970 *crucians*, 6,867 *quadrimaculatus*, and 175 *punctipennis* were dissected. The salivary glands of 10 *crucians* and 3 *quadrimaculatus* were sporozoite-positive.

Helena, Ark., Station. Activities at this station, established in September 1948, thus far have been limited, in the main, to reconnaissance surveys. Using records of previous malaria occurrence, an area for intensive study was selected. Blood films were collected from 3,518 children in school surveys and from 461 residents of experimental areas. No positive blood films have been detected to date, but malaria parasites were found in a blood film from a person suffering from a relapse of malaria acquired in Panama.

Four primary types of *Anopheles* habitats occur in the region: (1) sloughs and bayous in river overflow areas; (2) streams and sloughs associated with highland drainage ways; (3) irrigated rice fields; and (4) artificial impoundments.

Epidemiological Studies. In cooperation with State health departments, efforts were made to evaluate the relative accuracy of malaria case reporting by a systematic appraisal of reports of malaria on file with the several State health departments. Epidemiological assistants were assigned cooperating States to collect basic epidemiological data concerning each case of reported malaria. These data were evaluated. During the year, States cooperating in the appraisal program reported 3,131 cases of malaria. Appraisals were made of 780 or 25 percent of this number. In recording appraisal results, a four category formula (positive, presumptive, doubtful, and improbable) was used. As indicated in table 4, only 231 or 30 percent of the 780 cases appraised were found positive or presumptive, whereas 549 or 70 percent of the 780 appraised were found doubtful or improbable.

South Carolina, one of the States cooperating in the 1949 appraisal program, reported 2,310 of the 3,131 cases recorded in the five States involved. The combined total of the other States (Alabama, Arkansas, Georgia, and Mississippi) was 821. South Carolina inaugurated a revised case reporting system July 1, 1949, and an appreciable reduction in reported cases of malaria is expected

Table 4

MALARIA APPRAISAL RECORD

Fiscal Year 1949
July 1948 - June 1949

State	Cases Reported to State Health Officers	Cases Appraised	Cases Appraised as Positive and Presumptive**	Doubtful	Improbable
1. Texas	3,633	-	-	-	-
2. South Carolina*	2,310	473	40	244	189
3. Arkansas*	510	-	-	-	-
4. Oklahoma	247	-	-	-	-
5. Alabama*	173	141	101	30	10
6. North Carolina	113	-	-	-	-
7. Florida	106	-	-	-	-
8. Mississippi*	76	55	30	14	11
9. Tennessee	67	-	-	-	-
10. Georgia*	62	111	60	17	34
11. Louisiana	45	-	-	-	-
12. Kentucky	32	-	-	-	-
13. Missouri	7	-	-	-	-
Total	7,381	780	231	305	244

*States with CDC Malaria Appraisal Programs.

**Positive and presumptive cases combined because they were classified together under positive during the first half of the fiscal year.

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to result.

Although malaria morbidity and mortality statistics have been sparse and somewhat on the erroneous side in recent years, epidemiological investigations of reported and rumored cases of malaria since the appraisal program was initiated in 1947 support the thesis that transmission of malaria is rare in the United States.

TYPHUS INVESTIGATIONS

Investigations concerning the relative importance of various routes of transmission of typhus from rat to rat were carried on during the year with findings that helped to expand and crystallize knowledge in that sector. In the laboratory, it was shown that albino rats infected with typhus by exposure to infected rat fleas (*X. cheopis*) in open culture were able to infect other fleas after 5 and apparently not after 31 days. Similar results were obtained with animals infected by abrasion of infected fleas into the shoulder or by intraperitoneal injection of tunica suspension. Fifty-two of 121 rats injected with fleas collected from a focus of typhus in rats became positive; and 2 of 55 rats injected with the mite *Echinolaelaps echidninus* taken from a focus of typhus became positive. In the laboratory, test animals remained negative after exposure to micronized dust from the infected colony by abrasion, intraperitoneal injection, or through food. Transmission by cannibalism was shown to occur seldom and only when the victim is severely infected or weakened by exposure to low temperatures. In general, fleas were shown to be the chief reservoir of typhus, and mites, lice, dust, direct contact, and cannibalism of negligible importance in the transmission of murine typhus.

Table 5 portrays data tabulated from the Thomasville, Ga., typhus project for the period January through June 1949. This investigation was inaugurated in 1945 to determine the effectiveness of DDT dusting as a method of typhus control. More recently, emphasis has been on a study to ascertain how long typhus incidence reduction induced by DDT dusting is maintained after the discontinuance of dusting.

Brooks and Thomas Counties each were dusted five times (Brooks first in April 1946 and last in September 1947; Thomas first in May 1946 and last in July 1947). Grady, the control county, received no dust. Previously published findings show a marked decline in the incidence of human typhus, typhus in rats, and in the rat flea (typhus vector) population in Brooks and Thomas Counties as compared with Grady County.

During the period January-June 1949 the human incidence of typhus in Grady County (undusted) was 12. During the same period, the rate was one case each in Brooks and Thomas Counties. For the month of June 1949, complement fixation tests showed: Grady County, 37 percent of 234 rats positive; Thomas County, 8 percent of 239 rats positive; and Brooks County, 1 percent of 227 rats positive. Thus, the reduced rates of infection in rat and human typhus induced through DDT dusting have prevailed for almost 2 years after discontinuance of dusting, since Thomas County was last

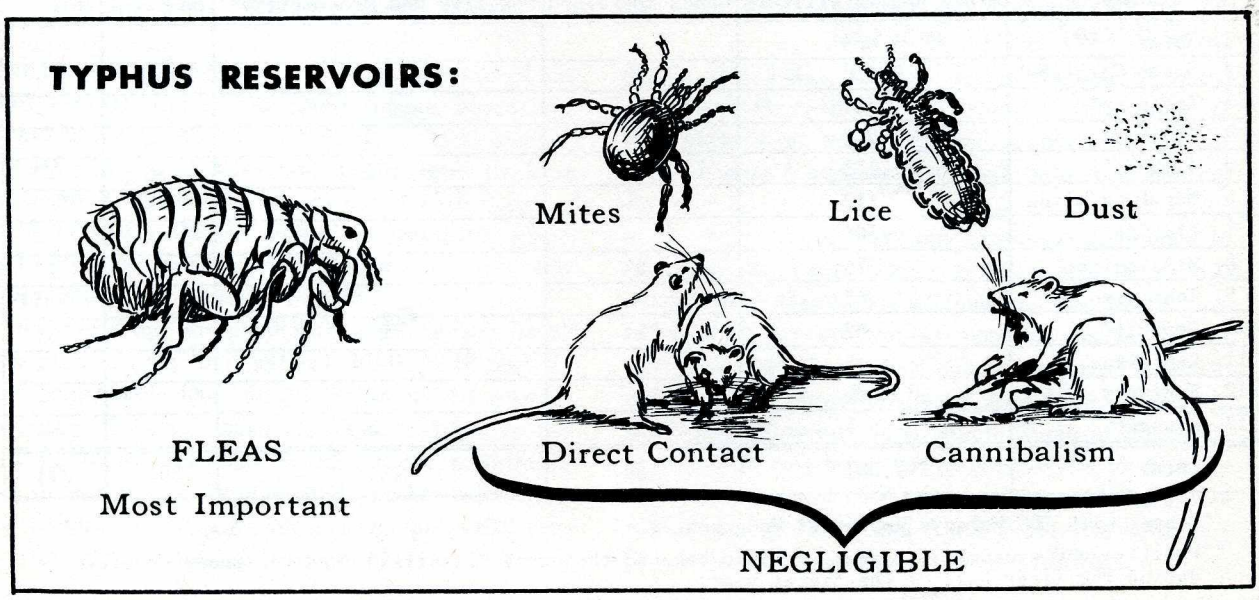

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Table 5

REPORT OF TYPHUS INVESTIGATIONS
Thomasville, Ga.

HUMAN INCIDENCE OF MURINE TYPHUS FEVER BY MONTH OF ONSET (These are tentative figures for probable cases where a complement fixation test was positive at 1:4 or higher.)

County	1949					
	January	February	March	April	May	June
Grady*	0	0	1	1	8	2
Thomas**	0	0	0	0	1	0
Brooks***	0	0	0	0	0	1

RAT INCIDENCE as indicated by a positive complement fixation test at 1:4 or higher.

Species	Grady Co.*			Thomas Co.**			Brooks Co.***		
	Number Examined	Number Positive	Percent Positive	Number Examined	Number Positive	Percent Positive	Number Examined	Number Positive	Percent Positive
Rattus rattus	115	38	33.0	108	7	6.5	199	2	1.0
Rattus norvegicus	119	49	41.2	131	13	9.9	28	1	3.6
R. rattus and *R. norvegicus*	234	87	37.2	239	20	8.4	227	3	1.3

ECTOPARASITE ABUNDANCE OF ALL RATS

County	Grady Co.*	Thomas Co.**	Brooks Co.***
No. of rats examined	236	242	235
Xenopsylla cheopis:			
Percentage of rats infested	60.2	13.2	11.5
Average number per rat	4.8	1.0	0.7
Leptopsylla segnis:			
Percentage of rats infested	21.6	4.5	1.7
Average number per rat	0.5	0.1	0.0
Bdellonyssus (Liponyssus) bacoti			
Percentage of rats infested	44.9	27.7	10.2
Average number per rat	9.5	5.9	0.9
Polyplax spinulosa:			
Percentage of rats infested	76.7	73.1	68.9
Average number per rat	6.9	6.4	4.3

*Untreated check county.
**Last cycle of dusting with 10% DDT completed July 30, 1947.
***Last cycle of dusting with 10% DDT completed September 30, 1947.

dusted in July 1947 and Brooks County in September of the same year.

DYSENTERY-DIARRHEA INVESTIGATIONS

In 1945, the Center joined with the National Institutes of Health in studies designed to explore the effects of controlling fly populations on the incidence of dysenteric diseases. Work along this line was continued during 1949 in three widely separated and otherwise diverse areas: in Hidalgo County, Tex., with headquarters at Pharr; Albuquerque, N. Mex.; and surveillance work in southwest Georgia, with headquarters at Thomasville.

Basically, the studies revolved around the reduction of fly populations of cities of high incidence of dysenteric diseases through the use of insecticides and the comparison of morbidity data from these cities with data from control cities of similar size and dysenteric disease history.

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In Hidalgo County, Tex., a group of cities of high dysenteric disease incidence was selected and fly control operations, utilizing chemicals, inaugurated in 1946 and continued through 8 months of 1947. This group was designated Group "A." A group of cities of similar dysenteric disease history was selected as controls and designated Group "B." Evaluation of results showed a marked reduction in fly populations of the treated cities (Group "A") during the study period, and that this reduction in fly populations showed a close correlation with a decline in the incidence of dysenteric diseases during the same period.

Figure 7 indicates the degree of fly control obtained and figure 8 shows the decrease in dysenteric diseases in terms of attack rates per 1,000 in children under 10 years of age.

Fly control operations were discontinued in Group "A" cities in August 1947 and commenced in Group "B" cities, previously control cities, in September of that year. The "cross-over" of the fly abundance lines in figure 8 dramatizes the measure of fly control resulting from the treatment program. This "cross-over," it will be noted, occurred soon after the cessation of fly control operations in Group "A" cities and the initiation of fly control in Group "B" cities.

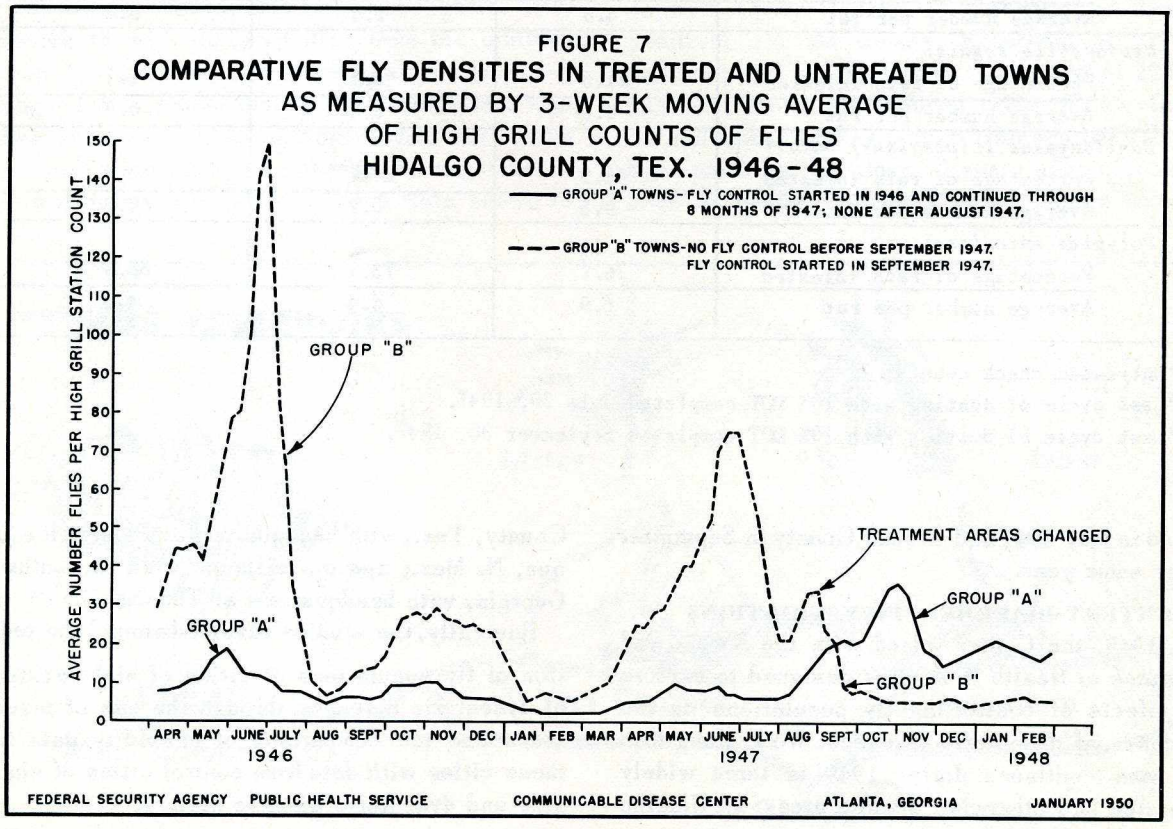
It was observed, during the studies, that the effect on *Shigella* infections was greater than on infections with the *Salmonella* group of organisms, indicating that fly control has a greater potential as a health measure in those areas where *Shigella* infections predominate as the cause of acute diarrheal disease.

The Hidalgo County project was discontinued in September 1948, except for compilation of family histories on a portion of the study group which is continuing.

The Thomasville project, which is continuing, is expected to yield additional information concerning various aspects of fly control in relation to dysenteric disease abatement, and perhaps produce a basis for helpful conclusions.

FLY CONTROL-POLIOMYELITIS INVESTIGATIONS

Based on the fact that flies can become infected naturally with poliomyelitis virus, the Center inaugurated investigational projects in Florence, Ala., (1946) and Wilmington, Del., (1947) to determine



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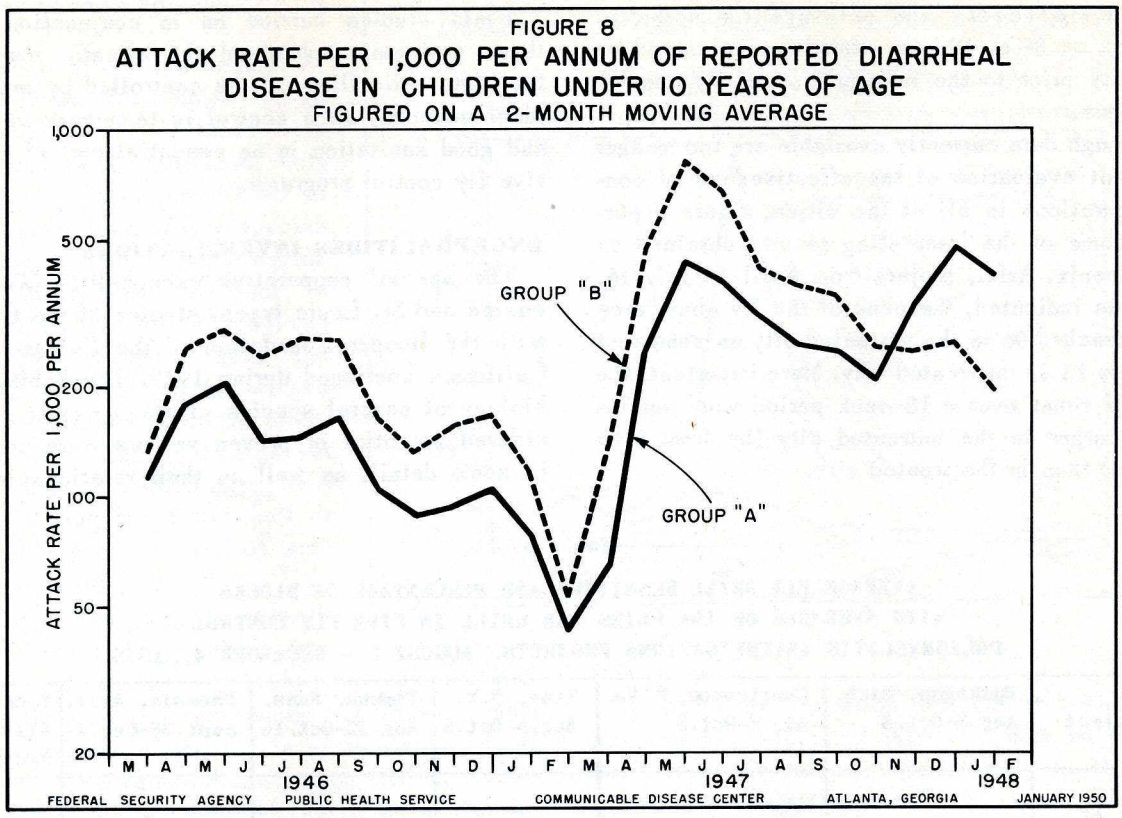

the role, if any, of flies in the transmission of poliomyelitis. From these two projects, it became evident that emergency fly control measures initiated after the development of poliomyelitis epidemics would not significantly influence the course of the epidemic.

In 1948 the Center joined with the National Foundation for Infantile Paralysis in a projected 5-year study to determine the effect of continuous or year-round fly control on the transmission of poliomyelitis. Five widely separated representative cities (Charleston, W. Va.; Muskegon, Mich.; Phoenix, Ariz.; Troy, N. Y.; and Topeka, Kans.) were selected for the study, using the following criteria: (1) reasonably high rank for that region of the country with regard to dysentery-diarrhea mortality, particularly during the summer months; (2) no serious outbreak of poliomyelitis within the past 3 years; (3) population of not less than 50,000 and not more than 200,000; (4) willingness of the city to participate in the program and to make financial contributions thereto; and (5) reasonably sound sanitation practices in the city, with particular regard to refuse collection and disposal or the adoption of a program to effect same.

Some 69,000 separate fly grill counts were made during the latter months of 1948, prior to the inauguration of fly control measures. As indicated in tables 6 and 7, fly abundance and species prevalence varied greatly among the five cities. The common house fly, for example, represented 92 percent of the total catch in Phoenix, Ariz.; 44 percent in Topeka, Kans.; 18 percent in Charleston, W. Va.; and only 3 percent in Troy, N. Y.

During the early spring months of 1949 an environmental sanitation survey was made in each of the five cities. These surveys revealed the principal fly breeding sources in the respective cities and provided a guide for subsequent fly control operations through chemicals and sanitation measures.

Fly control operations in the five cities encompassed: (1) application of exterior space sprays at approximately weekly intervals to city blocks of high fly density or high breeding potential; (2) application of DDT residual spray to selected surfaces close to continuous breeding sites; and (3) application of larvicides to large masses of fly-breeding media.

Preliminary information concerning dysentery-

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diarrhea mortality and poliomyelitis morbidity covering an 8- to 10-year period was obtained in each city prior to the inauguration of fly control operations.

Although data currently available are too meager to permit evaluation of the effectiveness of control operations in all of the cities, figure 9 portrays some of the interesting results obtained on the Phoenix, Ariz., project from April 16-July 16, 1949. As indicated, the peak of the fly abundance curve reached 96 in the untreated city as compared with only 13 in the treated city. More important, the fly grill count over a 13-week period was consistently larger in the untreated city (by from 3 to 86 flies) than in the treated city.

Field studies carried on in conjunction with these projects emphasized the already observed fact that while flies can be controlled by insecticidal methods, such control is temporary at best and good sanitation is an essential part of effective fly control programs.

ENCEPHALITIDES INVESTIGATIONS

The special cooperative encephalitis (Western equine and St. Louis types) studies of the Center with the Hooper Foundation of the University of California continued during 1949. The habits and biology of several species of mosquitoes considered potential or proven vectors were studied in some detail, as well as their relationships to

Table 6

AVERAGE FLY GRILL DENSITIES AND PERCENTAGE OF BLOCKS WITH AVERAGES OF 10+ FLIES PER GRILL IN FIVE FLY CONTROL-POLIOMYELITIS INVESTIGATIONS PROJECTS, AUGUST 8 - DECEMBER 4, 1948

Project	Muskegon, Mich. Aug.8–Oct.8	Charleston, W. Va. Aug.8–Oct.8	Troy, N.Y. Aug.8–Oct.8	Topeka, Kans. Aug.22–Oct.16	Phoenix, Ariz. Sept.26–Dec.4	Total All Projects
Total number of grill counts	15,260	14,630	10,005	12,100	17,240	69,235
Average number per grill	3.9	6.7	3.9	11.5	14.4	–
Number of blocks surveyed	1,451	980	822	1,406	1,564	6,223
Percentage of blocks with grill counts 10+ flies one or more times	11.1	31.4	31.4	16.7	36.7	23.9

Table 7

FLIES TRAPPED IN THE RESIDENTIAL AND BUSINESS SECTIONS OF FLY CONTROL-POLIOMYELITIS INVESTIGATIONS PROJECTS AUGUST 16 - DECEMBER 30, 1948

Project	Troy, N. Y. Aug. 16 – Nov. 10	Charleston, W. Va. Aug. 19 – Nov. 4	Topeka, Kans. Sept. 1 – Nov. 5	Phoenix, Ariz. Sept. 11 – Dec. 30	Total All Projects*
No. collections	57	92	64	79	292
No. specimens	54,390	35,996	148,446	222,836	461,688
Musca domestica	3.0%	18.0%	44.4%	92.3%	–
Blow flies	83.0%	75.0%	44.5%	7.0%	–
Other	14.0%	7.0%	11.1%	0.7%	–

*Muskegon trap data not available.

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the more common species of wild birds.

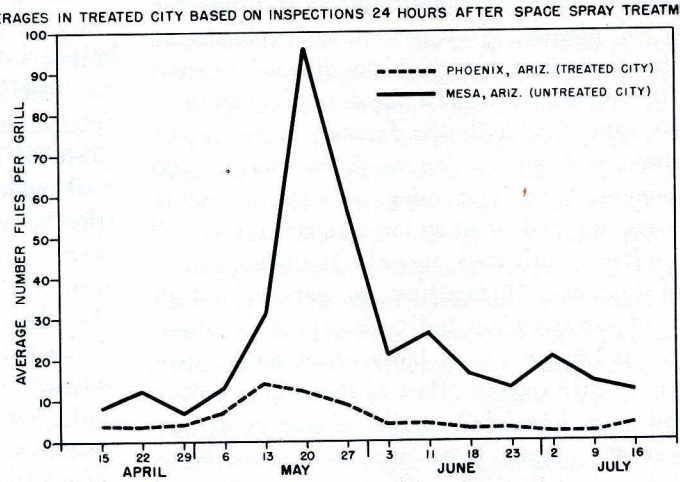
Table 8 offers the results of tests performed on some 10,000 mosquitoes in connection with these studies. As indicated, only one pool of *Culex tarsalis* out of 10,047 specimens of five species was positive for Western equine encephalomyelitis. A pool of mites (predominately *Liponyssus sylviarum)* collected from the nest of a tricolored red-winged blackbird yielded a strain of St. Louis virus. Examination is yet to be made of 26,000 mites collected during the latter half of the fiscal year, as well as sera from 567 wild birds.

FIGURE 9

AVERAGE NUMBER FLIES PER GRILL IN BUSINESS SECTIONS OF TREATED CITY — PHOENIX, ARIZ. UNTREATED CITY — MESA, ARIZ.

APRIL 16 – JULY 16, 1949

(AVERAGES IN TREATED CITY BASED ON INSPECTIONS 24 HOURS AFTER SPACE SPRAY TREATMENTS)



FEDERAL SECURITY AGENCY PUBLIC HEALTH SERVICE COMMUNICABLE DISEASE CENTER ATLANTA, GEORGIA JANUARY, 1950

Studies designed to clarify the epidemiology of Western equine encephalomyelitis were inaugurated during the year in three counties of Kansas, under the jurisdiction of the Office of Midwestern CDC Services. The selected study area (Allen, Anderson, and Bourbon Counties) registered a high incidence of encephalitis during past epidemic years. Field laboratories were established to handle the materials to be collected, including mites, wild birds, mosquitoes, and other insects considered possible vectors. Arrangements were consummated whereby collected materials would be distributed among designated laboratories for examination. Results of these studies to date are recorded in some detail in the summary of activities carried in Region VII during 1949 found on page 63 of this report.

Inasmuch as irrigation projects and water impoundments associated therewith may be prolific sources of *C. tarsalis*, particularly in the area of these studies (Missouri River Basin Development Project), special consideration was given to this phase of the problem.

In connection with laboratory reference diagnostic services during the year, Eastern equine encephalomyelitis virus antibodies were found in 21 birds from Georgia (white ibis and night heron), and in two skunks. Two wild birds from Louisiana and one from Mississippi also showed these antibodies. Western equine encephalomyelitis antibodies were found in three birds from Georgia and

Table 8

TABULATION OF MOSQUITO COLLECTING AND ATTEMPTED VIRUS ISOLATIONS IN STUDIES IN KERN COUNTY, CALIF.

Mosquito Species	Dates Collected	Number Tested	Laboratory Results
Culex tarsalis	July 1 – Aug. 31, 1948	4,451	One pool collected July 14 and July 21 positive for W.E.E. virus
Culex tarsalis	June 1 – 30, 1949	3,170	Not tested
Culex stigmatosoma	July 1 – Aug. 31, 1948	95	Negative
Aedes dorsalis	July 1 – Aug. 31, 1948	1,695	Negative
Aedes dorsalis	July 1 – 30, 1949	308	Not tested
Aedes nigromaculis	July 1 – Aug. 31, 1948	327	Negative
Culiseta inornata	July 1 – Aug. 31, 1948	1	Negative
	Total	10,047	

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one chicken from Mississippi.

PLAGUE INVESTIGATIONS

In the early part of the fiscal year, two field investigation units were established to study the ecology of plague, with particular emphasis on delimiting the routes by which the disease is most likely to spread from infected wild rodents to domestic rats. One unit was located in Salt Lake City, Utah, and one in Denver, Colo. Some 2,000 wild rodents, rats, and other animals including birds, were trapped or shot for examination of ectoparasites. Collected animals included specimens of 4 orders, 12 families, 24 genera, and 38 species of mammals; and 3 orders, 4 families, 5 genera, and 5 species of birds which have close contact with wild rodents. Part of the ectoparasites collected were forwarded to the laboratory at San Francisco for plague tests and the remainder to Atlanta for identification.

Plague infection was found for the first time in Salt Lake County, Utah, in a pool of fleas from a rock squirrel, *Citellus variegatus*. Subsequently, two additional pools of fleas, one from the same species of rock squirrel and one from a white-footed mouse, were found to be plague-infected. Two lots of fleas from prairie dogs, *Cynomys gunnisoni*, in Park County, Colo., also showed plague-positive.

As indicated in table 27, page 83, (Plague Suppressive Laboratory report), examination of material collected from 51,422 rodents from 113 counties in 12 States resulted in 70 positive findings. Plague infection was demonstrated for the first time this year in six counties: Arizona, one county; New Mexico, four counties; and Utah, one county. No plague in domestic rats was demonstrated during the year.

Since plague is transmitted mainly from one animal, or one species of animal, to another by exchange of fleas or other parasites, observations to determine the occurrence and extent of such exchanges were stressed in investigations pursued during the year. Most ectoparasites have rather specific host preferences. Cases of propinquity of plague-susceptible wild rodents, including ground and rock squirrels and native mice, with rats were observed. By collecting and examining ectoparasites from these animals, two cases of exchange of fleas from rock squirrels to rats, and one each from rats to a rock squirrel, a white-footed mouse, and a weasel were found. One species of mite, *Haemolaelaps glasgowi*, which is fairly common on rats in many parts of the United States, was found both on rats and on plague-susceptible wild rodents.

A second, and perhaps more important factor in determining the potential danger of plague to any city is the ability of the rats and their ectoparasites to support plague epizootics. This depends on the number and concentration of rats and the abundance of the species of rat ectoparasites capable of being plague vectors from rat to rat, and subsequently from rat to man. In Salt Lake City, the Norway rat was found to be rather common and some roof rats also were present in the downtown business district. Fortunately, the oriental rat flea, *X. cheopis*, was found to be rare on rats in Salt Lake City, and the Northern rat flea, *Nosopsyllus fasciatus*, only moderately abundant. In Denver, only Norway rats are present and they are not very common, but both of the above-mentioned species of rat fleas are present in small numbers.

The San Francisco laboratory examined some 80,000 ectoparasites, including 69,000 from 17,000 rats taken in San Francisco, during the year with only negative findings as to plague.

Rat ectoparasite and sylvan plague investigations in the Brownfield, Tex., area were terminated at the end of the fiscal year. Pack or wood rats and prairie dogs in combination with their natural flea parasites were found to be primary reservoirs in that area. Norway rats habored so few fleas that the likelihood of plague epizootics among them is considered small.

Q FEVER INVESTIGATIONS

In Los Angeles County, Calif., investigations conducted jointly by CDC, NIH, and the California Health Department indicated the highest Q fever attack rates in the following groups: persons in households where raw milk is consumed, persons working with livestock, and persons residing within a radius of ¼ mile of dairies. Milk was found to be a prolific source of the Q fever organism, *Coxiella burnetii*. Serological surveys showed the infection incidence in cattle in the Los Angeles area was 15 percent. Epidemiological investigations of the disease in cattle are being pursued.

BRUCELLOSIS INVESTIGATIONS

Field studies of brucellosis in Indiana revealed that human infections occur principally in three groups: (1) infection from foods of animal origin, (2) occupational disease in animal handling industries, and (3) occupational disease on livestock farms. Laboratory studies of brucellosis in Florida

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have shown that the ring (ABR) test on composite milk samples compares favorably with the serum agglutination test.

CREEPING ERUPTION INVESTIGATIONS

Field and laboratory investigations were initiated in response to requests from health officials in the Atlantic Seaboard States. A survey of physicians in the coastal areas of Florida revealed more than 7,000 cases. Studies designed to determine the source of infection and devise control measures are being continued.

RABIES INVESTIGATIONS

Laboratory diagnosis of rabies techniques were tested and improved during the year. Comparative studies indicated that Seller's stain is superior for staining brain tissue films. The mouse inoculation test was standardized and distributed to public health laboratories requesting it. It was found that penicillin in doses of 500 units/ml. failed to alter significantly the titer of street rabies virus, indicating that it can be utilized as a decontaminant in bacterially decomposed brain specimens submitted for examination.

HISTOPLASMOSIS INVESTIGATIONS

Studies have indicated that this disease is not as rare in animals as formerly was supposed and that it is possible that animals serve as reservoirs. Natural infection is found in dogs and rats. Experimental infection in dogs showed evidence of systemic clinical disease, progressive pneumonic involvement by radiographic diagnostic techniques, and skin sensitivity to histoplasmosis which persists after recovery.

INSECTICIDES INVESTIGATIONS

Activities in this field during the year were centered around, but not confined to, investigations, studies, and tests in search of improved insecticides for use in the control of house flies, many strains of which have manifested marked resistance to DDT.

A number of candidate insecticides were tested with respect to relative effectiveness, toxicity to humans, lasting qualities, and other characteristics of importance in an insecticide for general use. Some were discarded because house flies rapidly developed resistance to them, others because the health hazard associated with their general use appeared insurmountable, and still others because they did not have sufficiently long residual action.

At the end of the fiscal year, an experimental chemical known as compound 497 (now called dieldrin) was rated the most promising material tested. In field tests, dieldrin has proved more effective than DDT, even against nonresistant flies, and appears also to be effective as a larvicide. Laboratory tests show that it remains as effective against mosquitoes as DDT over a period of 17 weeks. Outdoor spray deposits of dieldrin at the rate of 100 milligrams per square foot have remained effective against flies for a period of over 2 months, and there are indications that considerably lower doses may be effective. Lack of knowledge concerning its toxicity to humans has prevented the sanction of this material for general use. Preliminary applications have indicated that dieldrin concentrates are quite toxic. On the other hand, the dilute emulsion appears to be reasonably safe if properly handled. On the basis of current information, a major danger associated with the use of this material as an insecticide will concern the spray operator rather than the occupant of the sprayed house. It is possible that this danger can be alleviated and probable that proper precautions may permit its use in outdoor spraying operations.

Methoxychlor, the p,p'-methoxy analog of DDT, gave erratic results in tests against house flies, and flies quickly developed resistance to it as well as to DDT. A combination of methoxychlor and DDT gave much better results than either material separately, and laboratory tests indicate that flies do not develop resistance to the mixture as rapidly as they do to either material. However, field tests of this material have not been encouraging.

Chlordan, one of the materials studied, proved effective in the control of DDT-resistant flies. However, its known toxicity to warm-blooded animals renders it unsuitable for interior residual spraying of houses, pending further investigations.

Other materials tested included the fluorine analog of DDT, gamma isomer of benzene hexachloride, and compound 118 (now called aldrin). The fluorine analog of DDT and gamma isomer of benzene hexachloride were found inferior to DDT as a residual for the control of flies. Aldrin was found effective against DDT-resistant flies, but it cannot be recommended until more information is available concerning the health hazard associated with its use.

The value of rosin as an adhesive for outdoor residual sprays was confirmed through widespread utilization in the 1949 operational programs. It is interesting that the adhesive was not effective

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when used with methoxychlor and appeared to interfere with the action of chlordan, but was effective with dieldrin.

In the spring of 1949, field investigations were inaugurated to find out more about the contamination of milk with DDT through the use of DDT residual spray in the control of flies and other insects in dairy barns. A series of dairy barns in the vicinity of Savannah, Ga., was sprayed, using the standard 5 percent emulsion at the rate of 200 milligrams per square foot. In one group of barns, no precautions were taken to prevent the spray from contaminating feed boxes and watering troughs; in a second group, covers on feed boxes were lowered to protect the inside from the spray; and in a third group, full precautions were taken by covering all feeding and drinking areas with auxiliary cloths before spraying operations were started. Feed storage areas were not sprayed at any of the dairies. Samples of milk were collected before and after spraying in each dairy and determinations made of DDT content. The results indicated that there was a considerable amount of DDT in the milk of animals even before the spray was applied. Subsequent tests with commercial feeds obtained from local markets showed that these feeds were contaminated with DDT, which explains, at least in part, the occurrence of DDT in pretreatment milk samples. After the spraying, there was a marked increase in the DDT content of milk from barns where no precautions were taken. There was little indication of an increase in the DDT content of milk from barns where the feed box covers were lowered before spray was applied or from those barns where full precautions were taken prior to spraying.

A final summary of results of investigations carried on to determine the effects of routine mosquito larviciding on fish was made during the year. At routine dosages of 0.1 pound per acre applied by hand, DDD, chlordan, and DDT are toxic to fish and will reduce significantly the population of fish in shallow ponds. At dosages of 0.05 pound per acre, DDT appears to be somewhat more toxic than chlordan or DDD. These three insecticides appear to have no significant effect on the fish population at dosages of 0.025 pound per acre. Toxaphene was found to be very toxic to fish, killing at dosages of less than 1 part in 22 million.

It is concluded that DDT spray or thermal aerosols can be applied by airplane at an output of 0.1 pound per acre without significant damage to the fish population in deep large bodies of water. In routine hand application for malaria larvae control, oil solutions applied at dosages of 0.05 pound of DDT per gallon of solution per acre or DDT dust at a rate of 0.1 pound of DDT per acre are generally recommended.

During the year, an entomologist from India, working under a National Institutes of Health fellowship, carried on some fundamental investigations on the relationships between the physical state and insecticidal action of DDT and other synthetic insecticides when applied to solid and liquid surfaces. From preliminary findings, it would appear that on solid surfaces the habits of the crystal is less important than whether or not the insecticide has fully crystallized. The nature of the solvent as well as the temperature and physical disturbance affects the rate of crystallization. Freshly applied solutions of DDT appear very effective; but as the solvent evaporates, there seems to be a tendency for the DDT to delay crystallization until a sudden temperature change or mechanical disturbances induce rapid crystallization. In the interim, the noncrystalline semiliquid mass does not appear to wet the surface of the insect and effectiveness is greatly reduced. After crystallization is complete, effectiveness is restored to a high level. On water surfaces (as used in anopheline larviciding) a similar situation holds except that there is an added factor of chemical or physical loss of the DDT itself. Whether this is sublimation, chemical reaction, or something else is not clearly established, but the nature of the solvent seems to have an important effect. Exposure to sunlight during storage of the stock solution, and disturbance of the surface film by wind or rain also were shown to decrease its effectiveness.

TOXICOLOGICAL INVESTIGATIONS

During the year it became increasingly apparent that the greatest limiting factor in the use of newer insecticides such as dieldrin was the lack of knowledge concerning the health hazards and how to combat them. Accordingly, studies were instigated designed to determine the extent of the hazard involved in the operational use of such materials and precautions or procedures that may make their use safer. Also involved was an effort to detect clinical symptoms which may be used as warnings as well as aids in diagnosis, and to devise possible antidotes or treatments for accidental

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poisonings.

Preliminary tests were conducted during this year to evaluate the hazard associated with spraying with chlordan the entire walls and ceilings of bedrooms and other rooms where infants might be exposed to the vapors for large portions of the day.

Dieldrin was placed under study late in the year, and in both instances results are too preliminary for reporting.

RODENTICIDES

The relatively new principal of poisoning rats by means of anticoagulants which rats will continue to accept over a long period of time was investigated. Single large doses are relatively ineffective so that the materials are fairly safe as regards accidental poisoning of domestic animals or children, but repeated small doses produce spontaneous hemorrhage which results in death of rats. In the case of dicoumarin, 2 milligrams per gram of bait was necessary to kill all test rats in a 2-week period. In comparable tests with compound 42 (a dicoumarin derivative) all rats were killed in less than 2 weeks at a rate of 0.2 milligrams per gram of bait for *R. rattus* (lowest concentration studied). In simulated field tests, all of 107 test Norway rats were killed when offered 1.0 milligram of compound 42 per gram of bait for 6 days, while 14.8 percent of them survived when the bait was removed after the 5th day.

Laboratory tests with caged wild Norway rats indicated that 1 or 2 weeks after surviving 6 milligrams of ANTU per kilogram of body weight, some degree of tolerance to ANTU is attained. Moreover, it was found that after 1 month many rats refused to accept the bait in which ANTU was previously offered. Corresponding field tests showed evidence of bait refusal but not of tolerance.

Laboratory tests with Castrix indicated that it was very toxic to rats but was very poorly accepted, apparently due to an obvious odor.

LABORATORY SERVICES

Laboratory services extended the States during the year included methodology research, reference diagnosis, training for laboratory personnel, consultation, and evaluation of laboratory performance. In each instance, there was adherence to the basic thesis that it is the principal function of the Center to support and supplement laboratory facilities and services supplied by State and other laboratories, not to duplicate or supplant their services.

The evaluation program, which received considerable attention during the year, is not pointed toward standardization but rather toward improvement in laboratory performance by State and other public health laboratories. Final plans for this program in the diagnosis of amebiasis were completed during the year and a majority of the State laboratories have indicated a desire to participate.

In the sphere of laboratory consultative services, program reviews were completed of 20 State health department and 4 municipal health department laboratories. Figure 10 portrays progress in this activity thus far.

Methodology research involves the evaluation and improvement of existing laboratory techniques and the development of new ones if the need exists. The goal is not to promote standardization to the point where all laboratories observe identical practices, but to make available the latest evaluation of all evidence bearing on each procedure, and to disseminate this evidence through training courses, demonstrations, and scientific publications.

Reference diagnostic services were provided during 1949 in parasitology, virus rickettsia, serology, enteric bacteriology, mycology, tuberculosis, and in certain other fields. The aim in this service is not to provide routine diagnostic services which can be supplied by laboratories and institutions within the States, but to help these laboratories with particularly difficult specimens and to encourage them to extend their field of coverage. It is anticipated that as improved methods and techniques are developed and passed on to State laboratories, they will not only be able to handle the bulk of referrals, but also will provide training and guidance that will raise the level of laboratories within the respective States.

In developing and conducting training courses for laboratories, emphasis is placed on laboratory diagnosis. The length and content of courses vary with the subject matter covered and the category

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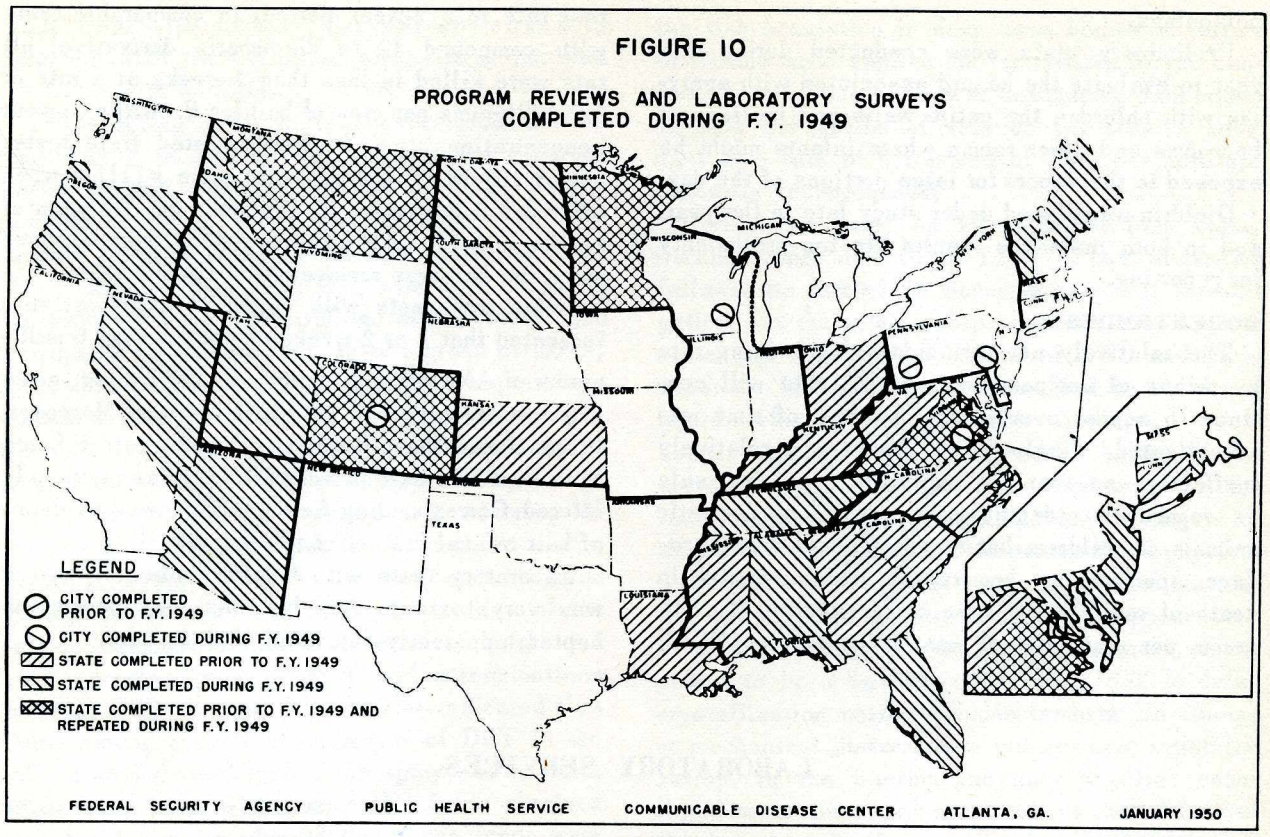

of trainees enrolled. During the year the length of courses varied from 1 to 6 weeks and the level of trainees from laboratory directors to laboratory technicians. Preference in processing enrollment applications is given to trainees from State and local public health laboratories. Six courses for laboratory directors were given during the year with an aggregate enrollment of 123, representing all sections of the country. A total of 179 trainees attended 12 "long courses" in the several fields. Included among trainees were representatives from 25 foreign countries and from 109 State or local health organizations. Table 9 summarizes the major activities in laboratory training during 1949.

The extension service made shipments of specimens of parasitological material and pictorial keys and charts of entomological material to 300 laboratories each month. Among laboratories receiving these shipments were 172 State and/or local health department laboratories. Table 10 indicates the volume and distribution of shipments by the extension service.

METHODOLOGY RESEARCH

Parasitology. (1) A simple bulk fixation technique for fecal material has been developed. When specimens are stirred into polyvinyl alcohol (PVA) fixative in a vial, trophozoites are fixed and can be shipped very easily, without damage. It is thus possible to preserve material from diarrhea patients for later microscopical diagnosis in laboratories located a considerable distance from the patient. (2) Triton X-30, added to Giemsa's stain, does not interfere with staining of other parasites. The inclusion of this detergent results in excellently stained blood cells, hemoflagellates, and microfilaria. Brilliant stains can be obtained even from blood smears several weeks old. (3) It has been found that *Trypanosoma cruzi* will remain viable in whole animal blood for several days. For diagnostic purposes, it seems practicable to mail whole blood specimens over a considerable distance to diagnostic laboratories. (4) Intensive study and comparison of methods for the diagnosis of amebiasis were initiated. Studies and surveys were conducted in the field in the Atlanta area and with reference diagnosis specimens, to evaluate test-performance. (5) Reference diagnostic services for serological tests for parasitic diseases are now available at the Center. The parasitology laboratory prepares and develops antigens to detect

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amebiasis, trichinosis, and echinococcosis.

Virus and Rickettsia: (1) Studies were made to determine the incidence of Newcastle disease virus among humans and fowls. There are many animals which show "normal" neutralization activity against this virus; this activity is associated with a thermolabile fraction of serum, while specific antibodies for the virus are thermostabile when exposed at 56°C. for 30 minutes. (2) It was found that subcutaneous injection of Eastern equine encephalomyelitis virus (E.E.E.) into horses resulted in demonstrable viremia for not longer than 60 hours after a brief incubation period. (3) Penicillin and streptomycin exert no detectable effect upon antibody serum or E.E.E. virus in tissues. These antibiotics can be used safely to prevent bacterial interference during studies with this virus. (4) In horse sera, neutralization antibodies against E.E.E. diminished 5-10 fold during refrigeration-storage.

Bacteriology (Diphtheria): (1) The diphtheria laboratory continued studies in animals on antibacterial resistance to *Corynebacterium diphtheriae* and began studies on complement fixation in relation to antidiphtherial immunity. These studies are part of a long-term evaluation of antiendotoxic resistance as a factor in diphtheria immunity and are a phase of methodology research, since the results will determine diagnostic procedures to some extent. (2) Study of the *in vitro* virulence test for *C. diphtheriae* was continued, with special emphasis on the factors responsible for falsely negative results given by *minimus* type strains. The data obtained from continuations of the comparative tests of media for the isolation of *C. diphtheriae* were submitted for statistical analysis. (3) Cultures of mycobacteria desiccated for 17 years were reactivated, and for the most part seemed to have retained their original characteristics. (4) A comparative study of plating media for the isolation of diphtheria bacilli was completed. The best practice for detection of these organisms should include the use of tellurite media.

Serology: (1) The known serological tests for human brucellosis are extremely variable in specificity and sensitivity when used by different laboratories. There are two principal procedures for these tests, the tube agglutination test and the slide agglutination test. During the past year all the physical components of the tube test have been reviewed and evaluated. Selection of optimal conditions was followed by trial of the three best

Table 9

LABORATORY TRAINING COURSES
FISCAL YEAR 1949

Length of Course-Weeks	Type of Course	Number Attending	Number of States Represented*
2	Laboratory Diagnosis of Parasitic Diseases (for Laboratory Directors)	36	13
6	Laboratory Diagnosis of Parasitic Diseases	67	30
4	Laboratory Diagnosis of Tuberculosis (for Directors)	45	28
4	Laboratory Diagnosis of Tuberculosis	38	18
2	Laboratory Diagnosis of Influenza	4	4
2	Laboratory Diagnosis of Bacterial Diseases (for Directors)	16	10
2	Laboratory Diagnosis of Bacterial Diseases (Part 2)	14	11
4	Laboratory Diagnosis of Bacterial Diseases (Enteric Bacteriology)	7	3
1	Laboratory Diagnosis of Mycotic Diseases (for Directors)	26	14
4	Laboratory Diagnosis of Mycotic Diseases	22	17
6	Rickettsial serology	14	6
1	Laboratory Diagnosis of Rabies (conducted by Veterinary Public Health Services)	21	14

*Students from Veterans Administration Hospitals, U. S. Marine Hospitals, Army and Navy laboratories, and nonprofit general hospital laboratories attended many of these courses.

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Table 10

DISTRIBUTION OF EXTENSION SERVICE MATERIALS
FISCAL YEAR 1949

Location	State Public Health Laboratories	County and/or City Laboratories	Veterans Administration Hospitals	Other Hospitals	Other Agencies
Alabama	1	–	–	1	–
Arizona	3	–	1	–	–
Arkansas	1	–	1	–	–
California	2	23	7	3	1
Colorado	3	–	–	1	2
Connecticut	1	1	1	4	–
Delaware	1	1	–	–	–
District of Columbia	1	–	–	–	2
Florida	2	–	2	–	–
Georgia	1	5	–	–	4
Idaho	1	1	–	–	–
Illinois	5	2	2	–	1
Indiana	1	–	2	–	1
Iowa	1	–	2	–	–
Kansas	1	–	3	–	–
Kentucky	1	–	1	–	–
Louisiana	6	–	2	2	–
Maine	1	–	–	–	–
Maryland	1	1	2	1	–
Massachusetts	1	2	3	4	1
Michigan	5	–	1	2	–
Minnesota	1	–	1	–	–
Mississippi	1	3	1	1	1
Missouri	3	1	3	–	1
Montana	1	–	1	–	–
Nebraska	1	–	1	–	–
Nevada	1	–	–	–	–
New Hampshire	1	–	–	–	–
New Jersey	1	–	–	1	–
New Mexico	1	–	2	–	–
New York	2	4	5	2	–
North Carolina	1	1	2	–	–
North Dakota	2	–	–	–	–
Ohio	1	–	3	–	1
Oklahoma	3	–	1	–	–
Oregon	15	–	1	1	1
Pennsylvania	1	–	6	1	–
Rhode Island	1	–	–	–	–
South Carolina	1	–	2	1	2
South Dakota	1	–	–	–	1
Tennessee	6	1	3	–	1
Texas	19	–	3	–	–
Utah	1	–	1	–	–
Vermont	1	–	1	–	–
Virginia	1	1	2	2	–
Washington	1	8	2	3	3
West Virginia	1	–	1	–	–
Wisconsin	1	1	1	–	–
Wyoming	1	–	–	–	–
Alaska	–	–	–	–	1
Canada	–	–	–	–	4
Hawaii	–	–	–	–	2
Puerto Rico	–	–	1	–	–
Totals	111	55	74	30	30

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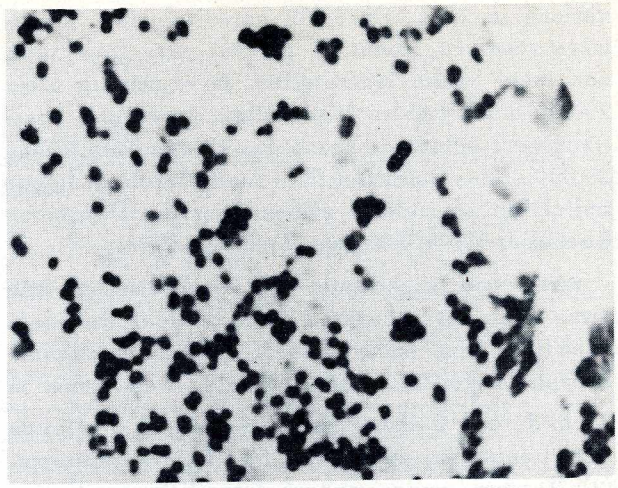
known antigen strains. No significant differences in diagnostic value could be found when these antigens were compared. (2) From comparative studies of complement fixation techniques, it was concluded that neither the Kolmer ice box fixation nor the Bengston water bath fixation was uniformly superior to the other. Approximately the same specificity was observed; some sera gave better results with one technique and others with a different.

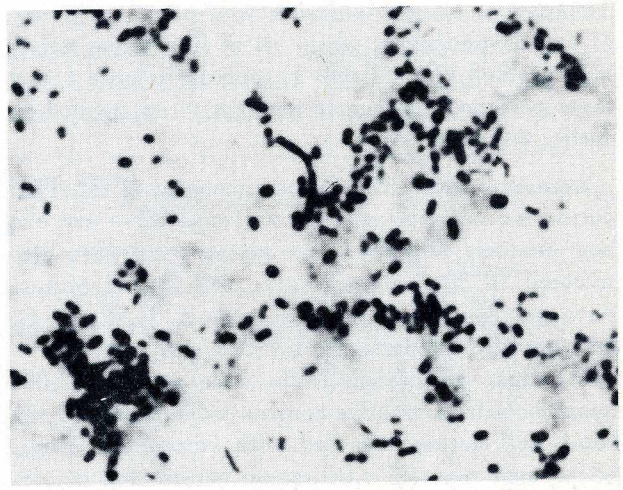
Enteric Bacteriology: (1) Detailed studies on characteristics of collected cultures have resulted in definition of Mimeae — a troublesome group of bacteria which have caused false laboratory diagnoses on several occasions. (2) The interrelationships of *Shigella* species, paracolons, and some "O" groups of *Escherichia coli* were studied serologically. (3) In collaboration with the American Public Health Association Subcommittee for Enteric Bacteriophage Typing, 'phages for *Salmonella typhosa* have been collected and standardized. Selected laboratories in the United States were furnished 'phages and directions for their use.

Mycology: (1) Soil samples and rodents were collected in Tennessee in search of extrahuman sources of *Histoplasma capsulatum.* Studies were made on collection, storage, and culture techniques in an effort to enhance the efficiency of present methods for isolation of this fungus. Thus far, *Histoplasma* has not been recovered from these materials. (2) A supply of histoplasmin has been produced and standardized. The skin-test antigen is available, and complement fixation test antigen has been supplied for use in the serology laboratories. A *Blastomyces* vaccine has been made and coccidioidin will be made available as soon as it has been standardized.

Tuberculosis: (1) A strain of tubercle bacillus, growth of which was markedly enhanced by streptomycin added to the culture media, was isolated from the sputum of a patient under treatment with streptomycin. (2) The slide-culture technique was developed for use in the test for streptomycin sensitivity. (3) Free fatty acids in media impair the growth of tubercle bacilli. Nearly twice as much of these acids was found in media prepared by autoclaving at 100° C. as in inspissated media prepared at 85° C. (4) The usual methods of concentration and examination of stained smears of sputum from tuberculosis patients gave fewer positive findings than were obtained from simple examination of stained smears of selected particles from similar specimens. Results from the use of this technique compare favorably with results from the use of egg media. (5) The toxicity of the usual sputum digestants for tubercle bacilli was evaluated. Digestants studied, listed in order of increasing toxicity, are sodium hydroxide, oxalic acid, sulfuric acid, and hydrochloric acid. (6) It was concluded that the routine use of mice for virulence tests cannot be recommended at present, although the procedure can be of some practical value.



Organisms of Tribe Mimeae from solid media. Coccoid and diplococcoid forms predominate.



Organisms of Tribe Mimeae from liquid media. Pleomorphic rods and filamentous forms are frequently found mixed with diplococci.

REFERENCE DIAGNOSIS

Parasitology: During the year, 34,000 specimens were received, including 32,000 arthropods from

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various sources. Of 1,832 parasitological specimens received, about 65 percent were from State and local health laboratories. In examining some 29,000 blood smears from malaria surveys, 4 positives were detected. These 4 positives were among 20,000 slides submitted from South Carolina. In one collection of malaria slides from the Dominican Republic, 300 of 500 were found positive.

Virus and Rickettsia: (1) Newcastle disease virus was not recovered from clinical materials submitted from human cases. (2) Eastern equine encephalomyelitis virus antibodies were found in 21 birds and 2 skunks from Georgia; 2 wild birds from Louisiana; and 1 wild bird from Mississippi. (3) Western equine encephalomyelitis antibodies were found in 3 birds from Georgia and in 1 chicken from Mississippi. (4) Myositis virus has been recovered from human sources in Alabama and in Tennessee. Feces isolation was positive in one of seven specimens, while all of five throat washings yielded virus. Table 11 records in more detail tests performed on human sera for virus antibodies during the year.

Serology: Some 39,000 specimens were received during the year, primarily from cooperative surveys and studies. Streptococcus typing sera were distributed to 32 laboratories in the United States, each set containing grouping sera A, B, C, D, G, and specific typing serum for 33 group A types.

(1) Host preference tests were run on 17,000 specimens from malaria control collections. Of the total, 0.8 percent reacted with human antiserum, 45 percent reacted with equine antiserum, 24 percent with bovine, 8 percent with porcine, and 1 percent with avian. (2) From rickettsial complement fixation serology tests, it was found that 112 of 639 human specimens were positive for murine typhus; 33 of 638 were positive for Rocky Mountain spotted fever. (3) In complement fixation tests, 10 percent of 18,900 rodent sera showed evidence of murine typhus. (4) Lygranum antigen was used to test for evidence of the lymphogranuloma-psittacosis group of pathogens in 89 sera; 6 of these were positive. (5) The heterophile antibody determination was positive in 13 of 83 sera submitted. (6) Routine complement fixation tests for parasitic diseases have been established and this activity transferred from the National Institutes of Health to the Center. During the last quarter of the year, 172 of 701 sera were positive for amebiasis, 15 of 88 for trichinosis, and 5 of 34 for echinococcosis. (7) Leptospira antibodies were detected in 8 of 229 human sera, 3 of 8 dog sera, and 0 of 20 rat sera.

Enteric Bacteriology: More than 3,600 items were included in services rendered 46 States, District of Columbia, Alaska, Puerto Rico, and 11 foreign countries.

(1) Of 2,250 cultures submitted for identification, there were 502 *Shigella* spp., 997 *Salmonella* spp., and 1,130 paracolons. (2) Bacteriophage typing was performed with 143 typhoid cultures received. (3) New *Salmonella* types were found three times and these new isolates designated *S. corvallis*, *S. colorado*, and *S. allandale*. (4) Of particular interest was the recognition of a culture isolated in a cloacal swab from a hen as *S. typhosa* (type E). This is the first recorded instance of the isolation of the typhoid bacillus from animals in the United States, and the second report of its presence in fowl.

Mycology: Services, involving 3,300 items, were furnished 37 States, District of Columbia, Alaska, the Philippines, Canada, and Australia.

(1) Cultures or specimens submitted for diagnosis included 126 pathogens, 56 of which were *Candida albicans*, 42 *Microsporum* spp., and 12 *Trichophyton* spp. (2) In the course of this service, the first isolations of *Blastomyces dermatitidis* in Georgia were made and the seventh known case of *Phialophora verrucosa* infection was diagnosed.

Tuberculosis: Routine diagnostic specimens of sputum, gastric and body fluids totaled 2,773 specimens, principally from Southeastern States. Cultures for typing were submitted by 11 States and Alaska. Streptomycin sensitivity testing was performed on 1,545 cultures from seven States.

FIELD TRAINING ACTIVITIES

In training, as in most Center activities, emphasis is placed upon rendering assistance to and cooperating with State and local health departments in developing and improving the techniques of public health personnel concerned with the control of communicable diseases. Type of training offered, fields covered, and methods employed are determined on the basis of needs of trainees served.

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Table 11

HUMAN SERA TESTED FOR VIRUS ANTIBODIES

I. Complement Fixation Test

Source of Specimen	Virus-Antigen							
	L.C.M.*		MUMPS		E.E.E.**		W.E.E.***	
	No. of Sera	No. Positive	No. of Sera	No. Positive	No. of Sera	No. Positive	No. of Sera	No. Positive
Alabama	7	0	1	1	–	–	–	–
Arizona	1	0	–	–	–	–	–	–
Colorado	5	1	–	–	–	–	–	–
Connecticut	9	0	4	2	1	0	–	–
Georgia	5	4	6	4	–	–	–	–
Kansas	1	0	–	–	–	–	–	–
Louisiana	2	1	5	5	1	0	–	–
Maryland	1	0	–	–	–	–	–	–
Mississippi	2	0	–	–	–	–	–	–
Missouri	3	1	–	–	–	–	–	–
Pennsylvania	3	0	3	3	–	–	–	–
South Dakota	–	–	–	–	2	0	4	0
Tennessee	1	0	–	–	–	–	–	–
Virginia	6	1	–	–	–	–	–	–

II. Neutralization Tests

Source of Specimens	Virus							
	L.C.M.		E.E.E.		W.E.E.		St. Louis	
	No. of Sera	No. Positive	No. of Sera	No. Positive	No. of Sera	No. Positive	No. of Sera	No. Positive
Alabama	–	–	28	0	8	0	4	0
Arizona	–	–	–	–	4	0	3	0
Arkansas	–	–	–	–	8	0	9	0
Colorado	2	0	–	–	12	2	13	1
Connecticut	1	0	10	0	1	0	1	0
Florida	–	–	2	0	2	0	2	0
Georgia	2	0	13	0	2	0	1	0
Indiana	–	–	2	0	2	0	2	0
Kansas	–	–	–	–	15	1	16	0
Louisiana	–	–	38	2	22	0	7	0
Maryland	1	0	1	0	–	–	–	–
Mississippi	–	–	9	0	5	0	4	0
Missouri	3	0	–	–	1	0	1	0
Ohio	–	–	–	–	1	0	–	–
Oklahoma	–	–	1	0	2	0	3	0
South Dakota	–	–	–	–	13	5	10	2
Tennessee	–	–	52	0	20	0	20	1
Virginia	5	1 (?)	8	2	–	–	–	–

*Lymphocytic choriomeningitis
**Eastern equine encephalomyelitis
***Western equine encephalomyelitis

Courtesy of the David J. Sencer CDC Museum

Three methods of lending assistance to States found productive during 1948-49 were: (1) the operation of regional training centers; (2) the assignment of experienced training officers to State health departments to assist in training activities, notably the operation of State training centers; and (3) the detailing of training officers for short periods of time to conduct decentralized training, usually specialized courses in various fields of public health. Progress also was made during the year in coordinating Center training activities with academic training in universities and schools of public health.

The following field training centers were operated during the fiscal year 1949: Albany, Atlanta, Columbus, and Savannah, Ga.; Cincinnati, Ohio; Denver, Colo.; Topeka, Kans.; and Troy, N. Y. New centers were established during the year at Amherst, Mass., and Pittsburgh, Pa. These training centers, other than the one at Pittsburgh which was in process of establishment in conjunction with the new School of Public Health at the University of Pittsburgh, were utilized during 1949 primarily for field training in the various aspects of environmental sanitation. More than 900 trainees from all sections of the United States attended one or more of the several types of training courses offered at these regional centers, including: courses for milk and food sanitation personnel, graduate sanitary engineers, graduate sanitarians, sanitarians (nonprofessional), graduate public health educators, and stream pollution control personnel. The headquarters in Atlanta conducted courses for rodent and insect control personnel and in housing sanitation techniques.

In addition to courses offered through regional field training centers and at headquarters in Atlanta, Center training personnel participated in a program of decentralized training which embraced courses in rodent control at Arlington, Va.; Chicago, Ill.; Kansas City, Mo.; insect and rodent control at University of Michigan, Ann Arbor, Mich.; and Tulane University, New Orleans, La.; and in fly control at Charleston, W. Va.

During the year, experienced training officers in the categories of health officer, health education, environmental sanitation, and clerical training were assigned to New York State, North Carolina, and South Carolina. Center personnel assisted with training at State field training centers in Florida, Louisiana, and Texas, particularly in environmental sanitation courses.

Figure 11 shows the location and distribution of Public Health Service and State training centers.

The training officer assigned to North Carolina joined the newly-created department of field training in the University of North Carolina School of Public Health and is cooperating in the work of that unit. The officer assigned to South Carolina expended much effort during the year in carrying on training for clerical personnel of the State health department in the proper utilization of public health records. Assistance in this field also was provided Kansas and Oregon during 1949.

Center training personnel assigned to New York State, consisting of a medical officer, public health educator, and sanitary engineer, worked with the Office of Professional Training in that State in developing and directing field training activities.

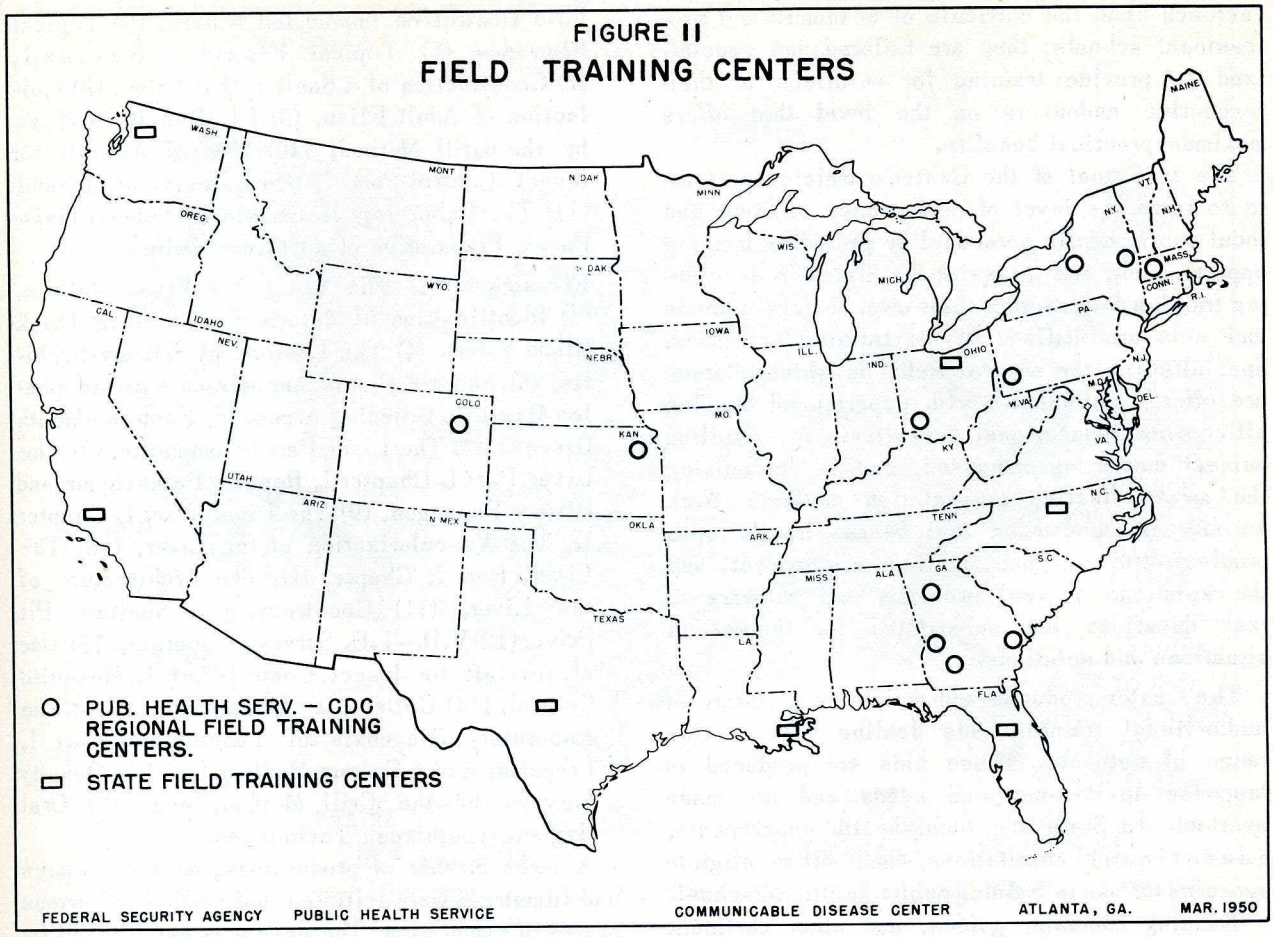
The Rocky Mountain Training Center, Denver, Colo., operated during the year from installations on the campus of the University of Colorado Medical School, under the direction of the heads of the Public Health School and Preventive Medicine Department. Graduate sanitarians and persons employed in health departments in the New England States are eligible to attend courses at the training center at Amherst, Mass.

The training center now under development at Pittsburgh, Pa., will maintain close liaison with the School of Public Health of the University of Pittsburgh and operate from facilities made available by the health department of the City of Pittsburgh.

Substantial progress was made during the year in developing the staff and facilities of the Cincinnati training center for administering an expanded program of practical training courses in stream pollution control techniques. These courses are designed to serve sanitary engineers and laboratory personnel from all parts of the country and thereby aid in speeding up the national program of water conservation and antistream pollution recently approved by Congress. During the year, 24 sanitary engineers participated in the advanced course in stream pollution abatement and 16 experienced bacteriologists attended courses dealing with water, milk, and food utensil examinations at this center.

Training activities concerning housing hygiene were augmented during the year to cover the demand for more assistance in that field which has grown with the expansion of Public Health responsibilities in the housing sphere. Training in the latest

Courtesy of the David J. Sencer CDC Museum



techniques of housing evaluation was conducted in Atlanta throughout the year, using Atlanta as a training area through agreement with the Atlanta Health Department. Fifteen trainees from housing agencies, State and local health departments, and the Public Health Service representing 13 cities in 11 States attended these courses. During the year, arrangements were completed for the establishment of a regional training center in housing evaluation techniques at Syracuse, N. Y. The New York State and Syracuse Health Departments are cooperating in this project.

The Center continued to offer training in various fields, including malaria control, rodent and insect control, fly control, and methods of field training, to visiting public health personnel from foreign countries. During the year, 124 persons from outside the continental United States attended one or more of the courses offered for foreign visitors. One hundred of this number attended courses at Atlanta and 24 at Albany, Ga., where a special course in insect and rodent control was conducted for foreign trainees.

In addition to Alaska, Hawaii, and Puerto Rico, trainees were enrolled from Australia, Bolivia, Brazil, Canada, Ceylon, Chile, China, Colombia, Denmark, Ecuador, Egypt, England, Finland, France, Germany, Greece, Guatemala, Holland, Honduras, India, Iran, Iraq, Italy, Korea, Lebanon, Mexico, Norway, Peru, Philippines, Portugal, Scotland, Sumatra, Sweden, Syria, Thailand, Turkey, Uruguay, and Venezuela.

In general, training courses (at headquarters, field training centers, and in cooperation with States and other agencies) consist of supervised field work, lectures and other classroom activities, and demonstrations. The length and content of courses conducted during the year varied. Emphasis was on providing practical training to meet the needs of trainees enrolled in each particular class. Care was exercised to avoid duplication of materials and techniques covered by trainees in previous training classes and studies. Center training activities, in short, are designed so as not to

Courtesy of the David J. Sencer CDC Museum

encroach upon the curricula of academic and professional schools; they are tailored and specialized to provide training for enrollees in their respective endeavors on the level that offers maximum practical benefits.

The twin goal of the Center's training program is to raise the level of performance of State and local public health personnel by providing training opportunities, and to assist the States in developing training facilities of their own. Modern methods and aids are utilized in all training activities. Specialists in the several fields in which courses are offered collaborate with experienced training officers and educational consultants in compiling subject matter encompassed, and in determining the most effective presentation methods. Work activity is carried on that bears directly upon problems trainees meet in their employment, and the solutions to real problems and answers to real questions are substituted for theoretical situations and solutions.

The Center produces and maintains a library of audio-visual training aids dealing with a wide range of subjects. These aids are produced in response to demonstrated needs and are made available to State and local health departments, educational institutions, and other eligible agencies for use in training public health personnel.

Training manuals, guides, and other pertinent instructional materials are prepared and produced in support of training activities. Publications in this category issued during 1949 include a comprehensive manual dealing with rat-borne diseases and their control, a fly control manual, and a variety of booklets and pamphlets of a more limited scope.

Audio-visual aids produced during the year include 11 motion pictures, 17 filmstrips, and 1 slide series. The film library distributed 4,251 motion pictures and filmstrips, 69 percent of which were placed on indefinite loan for use in strategic points and for redistribution. The remaining 31 percent were placed on short-period loan. Number of showings and estimated audience served, based on utilization guide reports from the field, are recorded in table 12. Figure 12 indicates the geographical distribution of motion pictures and filmstrips.

The following major productions were completed during 1949:

Motion pictures: (1) Concrete Ditching for Malaria Control, (2) Hand Ditching in South Carolina, (3) Epidemiology of Murine Typhus, (4) Malaria Control on Impounded Waters, (5) Topical Fluorides, (6) Topical Fluorides, Revised, (7) Construction of a Sanitary Pit Privy, (8) Collection of Adult Flies, (9) Fly Density Surveys by the Grill Method, (10) Use of Aircraft for Insect Control-Part I, Mosquito Control, and (11) The Laboratory Diagnosis of Tuberculosis-Part I, Preparation of a Culture Medium.

Filmstrips: (1) The Lung, (2) Vivax Malaria, (3) Identification of Malaria Parasites in Thick Blood Films, (4) The Lesions of Primary Syphilis, (5) Aquatic Plants Associated with Anopheles Mosquito Breeding Areas, (6) Foot-and-Mouth Disease, (7) The Liver, Part I-Composite, (8) The Liver, Part I, Chapter I, Hepatic Parenchyma and Biliary Passages, (9) The Liver, Part I, Chapter II, The Vascularization of the Liver, (10) The Liver, Part I, Chapter III, The Architecture of the Liver, (11) Constructing a Sanitary Pit Privy, (12) V.D.—T.B. Survey in Georgia, (13) Use of Aircraft for Insect Control-Part I, Mosquito Control, (14) Collection of Adult Flies, (15) The Laboratory Diagnosis of Tuberculosis-Part I, Preparation of a Culture Medium, (16) Fly Density Surveys by the Grill Method, and (17) Oral Hygiene-Toothbrush Techniques.

A large number of productions, motion pictures and filmstrips, were initiated and carried to various stages of completion. The need was established for numerous other productions which were placed on future production schedules.

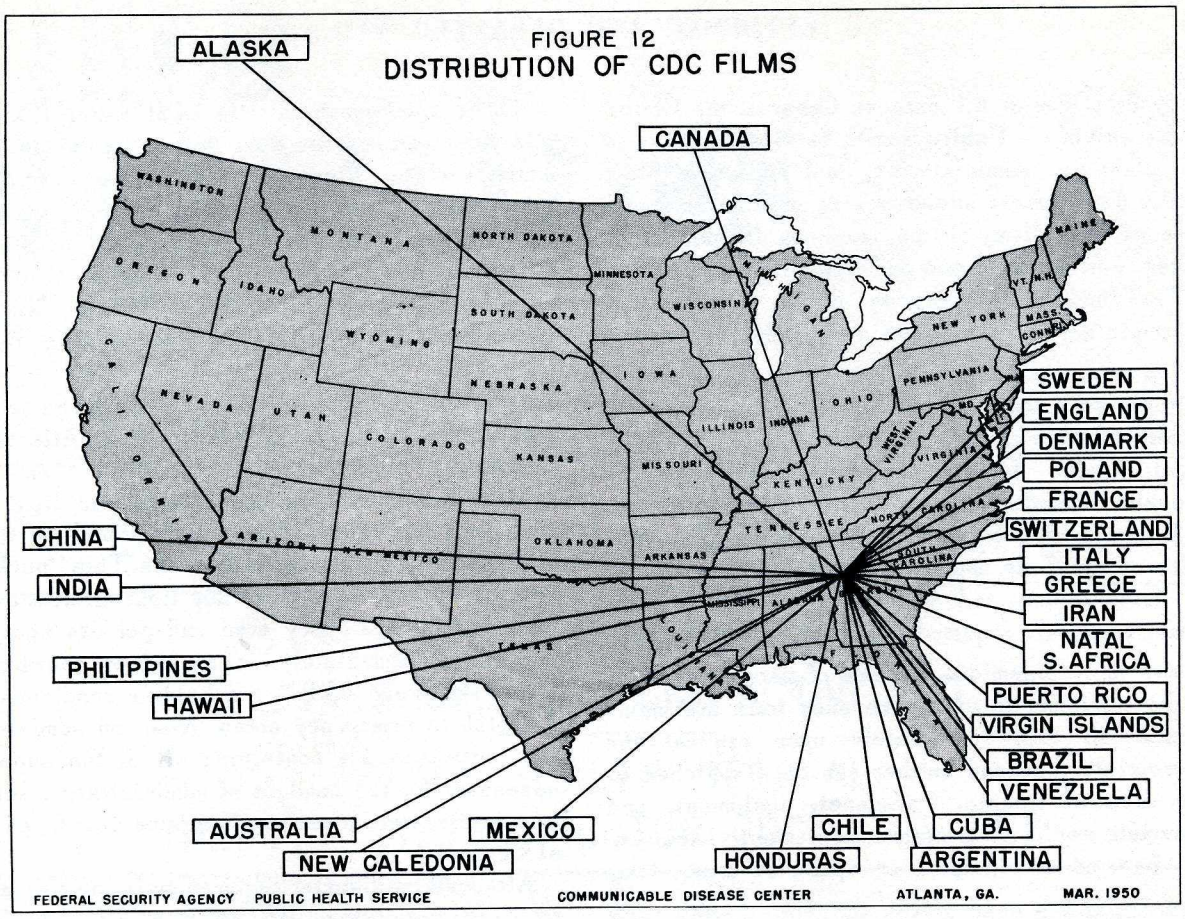
Through participation in meetings of the Interdepartmental Committee in the role of representa-

Table 12

ESTIMATES OF NUMBER OF SHOWINGS OF CENTER FILMS AND AUDIENCE SERVED BASED ON UTILIZATION REPORTS FROM THE FIELD FISCAL YEAR 1949

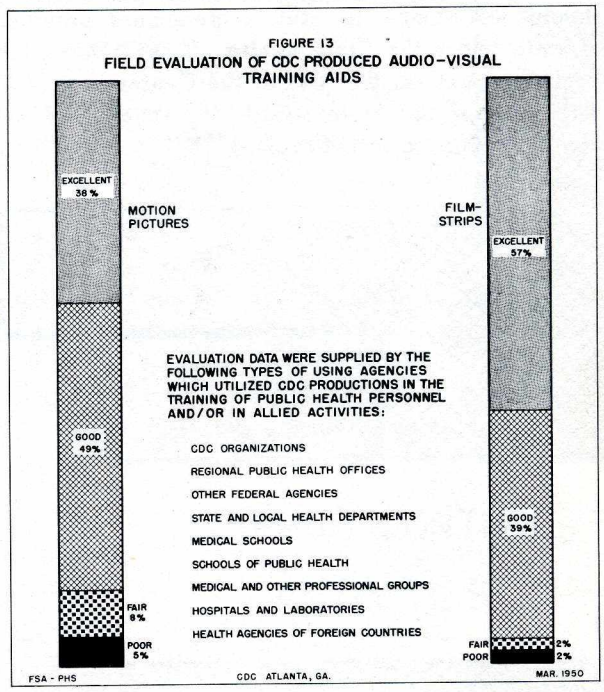
FILMS ON SHORT LOAN	Number of Prints	Estimated Showings	Estimated Audience
Motion pictures	643	975	34,125
Filmstrips	662	1,200	54,000
Total	1,305	2,175	88,125
FILMS ON INDEFINITE LOAN			
Motion pictures	1,500	10,250	358,750
Filmstrips	1,446	23,330	1,049,850
Total	2,946	33,580	1,408,600
Grand Total	4,251	35,755	1,496,725

Courtesy of the David J. Sencer CDC Museum



tive of the Public Health Service, progress was made during the year in coordinating activities of the Navy, Army, Public Health Service, and Veterans Administration with the view of eliminating duplication and overlapping in the production of audio-visual training aids. One outgrowth of this activity was the conclusion of an agreement whereby the Center and the Army Pictorial Services have undertaken jointly the production of a series of films on rodent control.

During the year a film catalog, listing motion pictures, filmstrips, and slide series available through the Center, was issued and distributed to current and potential users. A utilization guide was furnished with each film distributed as part of a continuous program to assist users in the proper utilization of audio-visual aids, and also as a means of obtaining from the field evaluation of Center productions. Figure 13, based on data obtained from reports received from the field, indicates ratings Center productions have received, types of audiences served, and progress being made in improving the quality of productions.



Courtesy of the David J. Sencer CDC Museum

EPIDEMIC AND DISASTER AID

By direction of the Surgeon General, the Center is the unit of the Public Health Service responsible for planning, administering, and rendering State health departments assistance in meeting emergencies of nonmilitary origin, such as floods, hurricanes, earthquakes, and widespread epidemics.

The fundamental purpose of the disaster and epidemic service is to provide trained and experienced personnel, supplies, equipment, and specialized services that may be necessary to supplement those available or normally procurable by State and local health departments when confronted by unusual demands.

Accordingly, the Center maintains limited stockpiles of materials and reserves of equipment, such as insecticides and portable water purification units, commonly required in coping with major disasters and epidemics. Rosters of personnel especially equipped to undertake such work are maintained so that immediately upon request the appropriate type and number can be dispatched to the area of trouble. Personnel, equipment, and materials employed in normal Center activities may be diverted to disaster or epidemic areas temporarily, if the need arises and State health officials petition the Center for aid.

When the Center supplies disaster and/or epidemic assistance to States, personnel provided operate under the State health officer making the request. That is, the role of the Center is that of supporter of the State health department and not that of assuming jurisdiction.

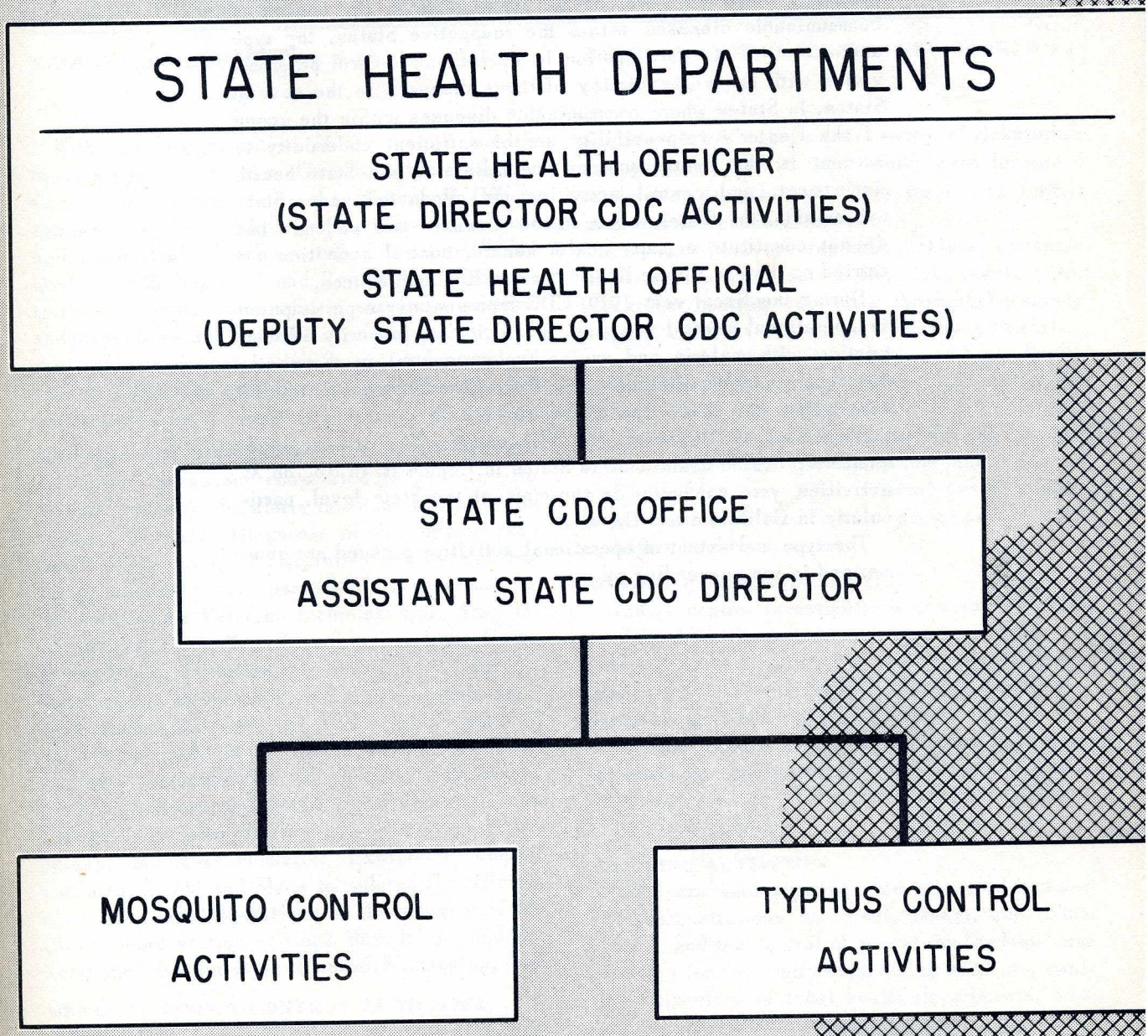
Three truck-mounted 100 GPM water filtration and chlorination units have been reconditioned and earmarked for disaster and epidemic aid. Two additional units are being prepared for this purpose. One of the units has been stationed at Kansas City, Mo., and is available upon call in that area. Other equipment is available at Atlanta, Ga., and through Regional Offices of the Public Health Service.

A motor drying unit has been acquired and is maintained in operating condition at Atlanta. A completely portable "package unit" spraying system has been developed for use in light aircraft to treat insect-infected areas, such as those accompanying floods and hurricanes. This "package unit" is readily adapted to any light aircraft available in the emergency area and permits spraying operations immediately. A reasonable number of these "package units" are held in readiness for dispatch to emergency areas. Also, an administrative activities kit containing all of the supplies necessary for the conduct of administrative activities in disaster operations has been developed and stockpiled.

Although no disaster required major participation by the Center during 1949, assistance was rendered in connection with the Northwest floods through assignment of personnel, loan of equipment, and supplies. Requests were received for assistance in dealing with poliomyelitis in North Carolina, psittacosis in Alabama, and Eastern equine encephalomyelitis in Georgia; Center personnel responded to these requests.

Courtesy of the David J. Sencer CDC Museum

FIELD ORGANIZATION



Courtesy of the David J. Sencer CDC Museum

Field Operations

Since the Communicable Disease Center is responsible for assisting State and local health departments in the control of communicable diseases within the respective States, the type and extent of its participation in operational control programs varies with the endemicity of these diseases in the several States. In States where communicable diseases within the scope of the Center's responsibility are of sufficient endemicity to warrant it, the Center assigns specialists to the State health department, and control activities are conducted under State supervision. In States where these diseases are endemic but do not constitute a major health hazard, control activities are carried on through Public Health Service Regional offices.

During the fiscal year 1949, CDC representatives participated in operational control programs in 15 States, primarily in connection with malaria and murine typhus control in the southeastern area of the United States. Regional CDC representatives cooperated with State health departments in control activities in Regions I, II, IV, V, VI, VII, VIII, and IX. The Atlanta Headquarters provided assistance to States in Region II. In Region X, activities were conducted in the main at the State level, particularly in California and Hawaii.

The type and extent of operational activities pursued are summarized in the succeeding pages.

Courtesy of the David J. Sencer CDC Museum

Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

Region I

Region II

Delaware
New Jersey
New York
Pennsylvania

REGION I HEADQUARTERS: BOSTON, MASS.

REGION II HEADQUARTERS: NEW YORK, N.Y.

With the reorganization of the Public Health Service in 1949, the Communicable Disease Center unit attached to the Region II Office assumed responsibilities for services in insect- and rodent-borne disease control in States situated in both Region I and Region II. This entailed a program encompassing extensive surveys and inspections, the formulation of training courses applicable in the respective States, and participation in technical consultations with health officials at all levels.

MALARIA AND MOSQUITO CONTROL ACTIVITIES

Regional personnel cooperated in dealing with a minor outbreak of malaria in Rhode Island in the summer of 1948. Diagnosis of the disease was confirmed by the CDC Laboratory and the epidemiology traced by CDC personnel. In response to requests by the Veterans Administration, Army installations, Coast Guard stations, and the Corps of Engineers, investigations on the possibility of local malaria transmission were inaugurated. Mosquito light traps were operated, identification of collections made in 37 locations, and evaluated findings submitted to appropriate authorities. Technical advice on mosquito control methods was extended to health officials of Pennsylvania, New Jersey, and Massachusetts. Exploratory conferences were held and plans formulated for efficient mosquito control operations in the vicinity of the Coast Guard station at Cape May, N. J., and the Veterans Administration Hospital, Wilmington, Del.

GENERAL INSECT CONTROL ACTIVITIES

A diligent search for specimens of the mite *Allodermanyssus sanguineus*, vector of rickettsialpox, produced 60 live mites which were forwarded to the Savannah Laboratory for use in further investigation of the disease.

A series of surveys and consultations, variously involving the problems of fly, tick, roach, mite, and spider control, were made throughout Regions I and II upon the request of Veterans Administration hospitals, Marine hospitals, and State health departments. Wherever feasible, demonstrations and training in control practices were included in the surveys. A model contract for pest control was formulated for use by Marine and Veterans Administration hospitals. Several health departments were assisted in testing pest control operators seeking licenses.

RODENT CONTROL ACTIVITIES

Rodent control investigations and surveys were conducted for State and local health departments, Veterans Administration, and other facilities. Findings were analyzed and appropriate recommendations submitted, including both temporary and permanent control measures. Where indicated, recommendations included training courses which were organized and conducted under the guidance of Regional personnel.

TRAINING ACTIVITIES

CDC personnel organized and presented lectures and demonstrations on plant, insect, and rodent control, and the control of insect- and rodent-borne diseases for university engineering students, sanitary inspectors of local health departments, hospital maintenance crews, and pest control operators.

Courtesy of the David J. Sencer CDC Museum

Similar courses were conducted at the New York Field Training Station, Troy, N. Y., including demonstrations in the use of insecticides and rodenticides. A series of courses in the disposal of solid wastes was given at the University of Massachusetts and to New Jersey local health department personnel.

The technical film library was used extensively and effectively in training courses and in civic educational programs.

Region III

District of Columbia
Maryland
North Carolina
Virginia
West Virginia

REGION III HEADQUARTERS: WASHINGTON, D.C.

★ North Carolina

J. R. NORTON, M.D., State Health Officer

This year, as last, Communicable Disease Center activities centered around malaria eradication through DDT residual spraying; and murine typhus control through ratproofing, rat poisoning, and DDT dusting for the control of rat ectoparasites. Expanded fly control operations were engendered by the poliomyelitis epidemic of 1948.

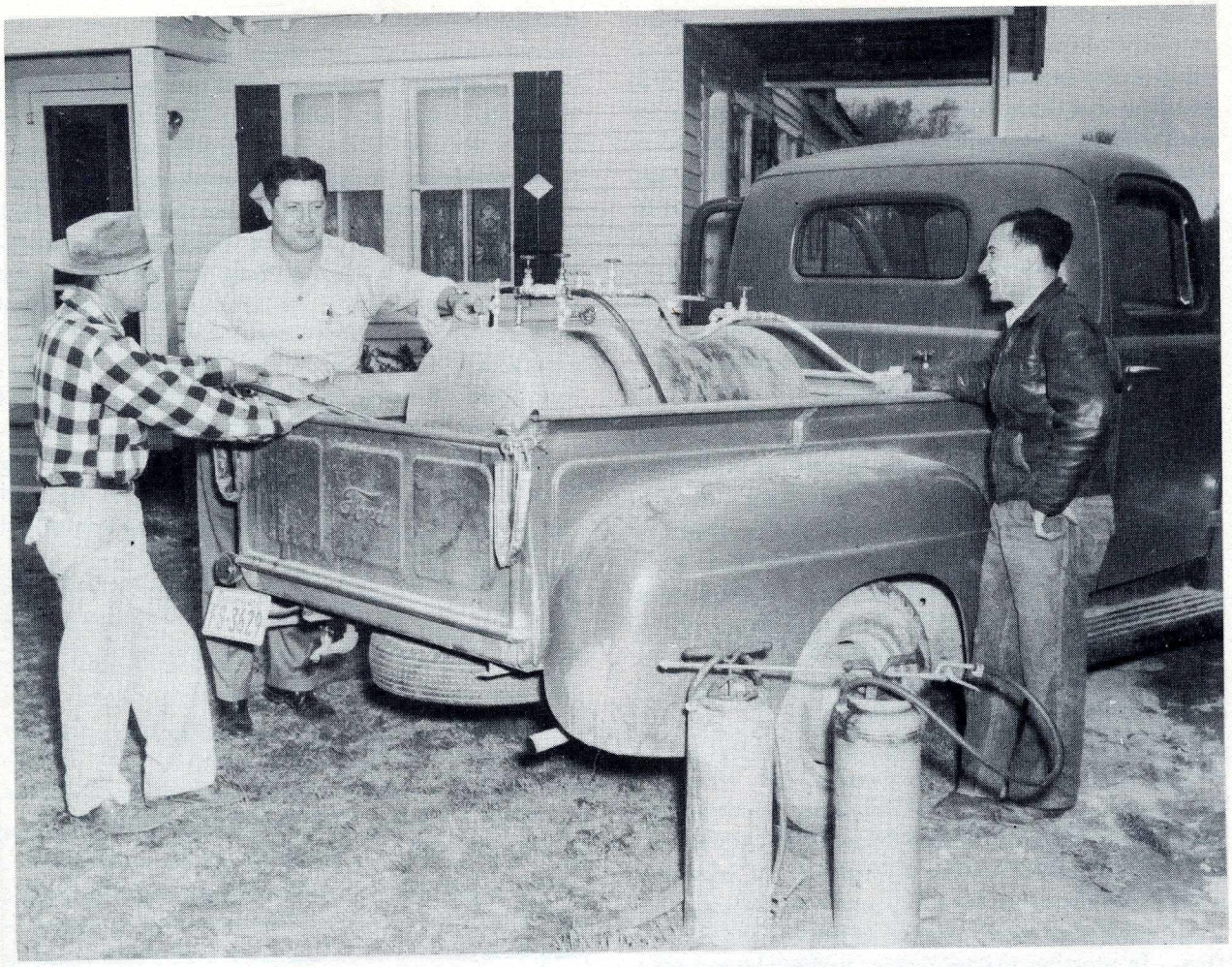
MALARIA ERADICATION

The incidence of malaria continued downward. No deaths from the disease were reported to the Division of Vital Statistics and only 103 cases were recorded by the Division of Epidemiology.

The malaria program continued to operate on a scale similar to that reported for the previous year. CDC funds were used on the residual spraying program for materials, equipment, transportation, and supervision. The localities in which the program operated paid the salaries of the laborers, maintained the equipment, provided office space and storage, and in some instances provided an incidental fund to cover minor expenses. Areas previously shown to be malarious by blood-slide surveys were given a preference in determining zones of operation. Other factors considered in the selection of areas to spray were: mortality and morbidity statistics, other epidemiological data, and the density of *A. quadrimaculatus*.

The spray crews, in the majority of cases, were composed of two men. One of these acted as working foreman. On most crews the spraying equipment consisted of an emulsion tank holding approximately 80 gallons, with hoses of 100 to 150 feet in length attached, mounted on the body of a ½-ton pick-up truck. Compressed air was supplied to the emulsion tank from a smaller air tank through a regulator valve. The compressed air in the air tank was supplied by an air compressor mounted on the motor of the truck. This equipment increased the ease and efficiency of operation considerably. While comparative statistics have not been compiled, it is believed that a two-man crew, on the average, sprayed four or five houses more per day than two men would have sprayed with the hand spray can formerly used. The cost of equipping the trucks with the sprayers was borne locally.

Courtesy of the David J. Sencer CDC Museum



A typical self-contained mobile unit utilized in residual spraying activities. A compressor attached to the motor of the truck provides compressed air which is supplied to the emulsion tank at the desired pressure through a regulator valve.

The construction of fish ponds continued on a large scale. These ponds are regarded as an important future malaria hazard. The State board of health has regulations requiring that they be constructed and maintained in such a manner as not to be favorable for *A. quadrimaculatus* breeding. In most instances, they are being constructed properly and maintained in a satisfactory manner. The volume of construction and the scattered locations make adequate inspection practically impossible. On the drainage program, 98,606 acres of water surface were drained and 72 acres eliminated by filling. A recent check of the records showed that the ponds being inspected by the North Carolina State Board of Health have a combined area of 18,459 acres, or 18.8 percent of the surface eliminated by draining and filling. This potential breeding area is increasing monthly.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating			35
Number of spray applications			87,141
Pounds of DDT used			81,698
Total man-hours expended	CDC	9,246	82,118
	Local	72,872	
Man-hour per application			0.94
Man-hours per pound of DDT			1.01
Pounds of DDT per application			0.94

*Data are from progress reports submitted to CDC Engineering Services by State health department.

FLY CONTROL

During the first quarter of the fiscal year, a large increase in fly control activities took place.

Courtesy of the David J. Sencer CDC Museum

This was attributed partly to the epidemic of poliomyelitis which was widespread in the State at that time. Technical supervision for the fly control program was furnished by the State office, as far as facilities would permit. Other expenses were borne locally. The State board of health purchased DDT concentrate in large amounts and resold it to local health departments at actual cost in order to give further assistance to fly control activities. Five local health departments purchased one or more sprayers, similar to the one described above, for use in fly control. Space spray equipment also was used in a number of localities.

TYPHUS CONTROL

Ratproofing activities were carried on in cooperation with CDC Activities of the North Carolina State Board of Health, local health departments, and municipal governments. Ordinances were adopted and funds were appropriated for employing supervisors and secretaries. In most cases, office and storage space was furnished by the local health departments. The cities provided a revolving fund or underwrote the program for the purpose of carrying on the ratproofing work. Central workshops, provided by the city governments, were set up for the purpose of prefabricating construction materials to be used on buildings to be ratproofed. The State board of health, through CDCA, provided a trained supervisor for the purpose of training the local supervisor in all phases of ratproofing activities. In starting the programs, surveys were conducted of the business establishments in each town, and estimates were submitted to the property owners for the purpose of getting agreements signed to carry on the ratproofing work. Of course the property owner has the privilege of employing a local contractor to do this work if he so desires, under the supervision of the director of the local typhus control program. A trained crew of carpenters, furnished by the cities, completed the actual ratproofing of the buildings, and bills were then submitted to the property owners in order that city funds could be reimbursed. Automotive equipment and other supplies were furnished by the State board of health, through CDCA. These supplies consisted of trucks, metal bending brakes, wheelbarrows, shovels, picks, ladders, and other equipment. The technical supervision of a sanitary engineer and a senior sanitarian was furnished by the State board of health. The results obtained through ratproofing were very effective.

DDT dusting operations were carried on in cooperation with the State board of health, local health departments, and municipal governments. The towns furnished foremen and laborers for distributing DDT dust and poisons. The State board of health, through CDCA, furnished the dust, automotive equipment, equipment for distributing dust, 1080, one laborer, and one area supervisor for each program. The State board of health furnished technical supervision for all dusting activities. All towns where dusting activities were conducted were completely covered with 10 percent DDT dust during this dusting season. The results obtained were very effective and met with the approval of the local officials and health departments. Evaluation activities consisting of bleeding and combing of rats trapped in each town were carried on, and this work proved that the DDT dusting controlled the ectoparasites on the rats.

Rat-poisoning activities were also carried on in connection with the dusting. The towns furnished all red squill and ingredients for the pre-

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)			
Number of counties reporting			10
Number of premises dusted			36,737
Pounds of DDT per premises			1.5
Man-hour per premises			0.2
Ratproofing**			
Number of projects reporting			7
Number of establishments ratproofed			1,011
Man-hours per establishment			45
Rat Reduction***			
Number of counties reporting			9
Number of establishments poisoned (poison bait - food)			23,785
Man-hour per establishment			0.5
Number of establishments poisoned (poisoned water - 1080)			657
Man-hours per establishment			2.3
Evaluation Activities			
Man-hours expended			3,119
Total man-hours expended (all activities)	CDC	15,528	88,093
	Other	70,565	

*Data are from progress reports submitted to CDC Engineering Services by State health department.

**904 man-hours maintenance; 6,693 initial eradication.

***1,102 pounds cyanogas at expenditure of 2,176 man-hours.

Courtesy of the David J. Sencer CDC Museum

pared bait. Cyano "A" dust was furnished by the local officials, and 1080 was furnished by the State board of health through CDCA. Close supervision of the 1080 poisoning activities was given by area supervisors.

In connection with the over-all program in North Carolina, poisoning campaigns were conducted in 16 towns. Supervision of the preparation and distribution of the poison bait was furnished by the State board of health and sanitarians from the local health departments.

There has been a definite downward trend in the number of cases of murine typhus fever reported to the North Carolina State Board of Health from the towns where ratproofing and dusting projects have been in operation. The ratio of local funds to CDC funds during 1948-49 was approximately five to one.

★ Virginia

L. J. ROPER, M.D., State Health Officer

Official status and equal recognition were given insect and rodent control work during the fiscal year by the creation of the Bureau of Insect and Rodent Control in the Division of Engineering of the Virginia Health Department. Working through local health organizations, the Bureau conducts surveys, makes appropriate recommendations, directs control operations, and where necessary assists in the setting up of operational programs.

MOSQUITO CONTROL

Mosquito control districts are provided for by State statute, which authorizes the State health department to contribute up to 25 percent of the funds expended for mosquito control by the respective districts. One new district was created during the year, bringing the total number of operating districts to 12. The State legislature appropriated $75,000 for allocation among these districts. Mosquito control projects were operated in five communities outside of the special districts. Pest mosquito control operations were carried on in connection with four Federal public housing projects, on a reimbursable basis.

Mosquito identification, both adults and larvae, were made by a consulting entomologist of the State health department. Findings indicate little evidence of locally transmitted malaria.

On a number of occasions assistance was given Army and Navy authorities in the direction of mosquito control within their respective installations. Work around permanent military establishments consisted mostly of surveillance, though considerable larviciding in these areas was handled by local malaria control districts.

Nine communities, in response to requests, were surveyed during the year and recommendations for mosquito control submitted. Six of the nine already have acted to implement the submitted recommendations.

FLY CONTROL

While Virginia health authorities for years have promoted good sanitation as a means of fly control, public interest in community fly control is a recent development. Fly surveys were made in three

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)			
Number of counties reporting			4
Number of premises dusted			7,511
Pounds of DDT per premises			2
Man-hour per premises			0.4
Ratproofing			
Number of projects reporting			–
Number of establishments ratproofed			–
Man-hours per establishment			–
Rat Reduction			
Number of counties reporting			1
Number of establishments poisoned (poison bait – food)			4
Man-hours per establishment			10
Number of establishments poisoned (poisoned water – 1080)			–
Man-hours per establishment			–
Evaluation Activities			
Man-hours expended			5,613
Total man-hours expended (all activities)	CDC	4,628	
	Other	5,547	10,175

*Data are from progress reports submitted to CDC Engineering Services by State health department.

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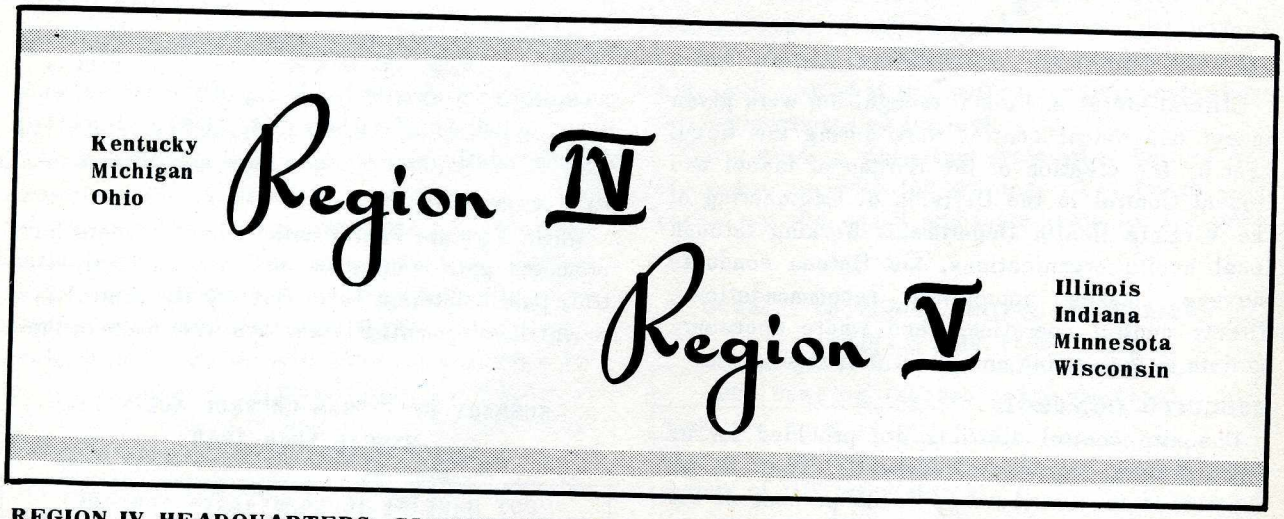
cities and educational campaigns cosponsored by civic organizations were conducted in two other cities. In order to better pursue such activities, key personnel of CDCA in Virginia attended a special fly control course conducted in Atlanta.

RODENT CONTROL

In two cities where murine typhus is a public health problem, DDT dusting and rat blood and ectoparasite surveys were conducted in cooperation with local health departments. CDC furnished DDT dust, general supervision, and a motor vehicle; local units furnished labor for dusting and trapping, direct supervision, and general transportation. Operations were confined to the immediate areas of recently reported typhus cases or where surveys revealed a concentration of positive rat bloods. The absence of new human cases of typhus indicated success of these operations.

Richmond, Norfolk, and Roanoke carried on limited ratproofing operations in accordance with rat control ordinances. Rat surveys were conducted in five communities during the year. Wide distribution was given to a rat control bulletin prepared by CDCA personnel.



REGION IV HEADQUARTERS: CLEVELAND, OHIO **REGION V HEADQUARTERS: CHICAGO, ILL.**

The activities of the Communicable Disease Center are centered in one of three sections in the Sanitary Engineering Division of the Regional Office. The entire office was consolidated with the Federal Security Agency Office and moved into new quarters February 25, 1949.

CDC representatives are assigned to the Regional Office by the CDC Headquarters in Atlanta. The permanent office staff of the CDC Section consists of one senior sanitary engineer and one sanitarian (entomologist).

With the consolidation of the Public Health Service offices into the Federal Security Agency Regional Office, a new office was established in Cleveland covering the States of Michigan, Ohio, and Kentucky. At the same time, Minnesota was removed from the jurisdiction of the Regional Office in Kansas City and transferred to the Region V Office in Chicago. The transfer of Minnesota to Region V and the establishment of the Cleveland Office took place toward the close of the calendar year. The CDC Section of this office, however, continues to serve as regional CDC representative for both Regions IV and V, under an agreement with the Headquarters Office in Atlanta and the Cleveland Regional Office. All CDC requests for both Regions are channeled into the Chicago Office for handling. The operation is the same as it has been for the past several years with the exception that correspondence for Michigan, Ohio, and Kentucky is received and answered through the Cleveland Regional Office.

The seven States served by the CDC Section are considered in the marginal area insofar as CDC operational activities are concerned. That is, most of the activities are consultative and promotional since there are only two operating projects in both Regions. One of these is the malaria control project located at Paducah, Ky., and the other is the fly control project in

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Muskegon, Mich.

The activities of CDC regional representatives are laid down in accordance with established policies of the CDC in Atlanta as follows: (1) technical consultation and promotional assistance on insect and rodent control; (2) fly control program; (3) disaster aid; (4) participation in State-local training activities; (5) general consultation and promotional activities to States in insect and rodent control; (6) insect and rodent control assistance to Federal agencies and institutions; (7) miscellaneous assistance to Public Health Service activities.

As part of the activities of the Regional CDC Office, close contact is maintained with the two operating projects.

MUSKEGON FLY CONTROL PROJECT

This project was started as part of a national experimental program. Actual operations started on August 1, 1948, when an entomologist was assigned to Muskegon. After his arrival, six entomological inspectors were hired, whose work consisted of making block by block inspections and fly counts, and in trapping flies with baited traps. An area inspector was assigned to Muskegon in January 1949 and started work on a block by block sanitary survey of the area. In April 1949, an inspector and two engineering aids were hired, and by June five inspectors were on duty.

Four large-type spraying machines, both mist and fog, were acquired for spraying operations. Spraying started on a limited scale the first part of May and consisted of regular treatment of dumps and low-class residential blocks. Since actual control operations were started toward the close of the fiscal year, no evaluation of the results are available at this time.

MALARIA CONTROL PROGRAM IN KENTUCKY

The residual spray program was similar to the one conducted during the past several years. The policy at the beginning of this season was to give each property owner the fullest benefit of the residual spray program by treating the entire premises. A fee system was used by which each premises was treated for a minimum of $3 which included the spraying of residences and three outbuildings. The fees collected, which are State funds, are supervised by the County and are used for hiring labor in connection with spraying activities. Approximately 13,000 premises were treated of which 2,654 were second applications to houses that were treated prior to July 1, 1948.

In addition to the residual spray program in the State, consultative and advisory services also were furnished. A total of 98 inspections was made around the various governmental installations.

Prior to and during the regular spraying program in Kentucky, approximately 21,000 circulars explaining the importance of the residual spraying program and how each property owner could help in the control of flies were distributed to schools, county officials, and homes. From time to time spot radio announcements were made over the Paducah radio stations, supplemented with newspaper articles to keep the public fully informed of the importance and value of the program. Close liaison was maintained with the Tennessee Valley Authority in Kentucky and with the Corps of Engineers. The State contributed 50 percent of the total cost of the CDC operations in Kentucky.

At the request of CDC headquarters, the CDC engineer proceeded to Washington to conduct a demonstration of mobile equipment at the 150th anniversary of the Public Health Service.

Close liaison was maintained with the pest control operators group, both on a national and local level. In conformance with the recommendations of the Chicago-Cook County survey, and at the request of the city health department, CDC undertook to assist the city of Chicago in adopting and enforcing a rodent control program. Personnel from Atlanta were detailed to assist in conducting a series of training schools in rodent control for city-employed personnel. As part of this program, arrangements were made to furnish consultant services to the mayor's committee on clean-up, and a temporary CDC rodent control specialist was assigned to the city of Chicago. The activities of this specialist consisted of instructing health department personnel in recognition of rodent infestation and furnishing recommendations for correction. Approximately 40 members of the health department staff have been trained. Upon completion of the program with the health department, additional training will be furnished inspectors in the Housing Bureau and other city departments as necessary. In addition, a rodent control specialist from Atlanta spent about 5 weeks in Chicago assisting the Regional Office in trying to coordinate the various city departments in their rodent control activities,

At the request of the Chicago-Cook County Survey Committee, and the county health departments, a rodent control exhibit was prepared for presenta-

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tion at the county fair. A series of exhibits with live rats and posters was displayed for the duration of the fair.

Fly control activities throughout the Region increased over the previous year. More and more communities requested literature and consultative services helpful in organizing community-wide fly control programs. Assistance was given to the city of Gary, Ind., in drawing up a bill for presentation to the legislature to enable communities to form mosquito and fly abatement districts. An enabling act was drawn up in a conference with officials of the city of Gary and presented to the attorney general for necessary action.

A resurvey and inspection was made of the fly control program at Mackinac Island. This is a rather unique area in that no mechanized equipment is allowed on the island, and all the transportation is furnished by horse and buggy, creating a considerable fly problem during the summer months. Recommendations were furnished to increase the efficiency of control efforts.

The CDC Section conducted the Schedules D-12 and D-20 of the Program Review covering insect and rodent control, and garbage. In accordance with existing agreements with the Bureau of Prisons and the Hospital Division of the Service, sanitary surveys on insect control, rodent control, and garbage were made at all of the Federal prisons and Marine hospitals in Regions IV and V. In accordance with this policy, a demonstration with a representative of the Bureau of Prisons from Washington was made at Chillicothe, Ohio, on the use of one of the newer insecticides.

In line with the Service policy of furnishing sanitation services to the U. S. Coast Guard, close liaison was made with the headquarters of the Ninth Naval District at Cleveland. Several meetings were held outlining policies and procedures, and a demonstration was given at a meeting of all key personnel. Several inspections were made at Coast Guard installations and detailed reports and instructions furnished for distribution to all of the approximately 200 installations in the District.

A considerable amount of time was spent in assisting the Milwaukee County survey in the preparation of insect control, rodent control, and refuse collection disposal reports.

★ Kentucky

BRUCE UNDERWOOD, M.D., State Health Officer

Malaria control through the application of DDT residual spray to premises in an 11-county sector in the southwestern corner of the State, known as the Purchase Area, comprised major CDC activities in Kentucky during the fiscal year 1949. This sector is bordered on the south by Tennessee, on the west and north by the Ohio River, and on the east by counties adjacent to the Kentucky Reservoir.

RESIDUAL SPRAY ACTIVITIES

Spraying was practiced on a premises basis. The interior of houses was treated with 5 percent DDT emulsion at the rate of 200 milligrams per square foot. Rosin was added in treating exterior surfaces, in accordance with recent findings that the introduction of rosin as a sticking agent extends the effective period of residual spray exposed to the elements. Barns housing dairy animals were not sprayed on the inside, in keeping with current precautions against the possibility of DDT contamination of milk. The addition of the sticking agent and adoption of premises treatment were designed to improve the degree of concurrent fly control resulting from the malaria program.

Householders were charged a fee of $3, which included the dwelling and a maximum of three outbuildings. Funds from this charge were used to defray the costs of spray crews and contact men. Contact men inspected each dwelling treated with respect to general sanitary conditions which afforded valuable guidance in the handling of complaints about the ineffectiveness of the spray.

Standardized spray trucks, equipped with pressure tanks, and Hudson Perfection spray cans, modified by the installation of a Shraeder valve, were used in all spray operations. DDT concentrate was mixed at the central plant. A paddle-type mixer was improvised which proved satisfactory in the handling of the sticking agent and reduced time and labor consumed in mixing. Spray

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trucks were equipped with 55-gallon drums filled with water for diluting the concentrate in the field.

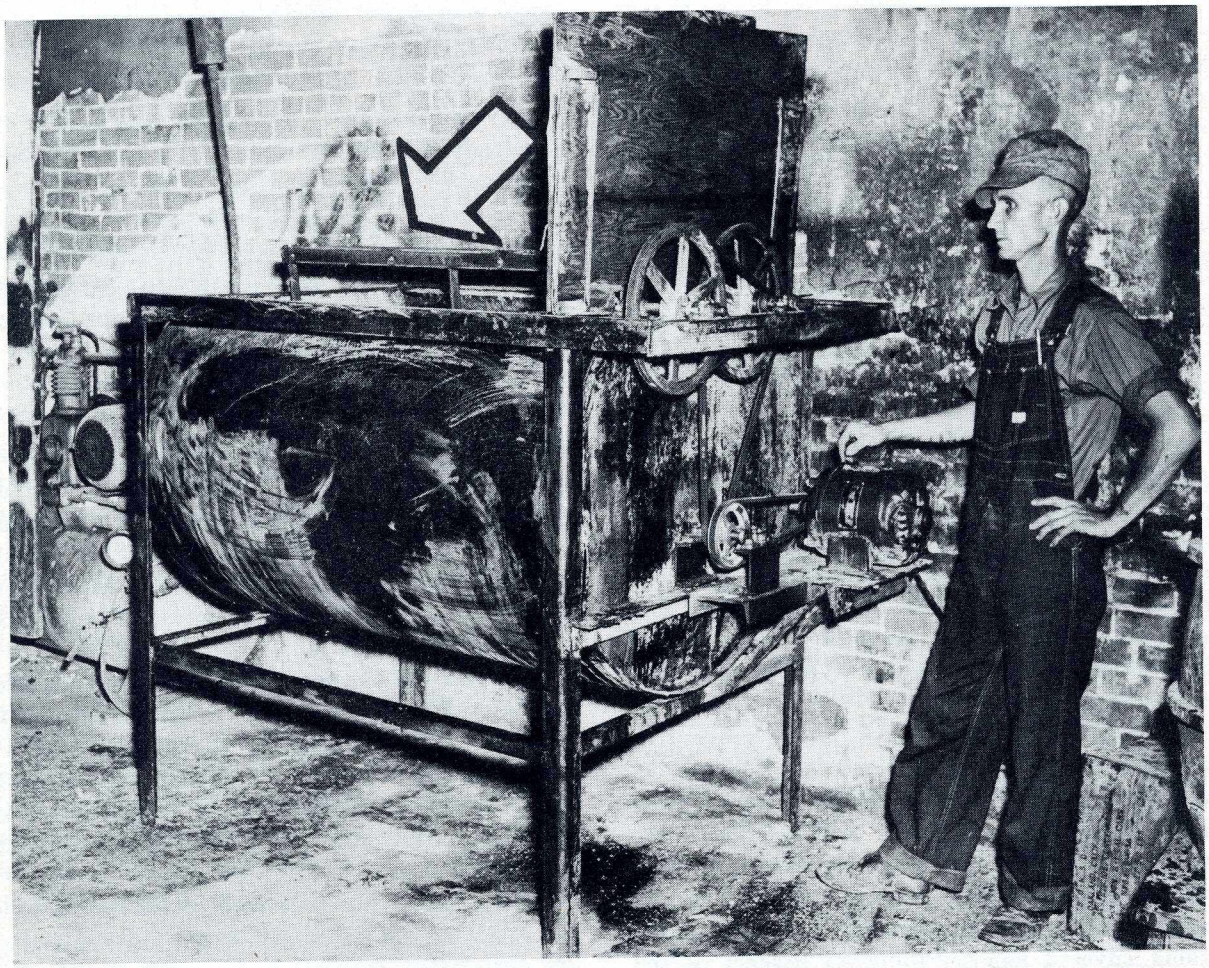
In anticipation of complaints about the lack of fly control by the residual spray, contact men were instructed to explain to citizens the importance of keeping their premises clean. In addition, radio and newspaper publicity was employed to keep the public aware of the necessity of practicing general sanitation as a means of insect control.

By the end of June, 136 complaints of low fly kill had been received. It was decided that respraying would be done only where necessary and that investigation of complaints would be made to determine the necessity of respraying. Since the fly kit developed by Technical Development Services was not available, it was necessary to improvise equipment and procedures adaptable to the situation at hand and personnel available. This was done, and 55 premises were tested for effectiveness of the spray in fly control by the end of June. Essentially, tests employed consisted of exposing flies (caught for the purpose) to sprayed surfaces and observing the results.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating			11
Number of spray applications			12,726
Pounds of DDT used			30,736
Total man-hours expended	CDC	5,296	47,368
	Local	42,072	
Man-hours per application			3.72
Man-hours per pound of DDT			1.54
Pounds of DDT per application			2.42

*Data are from progress reports submitted to CDC Engineering Services by State health department.



A paddle-type mixer, consisting of four paddles welded to a revolving shaft in a cylindrical tank, was devised to facilitate the blending of the DDT plus rosin formulation. Considerable saving in time and labor resulted from the change to this type of mixer.

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Besides savings that accrued through confining respray operations to premises where the original spray actually was ineffective, this testing program was of great value in demonstrating to home owners that usually the spray was effective and that further reduction in the fly population depended upon alertness of home owners in environmental sanitation.

OTHER ACTIVITIES

Malaria surveillance inspections (98) were made around nine establishments in Kentucky: Nichols Veterans Administration Hospital, Louisville; Army Medical Depot, Louisville; Fort Knox; Camp Breckinridge; Camp Campbell; Lexington Signal Depot; Veterans Administration Hospital, Fort Thomas; Outwood Veterans Administration Hospital, Dawson Springs; Bluegrass Ordnance Works, Richmond.

Although no organized typhus control activities were conducted by CDCA during the year, several conferences were held with officials in Bowling Green relative to the desirability of typhus control there. However, Bowling Green officials declined to appropriate funds for a control program despite the fact that this city is the principal typhus focus in Kentucky.

The State health department has initiated plans to incorporate into its program trained insect and rodent control personnel, and it is contemplated that this type of activity will be enlarged in the near future.

Region VI

Alabama
Florida
Georgia
Mississippi
South Carolina
Tennessee
Puerto Rico
Virgin Islands

REGION VI HEADQUARTERS: ATLANTA, GA.

Cooperative malaria and murine typhus control programs were carried on in each of the States comprising the Region, as in previous years. An engineer and an entomologist assigned to the Regional Office provided consultative services and served as coordinators of State-operated programs. The engineer was assigned to the Regional Office 6 months of the fiscal year and the entomologist 9 months.

The malaria control program in the respective States conformed to the pattern in effect during the past few years. DDT residual spraying was practiced in the rural areas and smaller towns (in malarious sections). In some of the cities a more permanent type of control program, such as drainage and filling, was conducted. Local contributions covered approximately 45 percent of the total costs of malaria control operations.

The number of cases of malaria reported to the respective State health departments continued to decline during 1949, indicating that the residual spray program was effective against the principal malaria vector, *A. quadrimaculatus*. Evaluation records of inspections made in the treated areas show 96 percent of sprayed houses free of "quads" at the time of inspection.

Seventy-six counties in the six States included in Region VI were approved for typhus control for 1949, each having reported 10 or more cases of typhus during the year 1946-47. The number of reported cases continued to decline during 1949, indicating a decrease in approved counties for the succeeding season.

Control activities consisted of DDT dusting of rat runs for ectoparasite control, rat poisoning, and ratproofing. Operations were carried on in many counties not on the approved list. Inspections showed rats relatively free of ectoparasites 6

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months after DDT dusting, confirming the thesis that one dusting per year is effective if applied properly and at the right season.

In rat poisoning, 1080 was employed in business districts, and red squill in residential areas.

Technical supervision and consultation services were furnished State and local health units by Regional CDC personnel.

★ Alabama

D. G. GILL, M.D., State Health Officer

Operational activities during 1949 centered around DDT residual spraying for malaria control in 31 counties, and murine typhus control through DDT dusting and rat reduction in 20 counties. Entomological surveillance was maintained in the vicinity of four active military installations, and limited ditch cleaning and maintenance practiced around Maxwell Field and Gunter Field, near Montgomery. The CDC engineer supervised locally financed drainage operations in Colbert County.

DDT RESIDUAL SPRAYING

Accumulated evidence indicates that the basic aim of the residual spray program, elimination of malaria, is being accomplished. However, the public is interested also in the control of household pests, particularly flies, and tends to measure the success or failure of the spray program in terms of its effect on the population of flies. Recognizing the practical import of this public reaction, in planning spray operations in the pre-approved counties, local officials were offered certain aid on condition that they provide sufficient funds to cover premises spraying on a county-wide basis. Thirteen counties elected to participate on the proposed basis. Eighteen counties declined the offer, and spraying was confined to the malarious areas in those counties. Areas treated were determined through consultation with local health officials and studies of morbidity, mortality, and entomological data. Urban areas were not included in CDC-supported spray operations, but assistance in the form of technical supervision and training for crewmen was provided municipalities undertaking spray programs on their own.

Five counties provided funds for a second treatment of houses during the 1948 insect season despite recommendations of health officials that one treatment was sufficient. Little, if any, better fly control was obtained in these five counties than in the single-treatment counties.

In the 13 counties accepting the county-wide premises spray program, 1949 season operations were started with optimism. The previous year's spray program had been more or less a failure in the eyes of the public because it failed to rid many houses of flies. The extension of spraying to entire premises was requested by the public in the hope that it would bring relief from flies. Unfortunately for the spray program, the mild winter and other factors caused a tremendous increase in the early fly population; and at the end of the fiscal year, large numbers of flies were present in many sprayed houses. Although few formal complaints were registered, the general public attitude prevails that DDT is of little value. However, inspections of sprayed and unsprayed sections indicated a definite degree of fly control by the spraying program.

For administrative and supervisory purposes, the spray program was set up under nine area headquarters. Other than 25,000 gallons of 25 percent concentrate on hand at the beginning of the season, DDT used by CDC crews was mixed in the State. Rosin was added in spray applied to outside surfaces. All spray trucks were equipped with compressors and air tanks. Hudson 310 G spray cans, converted for use with air tanks, were

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating			31
Number of spray applications			122,070
Pounds of DDT used			153,595
Total man-hours expended	CDC	118,216	163,606
	Local	45,370	
Man-hours per application			1.34
Man-hours per pound of DDT			1.07
Pounds of DDT per application			1.25

*Data are from progress reports submitted to CDC Engineering Services by State health department.

Courtesy of the David J. Sencer CDC Museum

standard equipment.

TYPHUS CONTROL

Activities in connection with the CDC typhus control program were conducted during 1949 in 20 counties. County-wide programs were carried on in Mobile, Covington, Pike, Dale, Houston, and Henry Counties. Operations in the other counties were determined on the basis of typhus incidence. In 48 cities of 12 counties, DDT dust was applied (one or more times) and poison bait material distributed.

Table 13 summarizes typhus control activities 1946-49 by years. It shows that whereas the number of premises inspected increased materially in 1949, premises treated, amount of DDT used, arsenic water, and man-hours expended varied little from the 1948 level.

Figure 14 shows reported typhus cases 1943-49. Although no marked decrease in reported cases was indicated through June 30, 1949, a great number of these reported cases were not from the previously recognized typhus area.

Table 13

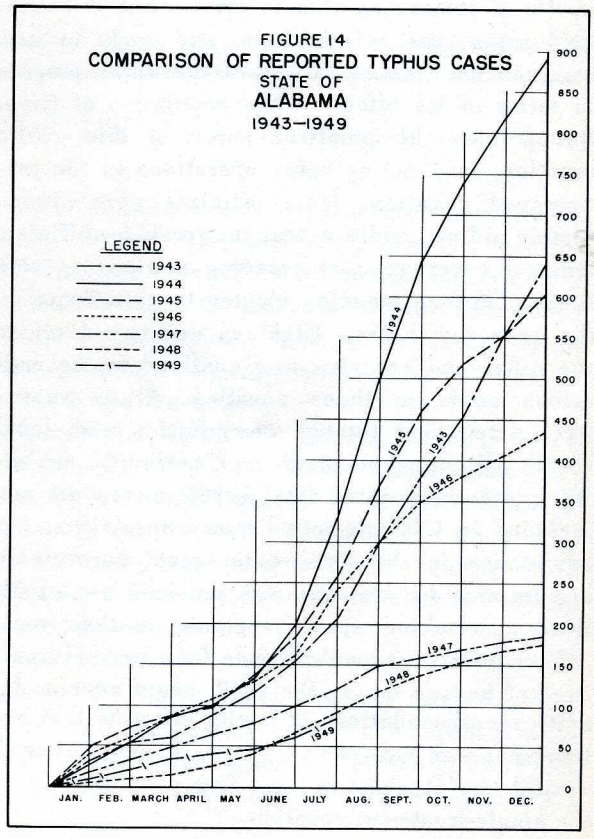
SUMMARY OF TYPHUS CONTROL ACTIVITIES 1946-49

Year	Premises Inspected	Premises Treated	DDT Pounds	Poison Bait Pounds	Arsenic Water Pints	Cyanogas Pounds	Total Man-hours
1946	56,312	33,747	145,112	29,923	20,760	7,301	93,649
1947	78,649	58,199	205,786	44,396	20,833	7,177	93,385
1948	103,769	87,430	413,624	52,286	29,952	8,468	95,155
1949	196,365	81,670	406,489	32,022	27,654	13,267	93,103

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		20
Number of premises dusted		81,670
Pounds of DDT per premises		5
Man-hour per premises		0.5
Ratproofing**		
Number of projects reporting		-
Number of establishments ratproofed		-
Man-hours per establishment		-
Rat Reduction***		
Number of counties reporting		10
Number of establishments poisoned (poison bait - food)		55,222
Man-hours per establishment		0.4
Number of establishments poisoned (poisoned water - arsenic)		15,411
Man-hour per establishment		0.4
Evaluation Activities		
Man-hours expended		11,401
Total man-hours expended (all activities)	CDC 33,319 Other 56,708	90,027

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**204 man-hours on maintenance.
***13,267 pounds of cyanogas used at expenditure of 9,104 man-hours.



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★ Florida

WILSON T. SOWDER, M.D., State Health Officer

Communicable Disease Center activities in Florida were carried on under the supervision of the Division of Entomology, Bureau of Sanitary Engineering, and embraced malaria and murine typhus control operations. Local units contributed 38 percent of the total costs of operational programs. The closest coordination with local health units was practiced with technical advice provided by CDC personnel at district and State levels.

RESIDUAL SPRAYING FOR MALARIA CONTROL

During the first half of the fiscal year, 7½ percent DDT emulsion was applied to unscreened or only partly screened houses. Operations under this policy covered 15 counties and resulted in the spraying of 12,536 of 13,954 houses inspected. During the last half of the year, spraying included outbuildings as well as houses. Emphasis was placed on spraying the interiors of outbuildings since no adhesive agent was added, and the strength was reduced from 7½ percent to 5 percent DDT. County-wide spraying was conducted in 22 counties and limited operations were carried on in 8 other counties.

Evaluation inspections showed 97.2 percent of 625 unscreened or poorly screened houses inspected were free of "quads." In houses not sprayed, only 82 percent were free of "quads." Concurrent fly control apparently was less satisfactory than in previous years.

Anopheles albimanus surveillance in the Florida Keys and the southern mainland continued during the year. Adults were taken at three locations on the Keys. Larvae were collected in a restricted area on Big Pine Key. Of 314,969 specimens collected, 622 adults and 89 larvae were identified as *A. albimanus*. No increase in malaria could be attributed to this species. However, laboratory findings show a colony established from specimens taken in this area are capable of transmitting one strain of *Plasmodium falciparum*.

Other activities included evaluation of certain equipment as a space control of adult mosquitoes, biological studies of *Mansonia* spp., a cooperative investigation of sand fly *(Culicoides)* biology and control, and inspections of water impoundments. During this period, 2,447,185 larvae and adult mosquitoes were identified and reported, in addition to 12 species of *Culicoides* from light-trap collections in 15 counties.

The Key West program to control *Aedes aegypti* mosquitoes was continued with emphasis on the elimination of breeding places. CDC participated to the extent of the loan of a vehicle. Of 18,219 wells and cisterns inspected, 45 wells were filled.

SUMMARY OF RESIDUAL SPRAY OPERATIONS
Fiscal YEAR 1949*

Number of counties participating		30
Number of spray applications		49,335
Pounds of DDT used		70,555
Total man-hours expended	CDC 12,446 Local 53,991	66,437
Man-hours per application		1.34
Man-hour per pound of DDT		0.94
Pounds of DDT per application		1.43

*Data are from progress reports submitted to CDC Engineering services by State health department.

TYPHUS CONTROL

No hard and fast pattern was followed in typhus control operations. Because of a reduction in funds, efforts were made to introduce modifications offering greater coverage at less cost. In pursuit of this objective, the following changes were adopted: (1) premises were dusted one time instead of twice as previously, (2) both typhus and malaria control projects were assigned to a single supervisor, (3) malaria control residual spraying and typhus control dusting were combined in the rural areas of three counties, and (4) the amount of evaluation trapping was reduced. These changes permitted expansion of the dusting program to include additional territory in the old projects and its extension to four new counties.

Control activities were carried on in nine counties. Dusting projects were operated in eight counties: Dade, Escambia, Hillsborough, Pinellas, Gadsden, Jackson, Madison, and Washington. Premises dustings for the fiscal year were 4,277 less than the 1948 total. However, since premises were dusted twice during 1948 and only once during 1949, the number of premises covered was much larger in 1949.

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In St. Augustine, St. Johns County, DDT residual spraying (5 percent DDT) was conducted on an experimental basis for rat ectoparasite control in lieu of DDT dusting. Particular attention was given to good coverage in attics, on sills, underneath buildings, and other rat harborages. One application was made to 271 premises. The prespraying *X. cheopis* index was 9.5 and the percentage of rat bloods found positive, 44.7. The postspraying *X. cheopis* index was 0.65 (199 rats from sprayed premises) and 5.04 for unsprayed premises (249 rats). The positive blood comparison was 20.7 percent in sprayed and 26.1 in unsprayed territory.

Spraying was started August 9 and completed September 3, 1948. By June 1949 the residual effect of the spray apparently had been materially dissipated, since the *X. cheopis* index rose precipitably.

Results of the experiment indicate that the initial degree of control from residual spraying is about the same as from dusting, but dusting appears to give control over a longer period. Moreover, spraying proved more expensive than dusting, particularly in terms of man-hours. Adherence to dusting as a means of rat ectoparasite control is indicated.

In three counties (Jackson, Madison, and Washington) a combined county-wide residual spraying and dusting program was conducted. Crews, usually consisting of one laborer for dusting, two for spraying, a contact man, and a foreman in charge of both activities, were transported in a single vehicle. When spraying was completed ahead of dusting, the spray crew assisted with the dusting and vice versa. Projects were operated in rural sections only. Residual spraying covered 5,011 premises and dusting 4,693. In Jackson County 280 more premises were dusted than were sprayed, while in Madison and Washington Counties the number sprayed exceeded those dusted by 598. The over-all cost of the combined operations approximated $5.24 per premises. A break-down of operational cost is shown in table 14.

The results of this limited operation indicate that if competently staffed, the combined procedure offers a method of treating rural premises at a cost below that required for separate spraying and dusting operations.

This year trapping was practiced periodically rather than on a regular monthly basis. However, trapping was done on all projects in all areas, including the St. Augustine experimental residual spray project. Table 15 summarizes the results of evaluation trapping activities. The *X. cheopis* index of 4.92 in the control territory was slightly lower than in the two preceding years when it was 5.16 and 5.15 respectively. Laboratory examination of blood sera showed 4.96 percent positive from treated and 18.60 percent from untreated areas, a slight decrease from the positive percentage in both the treated and untreated areas for 1948.

In Jacksonville, dusting was discontinued in three formerly dusted areas, but evaluation trapping was practiced periodically. Although these areas were last dusted in July 1948, the *X. cheopis* index was found lower than the average for dusted areas in the State. The Jacksonville rate was 0.12 compared with 0.15 for the State. All blood sera collected from the Jacksonville area rats registered negative.

Ratproofing activities were carried on in five towns and in some degree in a few other places where cases of typhus occurred recently. In all, 227 establishments were ratproofed. In Escambia County considerable progress was made in enclosing garbage cans in ratproof storage bins and in the installation of raised bins for storage of trash and rubbish in the business sections. Clearwater,

Table 14

COMBINED SPRAYING AND DUSTING COSTS
January 1 - July 2, 1949

Counties	DDT Spraying			10 percent DDT Dusting			Cost vehicles equipment/ premises	Total cost /premises
	Premises Treated	Super., labor cost/premises	Cost DDT /premises	Premises treated	Super., labor cost/premises	Cost DDT /premises		
Jackson	2,192	$0.73	$2.25	2,472	$0.66	$0.55	$1.47	$5.66
Washington	1,367	0.91	1.95	988	0.90	0.29	1.24	5.29
Madison	1,452	1.35	1.31	1,233	0.46	0.40	1.26	4.78
Totals	5,011	$0.99	$1.84	2,443	$0.67	$0.41	$1.32	$5.24

Courtesy of the David J. Sencer CDC Museum

Table 15

EVALUATION OF DDT DUSTING PROGRAM-TYPHUS CONTROL ACTIVITIES
FISCAL YEAR 1949

Area	Number rats Combed	Number "X. Cheopis"	Number rats with "X. Cheopis"	Mean number "X. Cheopis"	Percent rats infested "X. Cheopis"	Total fleas	Total mites	Total lice	BLOOD Percent positive	BLOOD Percent negative
Treated	1,407	320	82	0.23	5.80	1,227	2,759	5,700	4.96	95.04
Untreated	1,252	6,161	758	4.92	60.50	10,483	18,339	23,823	18.60	81.40

in Pinellas County, inaugurated ratproofing at the close of the fiscal year. Poisoning was practiced in some degree in five counties, including widespread distribution of poisoned bait along the water-front areas in Dade and Duval Counties. In Hillsborough County, poisoned bait was distributed in connection with the "home service" rendered by the local health unit. In all, about 5 tons of poisoned bait were distributed in 8,683 establishments. In addition, 1080 was placed in 1,746 establishments, and 133 pounds of cyanogas used in gassing burrows around 24 establishments. Considerable effort was expended in support of improved garbage disposal, harborage removal, and general environmental sanitation.

The number of reported cases of typhus continued to decline. During the calendar year 1948 there were 166 cases reported from 34 of the 67 counties in the State. This compares with 344 reported for the calendar year 1947. For the first half of the calendar year 1949 there were 49 cases reported compared with 67 for the same period in 1948.

OTHER ACTIVITIES

Representatives of the State CDC office continued to assist the University of Florida, Florida Health Department, and Alachua County Health Unit with the short course for sanitarians held in Gainesville. Six days each quarter were devoted to lectures and conducting trainees on field trips in connection with insect and rodent control. Information concerning rodent and insect control was disseminated through all normal channels, such as special publications, newspaper articles, radio talks, group discussions, addresses before civic organizations, and special meetings.

SUMMARY OF TYPHUS CONTROL ACTIVITIES
FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		9
Number of premises dusted		45,671
Pounds of DDT per premises		4
Man-hour per premises		0.5
Ratproofing**		
Number of projects reporting (five towns)		3
Number of establishments ratproofed		227
Man-hours per establishment		62
Rat Reduction***		
Number of counties reporting		5
Number of establishments poisoned (poison bait - food)		8,683
Man-hour per establishment		0.4
Number of establishments poisoned (poisoned water - 1080)		1,746
Man-hours per establishment		1.9
Evaluation Activities		
Man-hours expended		7,506
Total man-hours expended (all activities)	CDC 31,589	
	Other 44,960	76,549

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**396 man-hours expended on maintenance; 88 man-hours on initial eradication.
***133 pounds of cyanogas used in treating 24 establishments.

Courtesy of the David J. Sencer CDC Museum

★ Georgia

T. F. SELLERS, M.D., Director of Public Health

Operational control programs carried on during 1949 consisted of DDT residual spraying for malaria control and typhus control through rat-proofing of buildings, refuse collection and disposal services, rat eradication, and DDT dusting for the control of rat ectoparasites. In malaria control operations, State and local contributions covered 38 percent of the total cost and about 50 percent in typhus control activities.

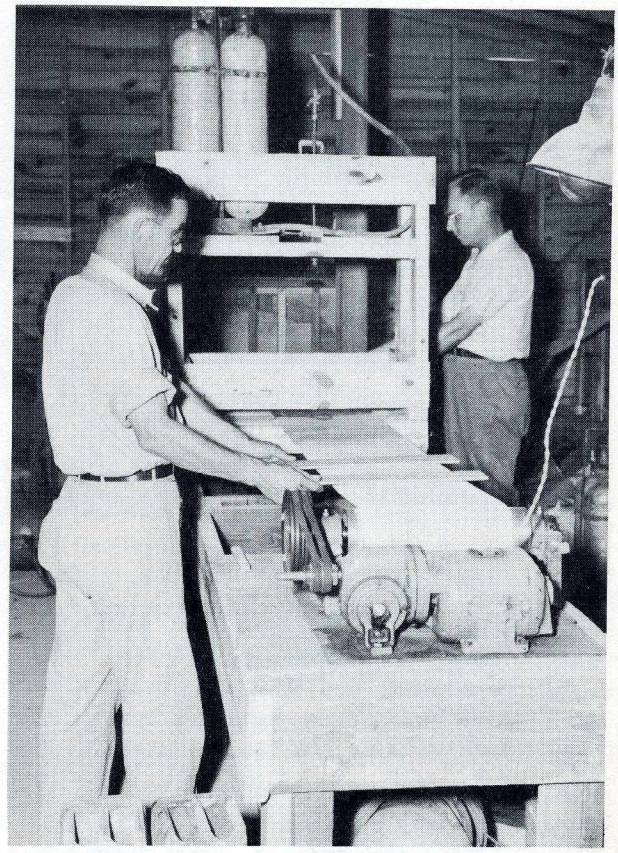
MALARIA CONTROL

The 1949 DDT residual house spraying program for malaria control followed the pattern and procedures of previous years. Operations were somewhat below the 1948 level because of reduced Federal allocations. Thirty-nine counties participated in the spray program during the fiscal year. Application was by the regulated pressure sprayers designed and developed by Georgia personnel. A mechanical agitator was added to the emulsion drums mounted on spray trucks which practically eliminated emulsion separation.

While the spray program was directed toward malaria control primarily, public clamor continued for improvement in the level of concurrent fly control and efforts were made to satisfy this demand. Through the cooperation of CDC a thorough 2-week training course in insect control was provided for district and area supervisors prior to the beginning of the spray season. This helped to increase the efficiency of spray crewmen. Owners or occupants of houses in the residual spray area were offered a nonresidential premises spray treatment on condition that they bear major share of the costs on the basis of amount of emulsion applied. Normally this treatment was applied prior to the regularly scheduled house spraying. In addition, coverage in the house spraying program was expanded to include those surfaces particularly favored by flies, such as lamp cords, edges of furniture, and structural and ornamental surfaces. Emphasis was placed on fly breeding areas in the nonresidential spraying program; and in connection with the scheduled house spraying, literature was distributed urging householders to practice sanitation as a fly control measure. As a result of this emphasis, fly control results were at a higher level than last year.

Investigations. Using house flies as test insects, investigations to determine the duration under field conditions of toxicity of various rates of DDT application were continued. Application rates ranging from 100 milligrams to 400 milligrams of DDT per square foot were tested and all produced satisfactory results up to 12 to 14 weeks. For longer periods, results were erratic regardless of strength. It was concluded that no marked increase in duration of toxicity of DDT residual is to be gained by applying at rates in excess of 100 milligrams per square foot.

During the latter half of the fiscal year, pro-



In support of entomological investigations, a machine was developed for the application of designated rates of DDT emulsion to test panels. As noted the machine includes a regulated pressure sprayer, nozzle, and a motor-driven conveyor belt. Practically any strength of application may be made by varying the strength of the emulsion, the air pressure, nozzle orifice, and belt speed.

Courtesy of the David J. Sencer CDC Museum

cedures and apparatus were developed for running field tests to determine the resistance of wild strains of house flies to DDT. A machine was developed for the accurate application of designated rates of DDT to test panels which were utilized in field investigations. Findings through the end of the fiscal year appear to indicate that resistance to DDT is a minor factor in the level of fly control through DDT residual spraying, at least in the area covered by the Georgia house residual spray program.

In an attempt to clarify certain questions associated with malaria morbidity reporting, trained workers were assigned to interview private physicians and secure from them malaria morbidity and mortality data. Interviews were conducted with 490 physicians in 83 counties in southern Georgia, considered the more malarious section of the State. Fifty-four percent of the 490 physicians interviewed advised that they had attended one or more cases of malaria during 1948 (through October). Interviewers accumulated 4,681 cases in this manner. During this period, private physicians in the 83 counties formally reported only 26 cases of malaria to the State health department.

Epidemiologists of the State health department question the authenticity of the cases accumulated by the interviewers. They point out that the diagnoses were based purely on clinical impressions, none of which were confirmed by reliable laboratories. The experience of State laboratories with respect to blood smears submitted by physicians fails to support these clinical diagnoses. Blood smear surveys in areas where the disease was said to be prevalent consistently failed to detect malaria parasites. These findings together with evaluation studies of officially reported cases have led State epidemiologists to believe the disease is overreported rather than underreported. Center epidemiologists concur in the view that malaria is overreported.

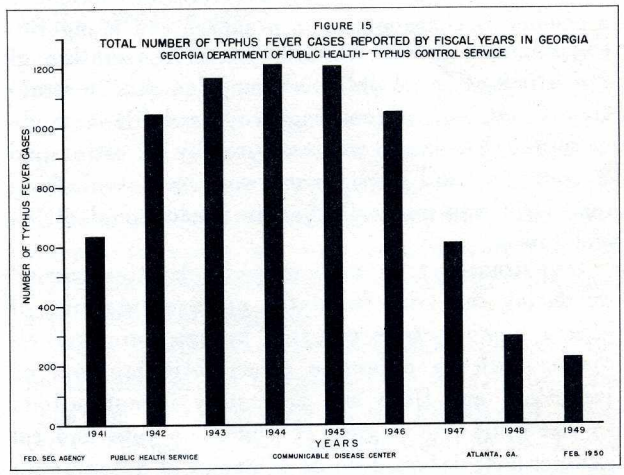
SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating		39
Number of spray applications		140,554
Pounds of DDT used		115,892
Total man-hours expended	CDC 41,377 Local 87,470	128,847
Man-hour per application		0.96
Man-hours per pound of DDT		1.11
Pounds of DDT per application		0.86

*Data are from progress reports submitted to CDC Engineering services by State health department.

TYPHUS CONTROL

The incidence of murine typhus for fiscal year 1949 was 223 compared with 290 in 1948, a decline of 23 percent. This reflects a decline of 81 percent from the 1945 level (figure 15) which is used in measuring control effectiveness, since the expanded typhus control program was initiated with the beginning of fiscal year 1946. The number of fatalities was 17 in 1949 compared with 27 in 1948, or a decrease of 37 percent.



This impressive reduction in morbidity and mortality incidences, in the main, has been in the larger metropolitan counties of Chatham, Bibb, Fulton, Richmond, and DeKalb. Murine typhus in these five counties may now be considered under control, and for the present, does not constitute a major public health problem.

DDT Dusting and Rat Eradication. Seventy counties participated in DDT dusting, antirat sanitation, and rat eradication operations. Operations were county-wide in 32 counties and on a selective basis in 38. Technical supervision, motor equipment and maintenance thereof, DDT dust, dusting equipment, and certain rodenticides were provided out of Federal and State funds. Participating counties and cities supplied necessary labor for DDT dusting, and placing poison bait and bait material. Some 371,000 pounds of DDT dust were used in treating 116,803 premises. Rat eradication activities were conducted on 72,924 premises. Red squill was the choice rodenticide

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in treating large areas. Arsenic and 1080 were used to some extent in business establishments, where trained personnel exercised direct supervision.

Ratproofing of Buildings. Ratproofing projects were pursued in Atlanta, Macon, Tifton, and Waycross. Ratproofing surveys were made in Americus and Jesup. In ratproofing operations, supervision was supplied by the State Typhus Control Service. Owners and/or tenants, through contributions to a community revolving fund, paid the costs of labor and materials. During the year, 945 business establishments were surveyed and 647 of that number ratproofed.

Refuse Collection and Disposal Service. Technical aid and other advisory services were extended a number of communities in planning and inaugurating programs designed to improve rat control through the elimination of rat food supplies and destruction of rat harborages. Improved land fill methods of refuse disposal were instituted by 12 cities and 2 counties, and preliminary work in establishing land fills was accomplished in 8 additional cities and towns.

Investigations. Investigational activities carried on during the year consisted of investigations of human typhus cases reported by practicing physicians, with the objective of establishing foci of infection; and field and laboratory investigations to ascertain the degree of typhus in rats and rat ectoparasite infestation as a means of determining the effectiveness of typhus control measures.

Investigations were made of 97 reported cases of typhus, and all rat-infested premises implicated in the foci of infection were dusted with DDT.

During the year, 8,131 rats were trapped and 69,700 rat ectoparasites were collected for examination and classification. The indicated reduction in the rat-flea index through DDT dusting was 34.3 percent. Of 3,098 rat blood specimens examined serologically, 371 were positive for murine typhus.

The infection rate of rats trapped was 12.0 percent in 1949 compared with 16.6 percent in 1948.

The special investigative study, initiated in Brooks, Thomas, Grady, and Decatur Counties in 1945, was continued in cooperation with CDC.

SUMMARY OF TYPHUS CONTROL ACTIVITIES
Fiscal Year 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		70
Number of premises dusted		116,803
Pounds of DDT per premises		3.2
Man-hour per premises		0.4
Ratproofing**		
Number of projects reporting (Surveys in two cities)		4
Number of establishments ratproofed (945 surveyed)		647
Man-hours per establishment		31
Rat Reduction***		
Number of counties reporting		21
Number of establishments poisoned (poison bait - food)		71,428
Man-hour per establishment		0.4
Number of establishments poisoned (poisoned water - 1080)		1,496
Man-hours per establishment		1.4
Evaluation Activities		
Man-hours expended		11,094
Total man-hours expended (all activities)	CDC 50,789 Other 94,290	145,079

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**2,316 man-hours expended on initial eradication.
***4,301 pounds of cyanogas used at expenditure of 6,282 man-hours.

★ *Mississippi*

FELIX J. UNDERWOOD, M.D., State Health Officer

Communicable Disease Center activities during 1949, particularly malaria eradication and murine typhus control, were carried on as an integral part of the operations of local health departments. Supervision was supplied by the division of sanitary engineering of the State board of health, as in previous years. Area and project supervisors, attached to local health departments, directed field operations.

Malaria eradication through DDT (7½ percent)

Courtesy of the David J. Sencer CDC Museum

residual spraying was practiced in 22 counties and murine typhus control through DDT dusting was on a county-wide basis in Harrison and Pike Counties and in 35 communities of other counties where previous trapping disclosed the presence of typhus-positive rats. Evaluation surveys were conducted in connection with malaria and typhus field operations.

MALARIA ERADICATION OPERATIONS

The cooperative program to eradicate malaria continued with encouraging results. During the fiscal year, 7½ percent DDT emulsion was applied to 130,149 premises (houses, outdoor toilets, and animal-housing barns). Additional premises were treated in connection with special projects.

Six cases of malaria were reported through June 30, 1949, none of which have been confirmed by positive laboratory slides. During the calendar year 1948, 125 cases were reported of which 12 were confirmed by positive laboratory slides. The State board of health encourages the reporting of malaria cases by offering physicians a bonus of $5 for each confirmed case reported and is contemplating increasing the amount to $10.

Although the regular 1948 spray season terminated June 30, 1948, Marshall County, which had been offered the program earlier did not accept the spray program until July and 5,995 premises were treated during July-September.

Nineteen of 20 preapproved counties cooperated in the 1949 spray season program which entailed the spraying of entire premises on condition that the respective counties appropriate $0.75 per premises. This formula resulted in increased local contributions and produced revenue to cover labor and miscellaneous items.

Regular 1949 spray season operations began in March and continued through June. Three-man spray crews were used. Crew foremen were paid out of CDC funds and laborers from local funds. Progress charts were maintained for each area. Transportation costs were held to a minimum by locating crews in strategic positions throughout the spraying area and by using roving mechanics to handle repairs and preventive maintenance. All vehicles and equipment were overhauled and serviced at the central shops and warehouse prior to assignment to field projects.

Automotive and other equipment was stored, when not in use, at the CDC warehouse located at the Delta Medical Center, Greenwood. Shops and a mixing plant also are located in the warehouse, which is centrally situated with respect to the spraying area.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating		22
Number of spray applications		133,686
Pounds of DDT used		204,780
Total man-hours expended	CDC 69,812 Local 102,130	171,942
Man-hours per application		1.29
Man-hour per pound of DDT		0.84
Pounds of DDT per application		1.53

*Data are from progress reports submitted to CDC Engineering Services by State health department.

Special Projects. Instructors in the Veteran Farm Training program in Scott County (a preapproved county) requested assistance in the spraying of the premises of the 425 veteran trainees. Necessary equipment and DDT were furnished, together with instructions, for each veteran to spray his own premises. A total of 1,275 premises received 5 percent DDT residual spray under this program.

In the Sardis Reservoir area, which is under the jurisdiction of the Corps of Engineers, a high anophelism index persists in the vicinity of Abbeville. Through an arrangement whereby the Corps of Engineers reimbursed CDC, 7½ percent DDT spray was applied to 146 houses and 287 barns and other outbuildings in this area.

In response to requests from the board of county supervisors, 5 percent DDT was applied to 3,759 houses and 5,910 barns in Clay County.

Entomological Inspections. Entomological inspections were made in sprayed counties for evaluation purposes during the period June 1-November 1, 1948. Table 16 summarizes the results with respect to *A. quadrimaculatus* and

Table 16

HOUSE INSPECTIONS ON RESIDUAL SPRAY PROGRAM IN SPRAYED COUNTIES FOR EFFECTIVENESS OF "ANOPHELES QUADRIMACULATUS" CONTROL June 1 - November 1, 1948

	Houses Inspected	Houses Positive "A. quad."	Percent Positive	Percent Control
Sprayed	1,337	30	2.2	94.7
Unsprayed	186	79	41.4	-

Courtesy of the David J. Sencer CDC Museum

table 17 with respect to fly control.

Higher fly counts were encountered throughout the region inspected than in any previous year. Conditions were favorable for fly breeding, and comparisons indicated that the general fly population was much greater than that of the previous year. Inspections made in sprayed counties during June 1949 showed an average of 42.2 flies per room, 21.4 flies per square yard (outside of houses), a control of 41.3 percent inside, and 36.3 percent control outside. Inspections of unsprayed houses in the same counties showed 71.9 flies per room and 33.6 flies per square yard (outside). In unsprayed counties, the count was 153.4 flies per room and 21.9 flies per square yard (outside).

Pest Control Programs. Pest control activities expanded appreciably during the year. Forty-one city-wide insect control programs were in operation during 1949, compared with 14 in 1948. This expansion stemmed from promotional work during previous years and the support of the State board of health, which furnished 42,950 pounds of 100 percent DDT powder and 2,325 gallons of 25 percent concentrate during 1949. Sponsors of these programs are cognizant of the basic importance of sanitation in insect control, and many communities have inaugurated sanitary land fills for the disposal of garbage and refuse.

Insect control as practiced in these programs included mosquito, fly, and rodent control activities throughout the year, usually under the supervision of a pest-control director affiliated with the local health department.

Figure 16 reflects the operations and results of a typical municipal pest-control program, Greenwood. The city was divided into two sections. Four blocks were chosen per section (blocks with highest fly count) and three count stations established in each block. Three grill counts were made per station. An attempt was made to cover the city each week with a 5 percent DDT-diesel oil solution fog. Treatments usually were made between 6 p.m. and 12 p.m. During the treatment period, May 26-August 8, 1948, sanitation methods practiced included: (1) collection of garbage from business areas daily and from residential areas semiweekly; (2) covered garbage receptacles were required with about usual compliance; and (3) collected garbage was hauled to an open dump about a mile from the business section.

Evaluation surveys showed an average fly control 1 day after treatment of 67 percent and virtually no control 1 week after treatment. Average mosquito control indicated was 80.2 percent 1 to 2 days after treatment.

Sanitary land fills for garbage disposal were used in some communities operating pest control programs and results were enhanced thereby. Larviciding was employed as a supplementary measure in communities where circumstances warranted.

TYPHUS CONTROL

Regular DDT dusting of business establishments and other selected premises was practiced in preapproved counties, Harrison and Pike. Under the sponsorship of municipal authorities and/or civic organizations, dusting operations were carried on in 35 communities where typhus-positive rats were discovered through previous trapping work. In these operations, supervision and DDT dust were supplied by CDC and the respective local health departments. Of 2,535 premises inspected, 691 were found infested. This indicated

Table 17

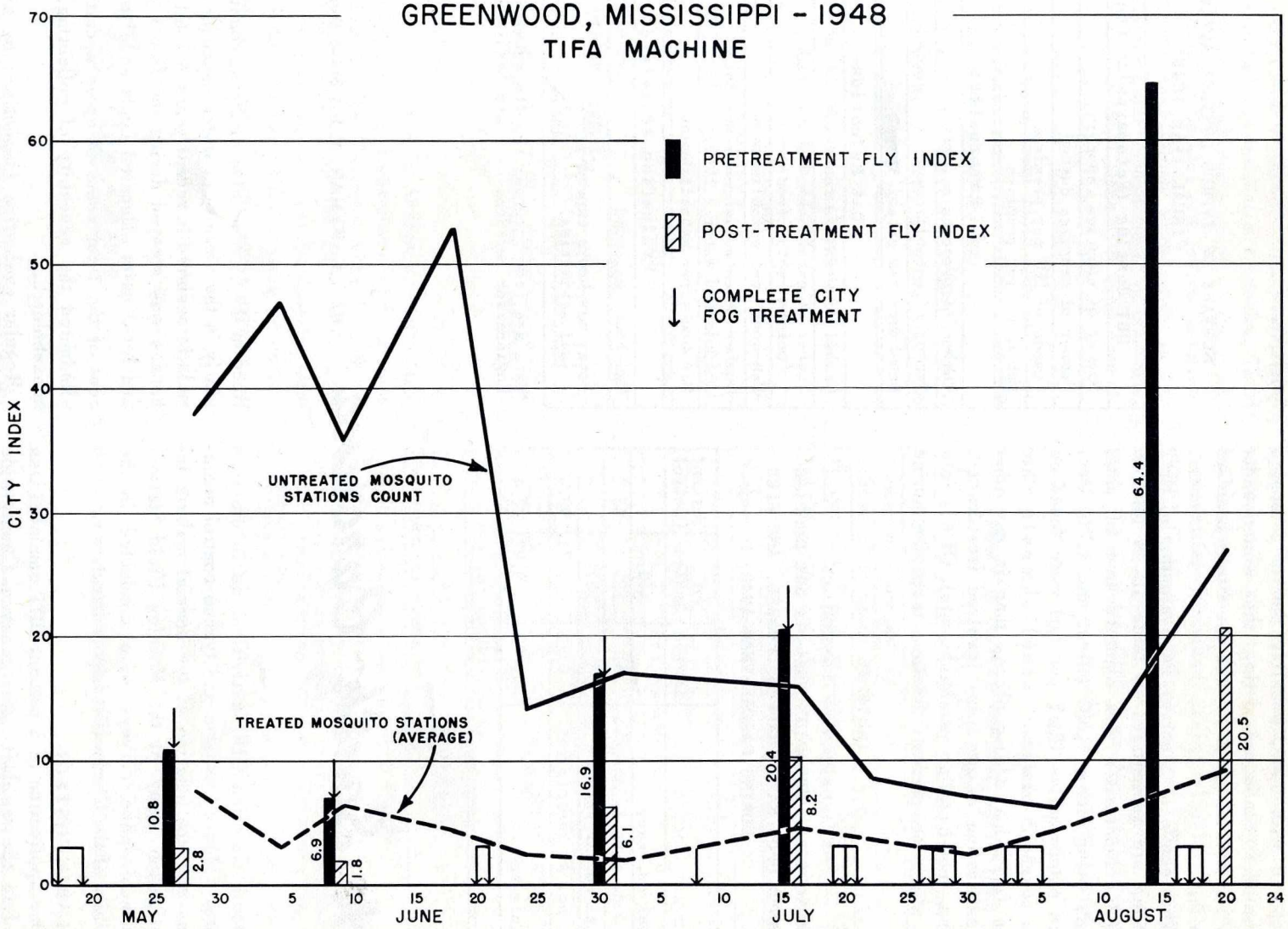
PREMISES INSPECTIONS ON RESIDUAL SPRAY PROGRAM IN SPRAYED COUNTIES FOR EFFECTIVENESS OF FLY CONTROL

	Premises inspected	Average no. flies/room	Average no. flies/sq.yd. (outside)	Percent of control (inside)	Percent of control (outside)
July 1-November 1, 1948					
Sprayed	1,337	5.0	8.5	57.6	42.2
Unsprayed	186	11.8	14.9	-	-
May 1949					
Sprayed	172	14.2	5.9	79.2	55.0
Unsprayed	121	68.3	13.1	-	-

Courtesy of the David J. Sencer CDC Museum

Courtesy of the David J. Sencer CDC Museum

FIGURE 16
FLY AND MOSQUITO CONTROL
GREENWOOD, MISSISSIPPI - 1948
TIFA MACHINE



a 25 percent reduction in premises infested as compared with 1948, possibly due to poisoning operations conducted during the winter under the supervision of CDC and the State board of health.

The results of a survey for evaluation of DDT dusting are summarized in table 18. A total of 9,888 ectoparasites was obtained from all rats, 1,489 being fleas, 6,683 mites, and 1,716 lice. More ectoparasites (24.7 per rat) were found on rats caught in business establishments other than food-handling places than in any other classification of premises involved (residences, farms, food-handling establishments). Of 611 rats on which complement fixation tests for murine typhus were run, 40 (6.5 percent) were found positive.

Table 18

EVALUATION OF CONTROL OF "XENOPSYLLA CHEOPIS" THROUGH DDT DUSTING BASED UPON RATS TRAPPED, COMBED, AND BLED DURING FISCAL YEAR 1949

	Dusted	Not Dusted	Percent Control
Total no. rats	243	472	-
No. rats with *X. cheopis*	36	129	45.8
Total no. *X. cheopis*	63	1,282	-
Av. no. *X. cheopis*/rat	0.26	2.71	90.4
Av. no. *X. cheopis*/rat infested	1.75	9.92	82.4

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		23
Number of premises dusted		12,453
Pounds of DDT per premises		1.4
Man-hour per premises		0.6
Ratproofing		
Number of projects reporting		1
Number of establishments ratproofed		19
Man-hours per establishment		11
Rat Reduction		
Number of counties reporting		16
Number of establishments poisoned (poison bait - food)		62,824
Man-hour per establishment		0.2
Number of establishments poisoned (poisoned water - 1080)		4,406
Man-hours per establishment		1.1
Evaluation Activities		
Man-hours expended		3,722
Total man-hours expended (all activities)	CDC 14,019 Other 22,409	36,428

*Data are from progress reports submitted to CDC Engineering Services by State health department.

★ South Carolina

BEN F. WYMAN, M.D., State Health Officer

South Carolina CDC activities, as in previous years, embraced malaria and typhus control operations and continuation of the special malaria investigation study at the Manning Field Station. Reconnaissance surveys were conducted in the vicinity of the Clarks Hill impoundment.

MALARIA CONTROL

One application of 5 percent DDT emulsion was used in the residual spray program. County-wide programs were conducted in the 23 coastal counties; partial programs were conducted in Aiken, Richland, Kershaw, and Chesterfield Counties, bordering the coastal area; and spot spraying was practiced in the 19 remaining piedmont counties, particularly in the vicinity of water impoundments where malaria occurred in recent years. A total of 177,866 houses was sprayed during the fiscal year. State and local units allocated funds equal to 56.1 percent of the total costs of spray operations. This eliminated the necessity of collecting fees from householders.

Regular evaluation inspections by six entomological aides indicated effective control of malaria mosquitoes which conformed to opinions expressed by residents of the sprayed areas.

The State board of health conducted an experi-

Courtesy of the David J. Sencer CDC Museum

mental program of total premises spraying—residences plus the inside of animal- and fowl-occupied outbuildings in Calhoun and Marion Counties. Total premises spraying, with rosin added to the emulsion, was studied in Berkley and Jasper Counties.

Entomological inspections were made in the vicinity of larger water impoundments in the State, particularly around the Clarks Hill development. The State board of health, which has supervision over malaria control on impounded waters, also conducted a preimpoundment blood film survey in the Clarks Hill area. Blood films were collected from 1,282 elementary school children.

Blood film surveys and other epidemiological investigations were continued in connection with the Manning Field Station study.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating			46
Number of spray applications			177,866
Pounds of DDT used			196,931
Total man-hours expended	CDC	42,672	221,841
	Local	179,169	
Man-hours per application			1.25
Man-hours per pound of DDT			1.13
Pounds of DDT per application			1.11

*Data are from progress reports submitted to CDC Engineering Services by State health department.

TYPHUS CONTROL

Ratproofing activities in Anderson, Charleston, Columbia, Greenwood, Lancaster, and Laurens were continued. The Cameron School and the Cedar Springs Institute for the Blind also were ratproofed. A total of 447 establishments were ratproofed during the year. DDT dusting for control of the rat-flea (typhus vector) was conducted in 10 counties. Three mobile dusting units were operated in nine southeastern counties. A typhus control aide and equipment were furnished each mobile unit out of State and CDC funds; local communities furnished additional labor and materials. Dusting operations covered 1,209 premises. The use of 5 percent DDT emulsion as a residual spray instead of DDT dust for rat-flea control was studied in an experimental project begun in Columbia.

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)			
Number of counties reporting			10
Number of premises dusted			1,209
Pounds of DDT per premises			2.5
Man-hours per premises			1.2
Ratproofing**			
Number of projects reporting			2
Number of establishments ratproofed			183
Man-hours per establishment			31
Rat Reduction			
Number of counties reporting			–
Number of establishments poisoned (poison bait – food)			–
Man-hours per establishment			–
Number of establishments poisoned (poisoned water – 1080)			326
Man-hours per establishment			7.1
Evaluation Activities			
Man-hours expended			8,291
Total man-hours expended (all activities)	CDC	16,590	27,679
	Other	11,089	

*Data are from progress reports submitted to CDC Engineering Services by State health department.

**2,193 man-hours maintenance; 2,176 initial eradication.

★ Tennessee

R. H. HUTCHESON, M.D., Commissioner of Public Health

Malaria control through residual spraying in the malarious areas and murine typhus control through DDT dusting, ratproofing, and rat eradication were continued during 1949. Because of an apparent decrease in the efficiency of DDT emulsion in controlling flies, several other formulations (90 percent water-wettable DDT, 50 percent water-wettable methoxychlor, DDT rosin emulsion) were tested in field operations. Early results indicate that methoxychlor is the more effective. Entomological in-

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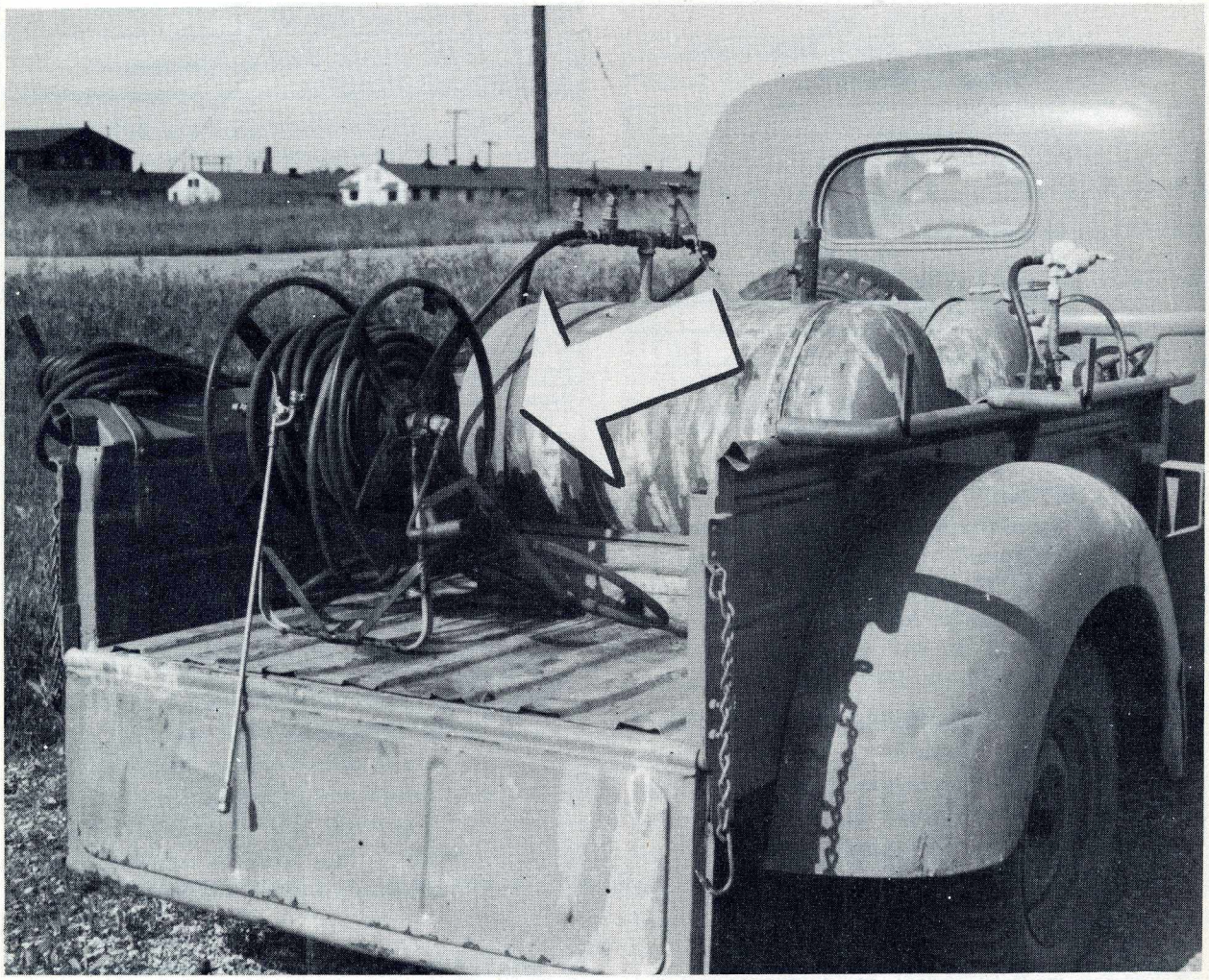
spections for measurements of control operations were conducted in connection with both malaria and typhus control activities.

MALARIA CONTROL

Increased local participation, through uniform appropriations based on the number of premises sprayed, made it possible to spray approximately 95 percent of the premises in the control areas. Complete premises spraying on a one-cycle basis was practiced for the third consecutive year. Adoption of the one-man crew, elimination of the advance contact man, and the utilization of a hose reel adapted to power spray units brought about a considerable reduction in spraying costs.

Entomological surveys and inspections, principally in the residual spray program areas, were conducted to determine the effectiveness of operations. Satisfactory control of the malaria mosquito was recorded. No complaints of ineffectiveness of DDT applications in fly control were registered during the early 1949 season, but they were numerous in 1948. Evaluation studies undertaken in DDT with rosin, water-wettable DDT, and methoxychlor sprayed areas pointed to methoxychlor as the more effective against flies. Inspections in unsprayed areas revealed the early 1948 fly population was nearly double that of 1947.

Aerosol generators were utilized with motor



The efficiency of spray crews was increased through the utilization of an experimental model reel hose adapted for use with power spray equipment. The reel, mounted on a portable rack, permits the sprayer to uncoil whatever length of hose is required as he proceeds to his targets, and to retrieve it readily at the end of the job by means of a crank attached to the reel. This permits the sprayer to reach far away places without returning to the vehicle to release additional hose and greatly reduces the time required to return the hose to the vehicle at the conclusion of a job.

Courtesy of the David J. Sencer CDC Museum

equipment in Pulaski and Knoxville operations. Studies indicated a lowering of the fly population in Pulaski, but it was not sufficient to prompt the city to inaugurate municipal control activities. Fly surveys were made in Gatlinburg and control procedures recommended. Impounded water investigations were continued in the Center Hill and Dale Hollow reservoirs, and in connection with private lakes in 8 middle Tennessee counties and 11 counties in west Tennessee.

TYPHUS CONTROL

Five cities (Nashville, Knoxville, Lebanon, Chattanooga, and Cleveland) participated in the cooperative typhus control program. Memphis operated a program entirely on its own.

The Nashville program, started in 1947, has resulted in a steady decline in the typhus incidence. During the year, 179 establishments were ratproofed. Supervisory and technical aid required 4,604 man-hours. In addition, 6,825 premises were dusted with 5 percent DDT and 1,182 premises inspected for ratproofing maintenance. Rats were trapped in 100 premises.

The Knoxville program, also started in 1947, was operated along the same lines as that in Nashville, with rat eradication carried on by contractual agreement between the city and individuals. Also Knoxville maintained a municipal ratproofing shop and crew. During the year, 244 premises were ratproofed, 3,642 inspected for ratproofing maintenance, and 2,073 dusted.

In Chattanooga, where municipal ratproofing shops were maintained, 106 premises were ratproofed, and trapping for evaluation purposes practiced in 199.

In Cleveland, 6 premises were ratproofed and 671 inspected for maintenance of ratproofing.

The Lebanon program, initiated this year, accounted for the ratproofing of 30 premises, the establishment of shops for fabricating ratproofing materials, and the employment of personnel to organize and pursue rodent control activities.

SUMMARY OF RESIDUAL SPRAY OPERATIONS
FISCAL YEAR 1949*

Number of counties participating		13
Number of spray applications		25,340
Pounds of DDT used		42,858
Total man-hours expended	CDC 34,693 Local 7,489	42,182
Man-hours per application		1.66
Man-hour per pound of DDT		0.98
Pounds of DDT per application		1.69

*Data are from progress reports submitted to CDC Engineering Services by State health department.

SUMMARY OF TYPHUS CONTROL ACTIVITIES
FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		2
Number of premises dusted		9,084
Pounds of DDT per premises		1.5
Man-hour per premises		0.3
Ratproofing**		
Number of projects reporting		3
Number of establishments ratproofed		509
Man-hours per establishment		28
Rat Reduction		
Number of counties reporting		1
Number of establishments poisoned (poison bait - food)		767
Man-hour per establishment		0.5
Number of establishments poisoned (poisoned water - 1080)		-
Man-hours per establishment		-
Evaluation Activities		
Man-hours expended		2,127
Total man-hours expended (all activities)	CDC 14,317 Other 13,356	27,673

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**2,193 man-hours maintenance; 2,196 initial eradication.

★ Puerto Rico

JUAN A. PONS, M. D., Health Commissioner

Control of *A. albimanus* through larvicidal and residual spray operations constituted the major activity in Puerto Rico and the Virgin Islands during 1949. The District Public Health Service office was deactivated and its functions, including CDC activities, transferred to Region VI. A reduction

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in funds attended this reorganization necessitating a curtailment in activities and personnel.

Only one case of malaria was reported from military installations covered by control operations and this case was contracted in the Vieques Island area where only emergency control was practiced during military maneuvers, February-April 1949. During the first half of 1949, malaria among the civilian population was reported in moderate amount in Vega Baja, where residual spraying was not practiced, and on Vieques Island.

Insular Health Department records show a decided decline in malaria morbidity and mortality during the period 1942-48. Morbidity declined from 1,099.8 in 1942 to 60.5 in 1948, and mortality from 99.4 to 11.8.

During the year, projects were operated in Puerto Rico at Fort Buchanan and San Patricio, Losey Field, Fort Bundy, and Fort Buchanan Warehouse. On the Losey Field project, larvicidal control was abandoned in favor of residual spraying and ditch maintenance with a considerable reduction in costs. Buildings within the control area were sprayed at 4-month intervals. Because of low costs already achieved through partial adoption of the mist larviciding technique, residual spraying was not substituted for larvicidal control in the Fort Bundy area. At Fort Buchanan and San Patricio a sharp reduction in cost was achieved by the adoption of mist larviciding and by confining ditch maintenance to those ditches necessary to insure adequate drainage of the area.

Ground control methods employed were designed for control of anopheline mosquitoes and generally were successful. However, complaints were received of infestations by pest mosquitoes, principally floodwater *Aedes*.

At the request of military authorities and the Insular Health Department, anopheline and culicine surveys were made in the Fort Bundy, Fort Buchanan, Camp Tortuguero, Henry Barracks, San Juan, and Vieques Island areas. The following areas were placed on or continued on a malaria surveillance basis: Camp Tortuguero, Henry Barracks, Salinas, Camp O'Reilly, Veterans Administration Hospital at San Patricio, Public Health Service Quarantine Station, International Airport, Tenth Naval District, and Vernam Field, Jamaica, B.W.I.

In cooperation with the Columbia School of Public Health, the feasibility of reactivating the residual spraying program for filariasis control on St. Croix was investigated. Scientific justification for resumption of the program was not established. However, the St. Croix government was assisted, through technical advice and loan of equipment, in organizing a control program in that area. Surveys on the island revealed the absence of *A. aegypti*, although this species was the most common domestic mosquito before the inauguration of residual spraying operations in 1946.

Because staff reorganization designated the entomologist as officer in charge, entomological activities were enmeshed with program direction. However, appropriate entomological activities were pursued in connection with the several activities. Bait and light trap studies were conducted and evaluation surveys made. In the Fort Losey control zone (under larvicidal control since 1942), a survey was carried on to determine the elapse of time required for anopheline populations to build back to hazardous levels. Most streams and ditches in the control zone remained completely negative for larvae in the 1-mile zone with only occasional larvae found in the 2-mile zone. Bait traps in the inner zone did not build up nearly as high as those in the outer zone, but *A. albimanus* populations taken in traps 75 feet from the Post housing area reached high levels. By the end of the year, breeding was more or less general over the entire area.

Schistosomiasis studies in the Fort Bundy area indicated that no stream within a 2-mile zone of the establishment was free of infection. Studies in other areas are being pursued.

Bait and light trap studies were pursued with the objectives of determining relative attractivity of various animals, effect of color on light trap catches, and observation of the "catching out" phenomena. In sampling *Culicoides* populations, larger catches were recorded in the painted traps (chrome yellow).

A parasitologist under the technical supervision of the Laboratory Division of CDC continued the collection of specimens and special studies, in collaboration with the School of Tropical Medicine. Specimens were forwarded to the CDC Laboratory for examination.

Courtesy of the David J. Sencer CDC Museum

Region VII*

Iowa
Kansas
Missouri
Nebraska
North Dakota
South Dakota

REGION VII HEADQUARTERS: KANSAS CITY, MO.

The Office of Midwestern CDC Services was established February 1949 with the underlying objective of rendering greater assistance to States in that area and providing facilities for dealing with public health problems associated with the Missouri River Basin Development program. In fulfillment of this mission, existent programs have been strengthened and new operating projects have been added, including (1) mosquito investigations in the Missouri River Basin; (2) encephalomyelitis studies in the Fort Scott, Kans., area; (3) rodent-borne disease consultative services in North Dakota, South Dakota, Nebraska, Kansas, Missouri, and Iowa; and (4) epidemic and disaster aid planning for the Midwestern area. In addition, considerable effort has been expended in formulating basic procedures for control programs for rabies, brucellosis, and Queensland fever.

MOSQUITO INVESTIGATIONS IN MISSOURI RIVER BASIN

This program entails investigations on reservoirs, investigations in irrigated areas, preirrigational investigations, bionomical studies, and supplemental collections for use by the virus unit. Activities are carried on through three field units strategically located within the basin area. Field unit No. 1 operates out of Concordia, Kans.; No. 2 out of Kearney, Nebr.; and No. 3 out of Huron, S. Dak.

Unit No. 1 is primarily responsible for investigations and studies in the Kansas River Valley. Under the Pick-Sloan Plan for development of the basin, most of the activity in this area concerns the construction of reservoir and irrigation projects along the Republican River. Accordingly, four plots consisting of approximately 4 square miles each have been selected for detailed preirrigation studies. They are located near Holbrook, Nebr.; Orleans, Nebr.; Superior, Nebr.; and Republic, Kans.

Construction work is in various stages of completion in the study areas, with irrigation water scheduled to be available in the Holbrook community by the spring of 1950. Special biological and surveillance studies along the shorelines are expected to indicate the type and amount of aquatic growth and related health hazard problems likely to be encountered in other localities.

Some 120 mosquito larval collection stations were established in the four plots, and routine inspections were started. In addition, light traps were located on each plot to ascertain the preirrigation mosquito population and other data.

Unit No. 2 inaugurated studies on irrigated land in Phelps, Hall, and Dawson Counties, Nebr. Similar studies are under way in the Scottsbluff area. The most common mosquito species collected and identified to date have been *A. dorsalis*, *A. nigromaculis*, *Aedes sticticus*, *Aedes stimulans*, *Aedes vexans*, *C. tarsalis*, *Culiseta melanura*, *Culiseta morsitans*, *Psorophora ciliata*, and *Psorophora signipennis*. Collections were made over an 11-county area.

Unit No. 3, operating out of Huron, S. Dak., has initiated preirrigation studies on the Oahe project and started collecting adult mosquitoes on the Belle Fourche project. Larval and adult collections were made in 16 counties. All potential mosquito breeding grounds in the area were staked and permanent collection stations established.

*During fiscal year 1949 Region VII and Office of Midwestern CDC Services operated in virtually same area.

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Special Mosquito Survey, Fargo, N. Dak. Entomological data were collected in the Fargo area from June 16 to September 24, 1948, utilizing two light traps which were operated 183 trap days. Table 19 summarizes material collected during this survey. The data were collected by the Fargo Health Department and identification of species was made by an entomologist from the Midwestern CDC Service Office.

ENCEPHALOMYELITIS INVESTIGATIONS

Clarification of the epidemiology of Western equine encephalomyelitis is the immediate objective of this investigation.

In planning the project, it was decided that a concentrated study in a limited area where the virus was likely to be found offered the logical approach. Analysis of available data indicated that Allen, Anderson, and Bourbon Counties, Kans., constituted such an area.

A field laboratory was established near Fort Scott, Kans., and operations were initiated April 1. In conference with representatives of the National Institutes of Health and Communicable Disease Center Headquarters, it was agreed that the Rocky Mountain Laboratory, Hamilton, Mont., would examine mosquitoes forwarded; that the Montgomery Laboratory would handle bird ectoparasites, domestic poultry sera, and other insects; and that Dr. H. J. Wenner, University of Kansas Medical School, would examine hemolyzed bird blood and horse brains and horse sera for virus.

Accomplishments. Field personnel located some 450 bird nests, 350 of them within the tricounty area. Some difficulty was encountered in obtaining sufficient blood from nestlings for inoculation into mice for isolation of virus; but by June, 500 nestlings had been bled and specimens forwarded to the laboratory for examination. Eighty nests were examined for mites. In about one-third of the nests, mites were present in sufficient number to be collected for shipment to Montgomery for virus isolation. In other instances, collections were made and sent to CDC for identification. Mosquitoes were collected in several ways, chiefly light traps. Ten traps were operated in the tricounty area and one at Lake Quivera. Catches from these traps are being collected for virus isolation.

Table 20 indicates the variety and volume of

Table 19

MOSQUITO COLLECTIONS-FARGO, N. DAK.
June 16-September 24, 1948

SPECIES	TOTAL SPECIMENS (Females)	NUMBER OF DAYS CAUGHT	DATE OF CATCH	
			First	Last
Aedes campestris	5	3	7/8	8/16
cincereus	46	26	7/3	9/18
dorsalis	55	26	7/4	9/15
flavescens	5	3	6/16	7/10
nigromaculis	52	17	6/28	9/5
vexans	3,703	91	6/24	9/24
Anopheles occidentalis	22	12	7/13	9/18
punctipennis	5	5	8/8	9/10
walkeri	7	6	7/3	8/31
Culex apicalis	18	12	7/28	9/20
pipiens	14	9	7/4	9/18
restuans	48	27	6/16	9/21
tarsalis	371	57	7/1	9/23
Culiseta inornata	40	23	6/16	9/24
incidens	1	1	8/31	8/31
morsitans	1	1	8/10	8/10
Mansonia perturbans	47	17	7/3	8/16
Uranotaenia sapphirina	13	8	6/25	9/7
Total	4,453			

Courtesy of the David J. Sencer CDC Museum

Table 20

FIELD COLLECTIONS MADE IN STUDY AREA AND FORWARDED TO THE LABORATORIES FOR EXAMINATION AND CLASSIFICATION

1949	February		March				April					May				June			
Week Ending:	19	26	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25
Bird Bloods																			
No. bloods	–	–	–	–	–	–	–	–	–	–	–	17	77	46	38	82	94	94	102
No. species	–	–	–	–	–	–	–	–	–	–	–	3	3	5	9	6	6	5	8
Bird Sera																			
Migrants: No. sera	–	–	–	–	–	30	43	–	–	–	–	–	–	–	–	–	–	–	–
No. species	–	–	–	–	–	3	4	–	–	–	–	–	–	–	–	–	–	–	–
Residents: No. sera	120	–	–	89	5	30	–	–	–	8	–	–	–	–	–	–	–	–	–
No. species	1	–	–	1	1	1	–	–	–	2	–	–	–	–	–	–	–	–	–
Mosquitoes																			
No. lots	–	–	–	–	–	–	–	–	–	2	1	2	21	2	21	32	43	31	53
No. specimens	–	–	–	–	–	–	–	–	–	–	–	75	200	–	200	800	210	210	500
Mites																			
No. lots	–	–	–	–	–	–	–	–	–	–	–	–	–	7	6	–	9	11	22
Other Insects																			
No. lots	–	–	–	–	–	–	–	–	–	4	2	1	–	2	–	–	1	–	14
No. specimens	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	–	–	–	8
Human Sera																			
No. sera	–	–	–	–	–	–	–	–	–	–	–	1 (suspected case)	–	–	–	27	26	70	37
Horse Sera																			
No. sera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1 (suspected case)	–
Domestic Fowl																			
No. sera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	23
Other Animals																			
No. sera	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–

Total rainfall from March 29-June 11 — 10.23 inches

material collected in connection with these activities. Laboratory examination of the material has not been completed. However, Dr. Herbert Wenner, University of Kansas Medical School, has submitted a progress report on his examinations of bloods from nestling birds (table 21). In addition, Dr. Wenner reported the isolation of an as yet unidentified virus from the blood of a red-winged blackbird. The blood was obtained about 10 miles from Kansas City.

RODENT-BORNE DISEASE CONTROL

Activities in this sphere centered around consultative services to State and local health departments and in organizing and conducting training courses in rodent control.

Three States (Iowa, Missouri, and South Dakota)

Table 21

PROGRESS REPORT OF DR. HERBERT WENNER ON EXAMINATIONS OF BLOODS FROM NESTLING BIRDS

Number bloods submitted	420
Tests completed	300
Results:	
Negative	298
Equivocal	2

Method of examination: Inoculation intercerebrally of young Swiss mice with 0.03 cc. of heparinized blood. The mice are observed twice daily for a period of 14 days.

Courtesy of the David J. Sencer CDC Museum

have personnel at the State level who devote major attention to rat control. South Dakota is the most progressive State in this respect, having a full-time State director of rat control activities.

Major accomplishments during the period include the holding of a 2-week rat control training course in Kansas City and the completion of a series of informal conferences with the Bureau of Animal Industry, U. S. Department of Agriculture, and packing house personnel during which rodent and insect control, with particular relation to the meat-packing industry, was explored. Twenty-one students participated in the 2-week rat control course and more than 100 attended the conferences dealing with rat and insect control in the meat industry.

Three rat control demonstrations were given for personnel engaged in or interested in ratproofing and other operational procedures. These were held in Lincoln, Nebr.; Des Moines, Iowa; Rapid City, S. Dak.; and Wichita, Kans. Attendance at the three sessions totaled 75.

At the close of the fiscal year, 13 municipalities in the Region had enacted rat control ordinances and 11 others were conducting rat control operations on a voluntary basis.

During the year, consultative and other services were rendered in connection with rat control activities in Iowa, Kansas, Minnesota, Missouri, North Dakota, and South Dakota.

Iowa. Rodent control activities are handled by the division of sanitary engineering of the State department of health on a part-time basis. Rat control in Des Moines is under the direction of a full-time employee. Considerable assistance was rendered this program by CDC personnel during the year. Mason City, which operates an efficient sanitary land fill for garbage disposal, employs a pest control operator on an annual basis for insect and rat extermination services.

Kansas. Personnel from the Midwestern CDC Services Office contacted State health department authorities in connection with rat control during the year and rendered assistance to programs in Lawrence and Wichita. The absence of anyone at the State level responsible for rat control greatly deters progress in the activity. A survey was conducted in Lawrence; Wichita was helped in training a person to direct a contemplated rat control program there.

Minnesota. This State was transferred to Region V during the year. Consultative services were rendered prior to this change, particularly with reference to Duluth, Minneapolis, and Willmar.

Missouri. At the State level, a sanitary engineer devotes part of his time to rodent control. Appropriate services were extended programs in St. Louis and Kansas City. St. Louis maintains a small ratproofing crew. Kansas City ratproofed approximately 2,000 business establishments during the year.

North Dakota. Grand Forks enacted legislation supporting rat control in 1948 but there was little effective activity during 1949. The Fargo program was supported by the assignment of a staff member from CDC. Minot passed a rodent control ordinance, and assistance was extended in inaugurating a complete control program. Some 160 establishments were ratproofed in Bismarck, although no full-time personnel were assigned to rodent control work.

South Dakota. A CDC man has been assigned to assist in the rat control program in this State. Five communities have enacted rat control ordinances and others are operating programs on a voluntary basis. Pierre, Deadwood, Huron, Sisston, and Rapid City have ordinances. Rapid City's main project has been the establishment of a sanitary land fill. Watertown has employed a person to handle rat control activities and progress is being made.

Nebraska. A rat control demonstration was held in Lincoln during the year. Hastings established a sanitary land fill to replace an open dump. Otherwise, rat control in the State is spasmodic.

INSECT CONTROL OPERATIONS

Activities in this sphere centered around demonstrations and consultative services in fly control, training courses in insect control, participation in seminars, and assistance to State and local health departments in planning insect control programs.

At the request of the Bureau of Animal Industry, studies were conducted to determine the prevalence of infestation in the packing house areas; and on the basis of these studies, an insect control training course was presented to packing house personnel. Insect control operations were carried on in Platte City, Mo., and the city-county health officer in Fort Scott, Kans., was assisted in formulating plans for fly control and mosquito abatement operations there. Utilizing both power and hand spray equipment, a fly control demonstration was conducted at the Old Soldiers' Home

Courtesy of the David J. Sencer CDC Museum

at Dodge City, Kans.

SPECIAL ACTIVITIES

Fortunately, there was no need for extensive disaster and epidemic aid in the Midwestern area during the year. However, personnel and equipment were held available to respond to calls in such emergencies, and planning in this activity was continued.

★ Missouri

C. F. ADAMS, M.D., Acting Director State Division of Health

Operational activities during 1949 consisted of DDT residual spraying of premises in the malarious sections of the State and larvicidal programs, where necessary, in the vicinity of military and Veterans Administration installations.

DDT RESIDUAL SPRAYING

During the period July 1 - December 31, 1948, operations centered around the spraying of premises missed earlier in the season, and the respraying of premises where results from the first treatment were not satisfactory. Spraying was practiced in 13 counties during the period January 1 - June 30, 1949.

Local participation, in the form of labor, warehouse and office space, utilities, and supplies, amounted to 34 percent of the total cost of 1949 operations.

Rosin was used in outdoor applications with effective results. Emphasis was directed toward the treatment of entire premises in all 1949 spraying, in view of noted decrease in concurrent fly control. It was discovered that the public tends to become lax in general household and premises sanitation in sprayed areas, placing reliance on DDT residual spraying alone. Organized educational efforts were used to combat this attitude.

MILITARY MALARIA CONTROL

At Fort Leavenworth Veterans Administration Hospital and Jefferson Barracks, local participation in control efforts was stressed. Equipment was loaned to the hospital for use in removing aquatic vegetation from nearby waters and in larvicidal operations. Military authorities at Fort Leavenworth Army Post carried on aerial larviciding at approximately 10-day intervals throughout the mosquito season. Some 1,800 units in the Veterans' Housing area at Jefferson Barracks were sprayed. In cooperation with National Guard units, larviciding was practiced on waters in the Guard training area.

ENTOMOLOGICAL ACTIVITIES

The CDC entomologist conducted evaluative surveys throughout the operational area and made malaria surveys of impoundments, including Lake Wappapello, Clearwater, Lake Ozark, and Lake Norfork. The field fly testing kit was used in surveys to determine the extent of DDT resistance of flies and in investigating complaints concerning the effectiveness of the spray program. These investigations indicated that in the majority of cases where complaint of poor fly control was registered, poor sanitation was practiced. However, it was indicated that continued public support of the spray program is contingent upon improvement in the effectiveness of the insecticide employed.

EDUCATIONAL ACTIVITIES

All available facilities were utilized in the dissemination of information concerning malaria and fly control. More than 35 newspapers and 6 radio stations in the area cooperated. Forty group meetings were arranged with educational, civic, and public officials.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating			13
Number of spray applications			43,766
Pounds of DDT used			53,989
Total man-hours expended	CDC	10,663	62,450
	Local	51,787	
Man-hours per application			1.18
Man-hour per pound of DDT			0.96
Pounds of DDT per application			1.23

*Data are from progress reports submitted to CDC Engineering Services by State health department.

Courtesy of the David J. Sencer CDC Museum

Region VIII

Arkansas
Louisiana
New Mexico
Oklahoma
Texas

REGION VIII HEADQUARTERS: DALLAS, TEX.

Activities of CDC personnel at the Regional level consisted of the rendering of technical supervision, consultative services, and other support to State-operated malaria and typhus control programs. Four of the five States in the Region (Arkansas, Louisiana, Oklahoma, and Texas) operated malaria control programs. Arkansas, Louisiana, and Texas also carried on typhus control programs. New Mexico, the fifth State, has no malaria problem of public health significance and did not carry on organized typhus control in 1949. However, a CDC representative was assigned to the New Mexico Health Department to advise with cities and towns engaged in rodent control activities.

Malaria control activities during 1949, as in previous years, consisted principally of the application of DDT residual spray to houses in the malarious areas of the operational States. Spraying at the rate of 200 milligrams of DDT per square foot was practiced in the rural areas by State malaria control personnel. Most of the cities and towns carried on their own mosquito control programs using DDT residual spray. Inspection records showed 98 percent of sprayed homes free of malaria mosquitoes.

The receding typhus incidence resulted in a decrease in the number of counties preapproved for typhus control operations and a corresponding reduction in CDC allocations. DDT dusting, ratproofing, and rat poisoning were conducted in many counties, however, including a considerable number not on the preapproved list. Counties not on the preapproved list provided local tax funds or assessed fees for work performed.

Activities other than malaria and typhus control included (1) rodent and flea collections in West Texas to determine possible plague foci, (2) fly control guidance, and (3) disaster aid in connection with the Trinity River flood in the Fort Worth area, May 1949.

A number of cities in the Region inaugurated fly control programs. Some sought and received assistance in planning and executing their plans and others proceeded on their own. The tendency was to rely mainly on chemical sprays to the neglect of environmental sanitation.

In March 1949, an entomologist was assigned to the Regional office to serve as consultant and coordinator in the malaria, typhus, and related control activities of the respective State health departments.

★ Arkansas

T. T. ROSS, M.D., State Health Officer

As in previous years, major attention was directed toward malaria control through DDT residual spraying and larviciding; and typhus control through premises sanitation, rat poisoning, and ratproofing. Supplementary to concurrent control resulting from residual spraying for malaria, a number of cities and smaller towns initiated programs specifically directed toward fly control.

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MALARIA CONTROL

Fifty counties participated in the 1949 control program. Application of DDT was at the rate of 200 milligrams of DDT per square foot. Spray crewmen collected a fee ($2.00 per house and 50 cents per outbuilding) from householders. Outbuildings were sprayed or not as householders prescribed. A second application was made available to those who requested it and paid a second fee. Houses of welfare clients were sprayed, with the local government paying a spray fee of $1.00 per unit.

All DDT concentrate was mixed in the State warehouse. Xylene was used as solvent and Triton X-100 as emulsifier. Open head type spray cans, fitted with air release valve and Schraeder valve for recharging, were used principally; Hudson and Lofstrand cans were employed in some instances. Automotive equipment, consisting of pick-up trucks and old Army tactical vehicles, was serviced and maintained through the facilities of a central garage.

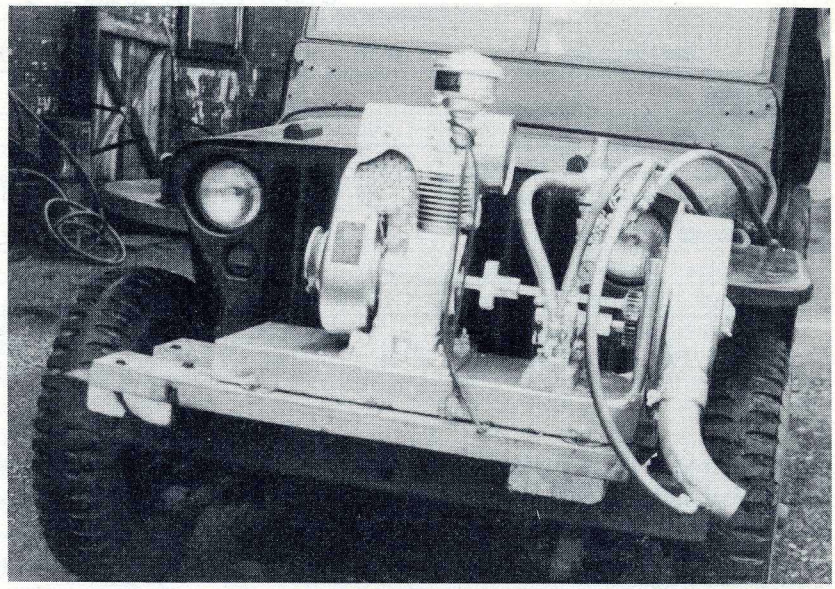
Larviciding was practiced in 22 towns in 19 counties. In most instances, a DDT oil mist spray was used. Some localities applied fuel oil with knapsack pressure sprayers. Power operated equipment was used in three zones, and six towns employed airplanes for larviciding areas not reachable by ground equipment. Practically all of the cost of larviciding operations was borne by local communities.

ENTOMOLOGICAL ACTIVITIES

As indicated in table 22, the residual spray (1948 season) produced effective control of *A. quadrimaculatus* and retained its effectiveness without appreciable decrease for 5 months. Of 2,314 houses inspected during the 1948 season, 96 percent were free of malaria mosquitoes in the afternoon. Of 119 houses sprayed in excess of 5 months prior to inspection, 93.3 percent were free of malaria mosquitoes; whereas, 97.4 percent of 647 houses inspected between 2 and 3 months after spraying were free of malaria mosquitoes.

Inspection records of sprayed and unsprayed houses are summarized in table 23, arranged to show the number of houses inspected on premises having various densities of *A. quadrimaculatus* indicated by the number occurring in favorable unsprayed resting places and the percentage of houses free of these mosquitoes in the afternoon. Included in the table are records of inspections of 2,314 sprayed and 196 unsprayed houses.

Results of entomological inspections carried on in the 14 CDC larvicidal zones are indicated in figure 17, showing the relationship between the average of the highest "A" station in each zone as compared with the average of the highest station in each zone. The latter indicates conditions which would obtain in the absence of control efforts. The "A" station average, as indicated on the graph, remained below the accepted standard count of 10 *A. quadrimaculatus* except for 2 weeks during the year. This is a much improved condition over the previous year when the average of these stations remained high from June through August. It is interesting to note that the highest average station counts per zone in relation to the Mississippi River stages at Helena coincide with each fall in the river's level. The graph shows, too, that the mosquito count dropped sharply with each rise in the river's level. This behavior was due to the fact that receding water left isolated pockets which immediately became breeding areas and each rise in the water interrupted breeding by flushing action on these pockets of water.



Mist sprayer made from root power sprayer used in larvicidal operations. The machine is mounted on a jeep and one man can operate it.

Courtesy of the David J. Sencer CDC Museum

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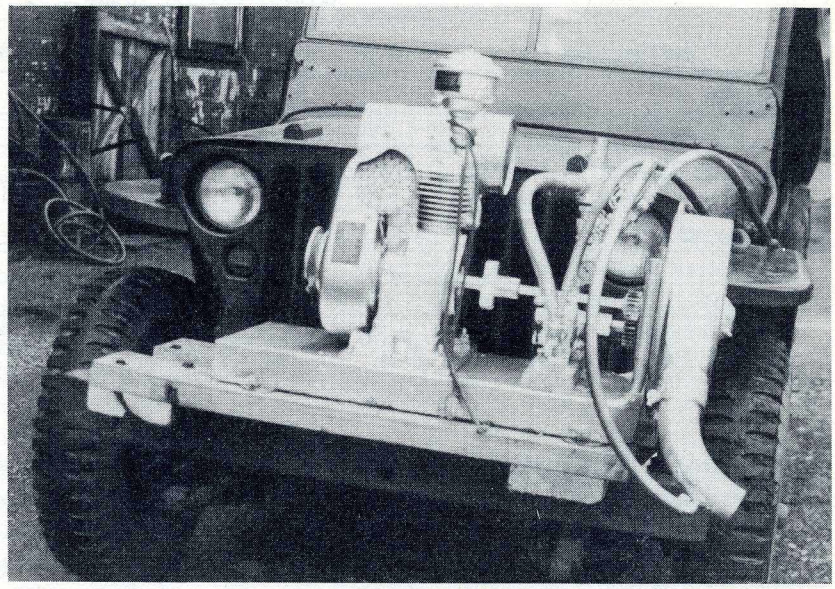

Mist sprayer made from root power sprayer used in larvicidal operations. The machine is mounted on a jeep and one man can operate it.

Courtesy of the David J. Sencer CDC Museum

Table 22

HOUSE INSPECTION - RESIDUAL SPRAY PROGRAM

Total Treated Houses Inspected and Percentage Free of "A. quadrimaculatus" in Afternoon

(Based on Spray Inspection Time Intervals)

Spray Interval		1948			1947		1946	1945
		300 mg. DDT/sq. ft.			200 mg. DDT/sq. ft.	300 mg. DDT/sq. ft.	200 mg. DDT/sq. ft.	100 mg. DDT/sq. ft.
		No. houses	Houses free of "A. quad."		% houses free of	% houses free of	% houses free of	% houses free of
Days	Mo.	Insp.	No.	%	"A. quad."	"A. quad."	"A. quad."	"A. quad."
0-28	1	161	155	96.3	98.5	100.	99.5	98.6
29-56	2	422	407	96.4	98.7	98.7	99.3	96.3
57-84	3	647	630	97.4	98.3	99.6	99.2	92.5
85-112	4	655	630	96.2	98.8	99.6	98.9	91.7
113-138	5	310	298	96.1	96.6	100.	98.6	77.0
over 138		119	111	93.3	-	-	-	-
Total		2,314	2,231	-	-	-	-	-
Percent		-	-	96.0	98.2	99.5	99.1	91.2

Table 23

HOUSE INSPECTIONS - RESIDUAL SPRAY PROGRAM - 1948

Total Treated and Untreated Houses Inspected and Percentage Free of "A. quadrimaculatus"

(Based on "A. quadrimaculatus" Density Groups)

Evaluations	Natural resting place - "A. quadrimaculatus" densities						
	0-10	11-30	31-50	51-100	101-200	Over 200	Total
SPRAYED							
No. houses inspected	1,290	495	145	151	85	148	2,314
No. free of "quads" in p.m.	1,266	475	136	142	79	132	2,230
% free of "quads" in p.m.	98.2	96.0	93.8	94.1	92.9	89.2	94.0
UNSPRAYED							
No. houses inspected	98	48	9	19	8	14	196
No. free of "quads" in p.m.	79	28	5	11	2	9	134
% free of "quads" in p.m.	80.6	58.3	55.6	57.9	25.0	64.3	57.0

Confronted with a deluge of complaints about the abundance of flies in sprayed houses and evidence that the complaints were well founded, a system of "special DDT residual inspection" was evolved to determine the killing power of the residue. The system used consisted of confining against a sprayed wall or ceiling of houses a known number of flies and observing their reactions. The flies (house or muscoid type) were incarcerated in a screened cage with one side in contact with the sprayed surface of the house. Three test cages of flies were affixed to the walls (in different rooms) of each house and a fourth cage (protected from contact with treated surface) used as a con-

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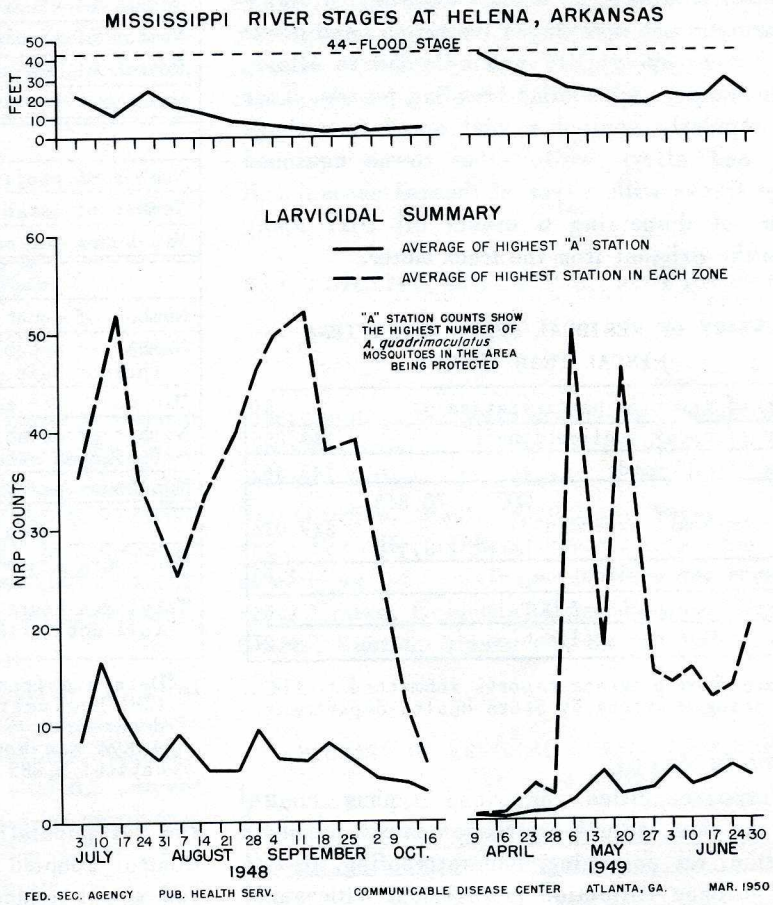
trol. Pertinent data, such as weather conditions, type of wall or surface, age of spray, spray pattern, crystalline structure, spray material, condition of screens, and abundance of flies outside, were recorded. Four hours of exposure to the sprayed surface was presumed to be sufficient to kill, but observations were continued up to 12 hours.

Evaluation of results was broken down into four categories: (1) 100 percent of test flies killed in 4 hours and flies in control cage unaffected; (2) over 50 percent of test flies killed in 4 hours and flies in control cage unaffected; (3) under 50 percent of test flies killed and flies in control cage unaffected; and (4) unsatisfactory test – flies in control cage affected.

Mosquitoes were used as test insects in inspections in District 2. The total number was not large but the over-all percentages approximated those obtained with flies.

Results of these special inspections are summarized in table 24. As indicated in the table, 100 percent kill was recorded in 27 percent of the tests and over 50 percent kill in 32 percent of the total tests.

FIGURE 17
ARKANSAS MALARIA CONTROL— FY-1949



Later in the 1948 fly season, a second type of testing procedure was used to determine whether or not flies actually roosted on a sprayed surface or preferred unsprayed situations such as clothing or furniture. This procedure consisted of visiting selected houses in the afternoon to observe the number of flies present, their location in the house, and other pertinent data; and returning to the same houses before daybreak the next morning to determine the number of live flies, their roosting place, and their behavior before being disturbed.

Flies were active at time of afternoon inspections. Nocturnal observations showed 90 percent roosting on treated surfaces, generally the walls and ceiling of the kitchen. Predawn inspections (made before flies outside of the houses resumed activity) disclosed that of 14,614 flies observed

Table 24

SUMMARY OF SPECIAL DDT INSPECTION CAGE TESTS USING MUSCOID FLIES

District No.	100% Kill		Over 50% Kill		Under 50% Kill		Unsatisfactory Test	
		%		%		%		%
1	54	21	85	33	94	32	35	14
2	37*	26	61*	44	36*	26	6*	4
	88	27	104	33	95	30	33	10
3	200	34	118	20	214	36	54	10
4	155	24	272	43	172	27	40	6
Totals	497	27	597	32	575	32	162	9

*Mosquitoes used in these tests.

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during afternoon inspections 4,687 remained on treated surfaces, indicating a reduction of 69 percent in fly population.

A number of cities and smaller towns operated fly control programs, as such, consisting of clean-up campaigns and spraying. Five towns used power equipment to apply DDT and chlordan to alleys, garbage dumps, and similar breeding places. Four towns regularly applied a mist spray to garbage dumps and alleys while other towns equipped garbage trucks with a type of thermal aerosol unit capable of dispersing a diesel oil DDT spray through the exhaust from the truck motor.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating		50
Number of spray applications		113,825
Pounds of DDT used		143,462
Total man-hours expended	CDC 70,863 Local 148,172	219,035
Man-hours per application		1.93
Man-hours per pound of DDT		1.53
Pounds of DDT per application		1.27

*Data are from progress reports submitted to CDC Engineering Services by State health department.

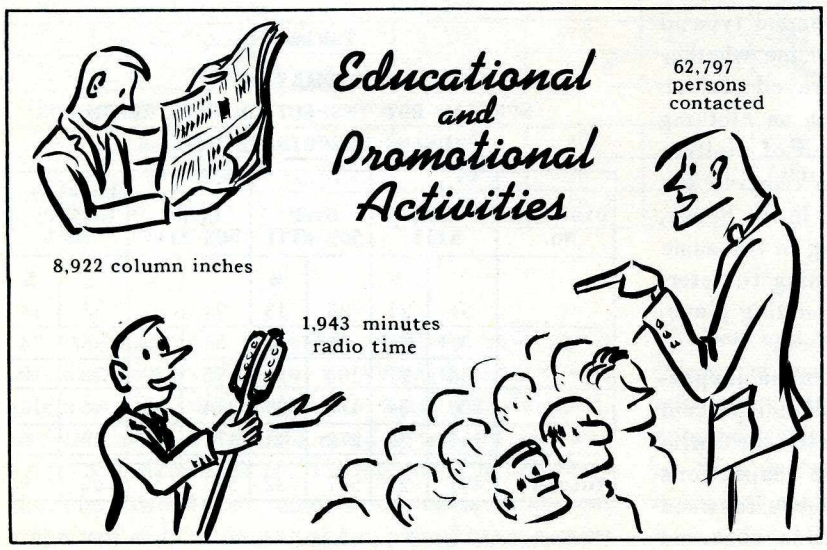
SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		-
Number of premises dusted		-
Pounds of DDT per premises		-
Man-hours per premises		-
Ratproofing**		
Number of projects reporting		2
Number of establishments ratproofed		338
Man-hours per establishment		48
Rat Reduction		
Number of counties reporting		2
Number of establishments poisoned (poison bait - food)		300
Man-hour per establishment		0.3
Number of establishments poisoned (poisoned water - 1080)		-
Man-hours per establishment		-
Evaluation Activities		
Man-hours expended		2,100
Total man-hours expended (all activities)	CDC 5,044 Other 22,686	27,730

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**4,694 man-hours expended on initial eradication; 2,883 on maintenance.

TYPHUS CONTROL

Twenty-five cities practiced typhus control during the year, including garbage control, premises sanitation, rat poisoning, and ratproofing. In two cities, garbage collection improvement with sanitary land fill disposal and rat poisoning reduced the rat population 80 percent. Improved garbage control coupled with periodic rat poisoning with red squill reduced the rat population as much as 95 percent in four cities. Two cities carried on organized ratproofing, and volunteer ratproofing was practiced in four others. It is estimated that property owners expended $15,000 in ratproofing old buildings, and rat control features were incorporated in plans for 2 billion dollars in new construction.



EDUCATIONAL AND PROMOTIONAL ACTIVITIES

During the year, 8,922 column inches of newspaper publicity and 1,943 minutes of radio time were utilized in the dissemination of information in support of malaria and typhus control operations. In addition, area supervisors contacted 62,797 persons through interviews and group

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meetings. A program of cooperation with the State health department in school, community, and home sanitation was instituted in October. Garbage collection and disposal inspections were made in 60 towns and inspections made of 998 schools. These inspections were responsible for 295 corrections of existing facilities and the installation of 338 new approved facilities. Increased emphasis was placed on basic sanitation in an attempt to overcome the tendency to rely upon chemical control of insects. Five colleges cooperated in the holding of communicable disease control workshops in connection with teacher education by allowing participating teacher credit for the courses. In-service training was accomplished through two courses in sanitation and community organization.

★ Louisiana

S. J. PHILLIPS, M.D., M.P.H., State Health Officer

Cooperative programs for the control of malaria and murine typhus were conducted during the fiscal year 1949 along the same lines and at about the same level as in 1948. Apart from the cooperative programs, considerable larviciding and drainage maintenance work was carried on by local communities in connection with malaria control.

MALARIA CONTROL

Residual house spraying, primarily in rural areas, was practiced in 18 of 26 parishes preapproved for malaria control operations. Approximately 50,000 units were sprayed with 6.5 percent DDT emulsion. All concentrate was prepared at a central mixing plant at Monroe. The material was supplied to the field in 55-gallon drums.

The parishes of Winn, Concordia, Madison, and Ouachita made appropriations out of public funds. In the other 14 parishes participating in the cooperative program, a fee of $1.00 was collected from each householder whose house was sprayed.

Spraying for the 1948 season was terminated June 30. Supervisory personnel for the 1949 season was engaged during October 1948, and spraying operations commenced about the first of April 1949. Spray crewmen were given 7 to 10 days of training prior to the opening of spray operations. Spraying was with 2½-gallon, pressure-type hand cans. Twenty-one of 62 spray crews were equipped with compressors and pressure storage tanks. Two-man crews were used in most instances; however, one-man crews were utilized in spraying sparsely-settled communities.

The following cities and towns in preapproved parishes carried on larviciding and drainage maintenance programs at their own expense, under the supervision of the State health department: Shreveport, Haynesville, Homer, Ferriday, Lake Providence, Hodge, Jonesboro, Tallulah, Bastrop, Natchitoches, Many Opelousas, Minden, Delhi, and Rayville. Other communities conducting larviciding and drainage maintenance programs were: Clarks, Columbia, Baton Rouge, Winnsboro, Colfax, Ruston, Alexandria, Boyce, and Mangham.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating			18
Number of spray applications			50,973
Pounds of DDT used			62,055
Total man-hours expended	CDC	15,808	69,123
	Local	53,315	
Man-hours per application			1.36
Man-hours per pound of DDT			1.11
Pounds of DDT per application			1.22

*Data are from progress reports submitted to CDC Engineering Services by State health department.

TYPHUS CONTROL

There was a slight increase in the incidence of murine typhus in the State during 1949. The increase occurred principally in parishes where previously the incidence had been very low, except in the parish of Caddo. Typhus control work on a parish-wide basis was discontinued in Caddo Parish, and an increase of six cases was recorded in 1949; whereas in Orleans Parish, where parish-wide control work has been continuous, 1949 reports

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show a decrease of seven cases.

It is probable that the extraordinarily warm and long summer contributed to the increase in typhus. There are indications, too, that the extensive educational program carried on in connection with typhus control has resulted in better reporting and hence contributed to the increase in recorded cases of typhus.

Control operations carried on during the year included DDT dusting for the control of rat ectoparasites in six parishes, ratproofing on a somewhat reduced scale, and rat reduction through poisoning in five parishes.

Ratproofing activities decreased during the year due to the completion of projects previously commenced and the continued high cost of ratproofing labor and materials. The New Orleans project was continued during 1949.

In rat poisoning operations, a new pecan crumb bait was developed and introduced with excellent results, particularly with respect to the Alexandrine rat; it also proved satisfactory with Norway rats. The use of 1080 in souffle cups was discontinued in favor of a type of permanent station of dispenser approved by the U. S. Wildlife Service and the Louisiana Health Department.

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		6
Number of premises dusted		39,390
Pounds of DDT per premises		3
Man-hour per premises		0.4
Ratproofing**		
Number of projects reporting		2
Number of establishments ratproofed		189
Man-hours per establishment		33
Rat Reduction		
Number of counties reporting		5
Number of establishments poisoned (poison bait - food)		25,095
Man-hour per establishment		0.3
Number of establishments poisoned (poisoned water - 1080)		4,120
Man-hour per establishment		0.8
Evaluation Activities		
Man-hours expended		5,650
Total man-hours expended (all activities)	CDC 25,239 Other 19,996	45,235

*Data are from progress reports submitted to CDC Engineering Services by State health department.

**574 man-hours maintenance; 965 initial eradication.

★ Oklahoma

G. F. MATTHEWS, M.D., Commissioner of Health

The malaria control program continued on essentially the same basis as in previous postwar years. The principal control activity was DDT residual spraying in the southeastern section of the State. Larvicidal operations were conducted by a few cities and a minor project was carried on in the vicinity of the Veterans Administration Hospital at Muskogee. Local communities conducted fly control operations with supervision and consultative services provided by the State CDC office.

DDT RESIDUAL SPRAYING

County-wide spraying operations were conducted in eight counties (Atoka, Choctaw, Haskell, Jefferson, Latimer, Okfuskee, Pushmataha, and Sequoyah). Limited operations were carried on in six counties (Bryan, LeFlore, McIntosh, McCurtain, Muskogee, and Pittsburg). Supervision, equipment, transportation, and chemicals were provided through Federal and State allocations. In the eight county-wide programs, local units appropriated funds to cover the costs of spray crews; and in the limited spray counties, householders were charged fees to cover spray crew costs.

In the counties where DDT residual spraying has been practiced most extensively, there has been only one death attributed to malaria since 1946. This one death was reported from Choctaw County in May 1949. During the period 1935-44, deaths from malaria in this area averaged 24 per year. Morbidity reports for the first 6 months of 1949 list 42 reported cases of malaria.

Because the public tends to base the success

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or failure of the residual spray program on the presence or absence of flies in the treated area, the problem of muscoid flies received increasing attention during the year. An extensive educational program designed to inform householders, public officials, and others concerning the fundamentals of fly ecology and sanitation was undertaken. Promotion of premises spraying as a means of more effective fly control was coupled with the educational program. Late in the season, fly surveys were initiated in communities as a special service incidental to the DDT spray program. Information obtained through these surveys clearly indicated (1) that the 1949 fly population was greater than in any season since the inception of the DDT spray program and (2) that community and household sanitation are necessary features of effective fly control.

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating		14
Number of spray applications		26,351
Pounds of DDT used		33,507
Total man-hours expended	CDC 8,534 Local 25,499	34,033
Man-hours per application		1.29
Man-hours per pound of DDT		1.02
Pounds of DDT per application		1.27

*Data are from progress reports submitted to CDC Engineering Services by State health department.

LARVICIDING

Reconnaissance surveys related to the malaria transmission hazard were conducted in areas surrounding military installations and Veterans Administration Hospitals as follows: Tinker Air Base and Will Rogers Memorial Hospital, Oklahoma City; Fort Sill, Lawton; Naval Ammunition Depot, McAlester; Veterans Administration Hospital, Muskogee; and Oklahoma Veterans Hospital, Sulphur. Malaria mosquito production was demonstrated in each of these areas; however, the production of *A. quadrimaculatus* and the incidence of malaria indicated control activities only at Muskogee in 1948. DDT in diesel oil was used as a larvicide in this area. No larviciding was practiced in the area in 1949, but control recommendations and consultative services were made available to local authorities.

ENTOMOLOGICAL ACTIVITIES

Surveys of malaria mosquito and muscoid fly densities and evaluative inspections were conducted in all areas included in the DDT residual spray program. In cooperation with the Corps of Engineers, Department of the Army, special studies of the mosquito problem were conducted in the reservoir areas of Texoma and Wister.

Findings of entomological inspections for the evaluation of the effectiveness of the spray program are summarized in table 25. From July through October 1948 inspections were made in 412 locations and inspections in 303 locations were conducted in June 1949.

COMMUNITY FLY CONTROL

Unusually high poliomyelitis incidence resulted in an abnormal demand for consultative services and requests for direct participation in the development of community fly control programs. A bulletin outlining detailed plans for organizing and operating community fly control programs, utilizing various chemical control methods, was edited and distributed. Additional guidance was given through personal contact with local officials and through the press and radio in an attempt to disseminate authoritative information on the present status of scientific knowledge on the relation of flies and

Table 25

SUMMARY OF INSPECTIONS WITH RESPECT TO INFESTATION BY "A. QUADRIMACULATUS"

Year	1948						1949	
Month	July	Aug.	Sept.	Oct.	Total	%	June	%
Sprayed houses inspected	119	124	65	58	366	-	273	-
Sprayed houses with "quads"	4	3	0	0	7	1.9	0	0.0
Unsprayed houses inspected	17	13	8	8	46	-	30	-
Unsprayed houses with "quads"	9	5	1	0	15	32.6	2	6.7
Resting places inspected	136	137	73	66	412	-	303	-
Resting places with "quads"	135	131	65	17	348	84.5	137	45.2

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poliomyelitis. The importance of sound sanitation practices was emphasized in all fly control activities.

Community fly control efforts during the year were extensive though somewhat sporadic. Some 25 communities purchased space spray equipment, and many others used other types of power equipment through contract operators.

★ Texas

GEORGE W. COX, M.D., State Health Officer

Operational programs encompassed malaria, murine typhus, and plague control activities. There was no material expansion of operations during the year.

MALARIA CONTROL

The DDT residual spray program was continued in the malarious sections of east Texas and the lower Rio Grande Valley. In east Texas, the popular method of application was the hand sprayer; while in the valley area, power sprayers were more effective. Two applications were made in the valley area and one in east Texas. During the 1948 spray season a 7 percent emulsion was used, while 5 percent was used during the 1949 spray season with greater emphasis on comprehensive coverage. Two methods of local participation were employed during the 1948 season: (1) direct appropriation from county funds; and (2) a minimum charge to householders, based on number of rooms treated, to supplement county funds. In 1949 season operations, local participation was by direct appropriations from counties.

Satisfactory control of malaria mosquitoes was obtained, but more and more complaints were made about the reduced level of fly control. Field follow-up investigations were made in an effort to evaluate the degree of fly control. It was concluded that relative freedom from flies cannot be achieved by DDT residual spraying where there is a prime source of fly breeding in the community. Many communities, rural and urban, desire expansion of fly control operations, and public officials express assurance that additional support would be available if more comprehensive control could be integrated with the residual spray program.

Technical assistance was furnished cities with

SUMMARY OF RESIDUAL SPRAY OPERATIONS FISCAL YEAR 1949*

Number of counties participating		38
Number of spray applications		71,870
Pounds of DDT used		72,225
Total man-hours expended	CDC 67,236 Local 57,866	125,102
Man-hours per application		1.74
Man-hours per pound of DDT		1.73
Pounds of DDT per application		1.01

*Data are from progress reports submitted to CDC Engineering Services by State health department.

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		49
Number of premises dusted		23,676
Pounds of DDT per premises		4.5
Man-hours per premises		1.6
Ratproofing**		
Number of projects reporting		11
Number of establishments ratproofed		823
Man-hours per establishment		52
Rat Reduction***		
Number of counties reporting		8
Number of establishments poisoned (poison bait - food)		867
Man-hours per establishment		1.3
Number of establishments poisoned (poisoned water - 1080)		16,006
Man-hours per establishment		1.4
Evaluation Activities		
Man-hours expended		23,842
Total man-hours expended (all activities)	CDC 75,037 Other 81,955	156,842

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**427 man-hours initial eradication.
***265 pounds cyanogas at expenditure of 523 man-hours.

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populations above the limits of eligibility for residual spraying, and approximately 30 cities carried on larvicidal and partial residual treatment programs. Limited larvicidal operations were carried on in the Fort Worth-Dallas area in connection with extra-cantonment malaria inspection work.

TYPHUS

Typhus control measures included DDT dusting, rat eradication, and ratproofing. Dusting was carried on in the more densely populated areas with the participating agency providing the major share of the labor involved. Rat eradication measures (1080 in business establishments and red squill in residences) were practiced as an adjunct of dusting operations. Mobile units were used in the more sparsely populated areas and stationary units in the cities. Control operations were on a selective basis rather than county-wide, as in previous years. This resulted in a slight curtailment in coverage but permitted effective treatment in areas of known and suspected typhus foci. Trapping, bleeding, and combing before and after dusting indicated effective control of the typhus vector.

Ratproofing operations were conducted at approximately the same level as last year. Stress was placed on proper garbage handling and disposal in communities where ratproofing was carried on. Maintenance of ratproofing was emphasized in areas where ratproofing previously had been practiced.

Region IX

Colorado
Idaho
Montana
Utah
Wyoming

REGION IX HEADQUARTERS: DENVER, COLO.

Communicable Disease Center activities carried on in Region IX during 1949 centered around (1) rodent control, (2) plague investigations, (3) insecticidal and rodent control demonstrations, and (4) educational and training activities.

RODENT CONTROL

Rodent control surveys were conducted in Burlington, Colo.; Sheridan, Wyo.; and Provo, Utah. A ratproofing survey, designed to determine infestation, rat harborages, caliber of garbage disposal, and potential proofing problem, was conducted in Salt Lake City, Utah. The CDC rodent control specialists assigned to Colorado assisted in rodent control surveys and rat poisoning programs conducted in various small towns under the sponsorship of the State department of health; he also cooperated in a program of the Tri-County Health Unit to promote proper garbage handling and the substitution of sanitary land fills for garbage dumps.

Ratproofing (Denver). During the period July 1, 1948-April 1, 1949, the following ratproofing activities were carried on in Denver: (1) 194 premises were ratproofed, (2) 548 premises were surveyed for ratproofing, and (3) 900 premises were poisoned with red squill bait. In addition, approximately 40 city blocks, in the stockyard area, and unauthorized dumps were poisoned. In Denver, the city conducts necessary surveys to determine the degree of infestation in business establishments, the extent of the proofing problem, and submits a cost estimate to the occupant and/or owner. The owner or occupant then may contact a pest-control operator and arrange for ratproofing. The Denver Health Department helps in training pest-control operators in ratproofing and other rat control procedures.

Salt Lake City. An evaluation survey was made to determine the degree of infestation and to provide other pertinent data. Complete ratproofing surveys were made of 23 buildings during March

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and plans readied for actual operations. Simultaneously, concentrated attention was given to improved garbage handling procedures.

PLAGUE INVESTIGATIONS

Plague investigations in the Region centered in Denver, Colo., and Salt Lake City, Utah.

In Denver, a study of rodent infestation indicated that 80 percent of the city's rats are in the downtown district, the old Mexican residential section, and the stockyard area; and that all of the rats in the city were of one species, the Norway rat (*R. norvegicus*). The study also indicated that *X. cheopis*, the vector flea involved in the transmission of bubonic plague, is infrequent in Denver. Studies, thus far, have been confined to Denver and adjacent counties. Plague has not been detected in this area up to the present time.

The Salt Lake City investigations project, embracing the city and the adjacent counties of Salt Lake, Davis, Weber, Morgan, and Summit, has been concerned with domestic rats, wild rodents, and predatory birds. Both the Norway rat (*R. norvegicus)* and the roof rat *(R. rattus)* were found in this study area. Plague infection was detected by the San Francisco Plague Laboratory in a pool of 39 fleas taken from two ground squirrels trapped September 21, 1948, south of the mouth of Height Canyon along Wastach Boulevard, Salt Lake City. A pool of fleas taken from four white-footed mice trapped September 22, 1948, 1 mile east of Evergreen Picnic Grounds along the road in Millcreek Canyon, Salt Lake County, also was found positive for bubonic plague.

INSECTICIDAL AND RODENT CONTROL DEMONSTRATIONS

A rodent, fly, and mosquito-control demonstration was given in connection with the training activities of the Rocky Mountain Sanitation Training Section of the University of Colorado. Other demonstrations included (1) a mosquito control demonstration for mosquito control personnel of the city of Denver; (2) a fly control demonstration at Fort Lupton, Colo., farm labor camp; and (3) a rodent control demonstration at the Denver National Home Show.

EDUCATIONAL AND TRAINING ACTIVITIES

A 4-week rodent control training program was conducted for Denver rodent control personnel. A 1-day rodent control training course was given to Salt Lake City personnel. A 5-day insect and rodent control training course was conducted for students of the Rocky Mountain Training Section.

Region X

Arizona
California
Nevada
Oregon
Washington
Alaska
Hawaii

REGION X HEADQUARTERS: SAN FRANCISCO, CALIF.

★ California

WILTON L. HALVERSON, M.D., Director of Public Health

Personnel and funds made available to California through the Communicable Disease Center were integrated into the operations of the Bureau of Vector Control, State Department of Health, except those expended in Q fever investigations. Principally, CDC personnel engaged in the following activities: (1) identifying vectors and other insects submitted from local health departments, mosquito

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abatement districts, and special surveys; (2) investigating vector-borne-disease potentialities of the Central Valley Project; (3) investigating the biology and control of *A. nigromaculis*; (4) investigating the biology and control of *Hippelates*; and (5) demonstrating rodent and fly survey and control methods, and training local personnel in their application.

This procedure, in the utilization of CDC personnel and funds, enabled the Bureau of Vector Control to adhere to its basic philosophy of leaving primary responsibility for control operations with local authorities and concentrating on helping them do the best job possible. Center personnel assigned to California activities during 1949 included four entomologists, two veterinarians, two biologists, two engineers, one nurse, four medical technicians, one entomological inspector, and four clerks.

Malaria and encephalitis constitute the greatest potential of proven vector-borne-disease in California, although currently at a relatively low incidence. During the calendar year 1948, 46 cases of malaria were reported, 33 of which were not properly chargeable to California. Encephalitis was reported in 69 instances, only 2 of which were confirmed by laboratory diagnosis. Dysentery and diarrhea, not proved to be vector-borne in California, had fairly high incidence during the year. There were 498 cases of dysentery and 132 cases of diarrhea of newborn reported. Relapsing fever (five cases), Rocky Mountain spotted fever (three cases), tularemia (seven cases), and plague (no cases) are vector-borne diseases of high potential in California, but were at low incidence this year.

During the fiscal year, CDC personnel assigned to the identification and evaluation unit participated in identifying 20,000 fleas, mites, lice, and ticks collected from 1,600 hosts acquired in connection with wild rodent surveys for plague recovery. Other activities included the identification of some 7,000 specimens from mosquito surveys in connection with the Central Valley project and 500 miscellaneous arthropods submitted by local health agencies.

Primary aim of activities in the Central Valley project area was to offer assistance to the planning, construction, and operating agencies in features of the program associated with the mosquito-borne-disease potential. The program entails the construction of 38 major reservoirs, 11 major canal systems, and the utilization of same in irrigation. In the absence of proper preventive measures, such operations greatly increase the mosquito breeding potential.

Late in 1948 a CDC entomologist was assigned to cooperate with the Coachella Mosquito Abatement District entomologist in a program of investigating the *Hippelates* problem in the Coachella Valley. The objectives of this project are: (1) test insecticides against adult gnats in the laboratory; (2) develop satisfactory field sampling techniques for gnats; and (3) study the biology and ecology of the gnat with the idea of devising more permanent control measures.

Previous work had revealed that satisfactory gnat control was not obtainable through airplane and ground space spraying with DDT. During the fiscal year, a number of insecticides were tested using a Hoskins-Caldwell settling chamber. The more promising materials are BHC, dieldrin, and aldrin. These materials were nominated for use in field tests during the fall peak of *Hippelates*.

Considerable effort was expended in improving bait traps and techniques so as to catch gnats more nearly in proportion to the true population in the field. Progress was made, but there remains room for improvement.

Efforts to establish a colony of *Hippelates* were unsuccessful. In a few instances eggs were recovered from females, but attempts to keep them alive were not successful.

Activities in behalf of fly control centered around training courses for State and local health department personnel and investigations of fly breeding in garbage and trash dumps, in cannery wastes, and in municipalities.

In California, municipal and county health departments have operated rodent control programs for a number of years. Participation in this activity at the State level consisted, in the main, of consultative services and the holding of training courses for local health department personnel. Two mobile units, equipped and staffed, operate throughout the State in urban areas. Upon the request of local health officers, a mobile unit moves into the area and makes a rodent survey. Rats are trapped, blood samples taken, and ectoparasites collected for entomological studies and plague tests. Consultative services are furnished also, particularly with respect to infestation, proper sanitary measures, garbage collection and disposal, equipment, and related items.

Serological surveys during 1948 indicated that Q fever is endemic in the Los Angeles area. Approxi-

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mately 800 cases have been investigated in various parts of the State since the first recognition of the disease in 1947. It is estimated that some 40,000 human cases have occurred in the Los Angeles area.

Careful epidemiological studies have been made of outbreaks in nonendemic as well as endemic areas. There are indications that the mode of transmission and other epidemiological factors vary considerably. Human association with cattle, sheep, and other domesticated animals appears to be more important in the spread of the disease in some areas than in others.

More than 18,000 animals have been tested serologically to determine the prevalence of Q fever infection. In northern California, 40 percent of the general population of domestic cattle and sheep were found to have been infected with the disease. Infection in dairy herds in the Los Angeles area varied from 15 to 70 percent. It is estimated that approximately 3 percent of the general population of domestic cattle and sheep are implicated. Less than 0.5 percent of wild animals tested were found infected.

★ Washington

J. A. KAHL, M.D., State Director of Health

Communicable Disease Center activities in Washington during 1949 centered around rodent control operations inaugurated in Spokane in January 1949. Prior to that time only limited rodent control work was carried on in the State.

Rodent control was inaugurated following a survey which disclosed a high percentage of buildings in the Spokane business area were infested with rodents.

A 2-week training course on rat control was conducted for city sanitarians, pest control operators, and other interested persons before control operations were started. The course included instructions regarding rat habits, rat-borne diseases, garbage collection and disposal as related to rat control, ratproofing, rat poisoning, and practical demonstrations in the field. During the same 2-week period, the public was informed concerning rat control and its importance, through talks to civic and business groups and through conferences with business and civic leaders.

Control operations were concentrated in the downtown business area. The city was divided into five districts and a sanitarian in addition to his other duties was placed in charge of ratproofing and rat eradication in each district. Infested buildings housing food-handling establishments, meat markets, bakeries, and packing houses were given preference. By the end of the fiscal year, 317 premises had been surveyed for ratproofing and 133 of this number ratproofed. Ninety-one of the 133 premises ratproofed during the year were also freed of rats.

Postcontrol inspections indicate that the program resulted in a general improvement of garbage and waste handling by business establishments

SUMMARY OF TYPHUS CONTROL ACTIVITIES

FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)			
Number of counties reporting			-
Number of premises dusted			-
Pounds of DDT per premises			-
Man-hours per premises			-
Ratproofing**			
Number of projects reporting			1
Number of establishments ratproofed			133
Man-hours per establishment			17
Rat Reduction			
Number of counties reporting			1
Number of establishments poisoned (poison bait - food)			4
Man-hours per establishment			22
Number of establishments poisoned (poisoned water - 1080)			-
Man-hours per establishment			-
Evaluation Activities			
Man-hours expended			-
Total man-hours expended (all activities)	CDC	1,910	
	Other	1,323	3,233

*Data are from progress reports submitted to CDC Engineering Services by State health department.

**180 man-hours on initial eradication.

Courtesy of the David J. Sencer CDC Museum

throughout the city, and gave impetus to the movement to establish a universal garbage collection system which is now in operation.

Activities apart from the Spokane program included assistance to a number of other cities in planning and promoting rodent control work.

★ Hawaii

C. L. WILBAR, JR., M.D., President of Board of Health

In Hawaii, Communicable Disease Center activities during 1949 were directed against the two rodent-borne diseases, endemic typhus fever and plague. Plague surveillance and control programs continued on the islands of Hawaii and Maui and plague surveillance measures were conducted on Oahu and Kauai. Procedures for the control of typhus fever were carried out in the city of Honolulu.

Territorial financial participation amounted to 90 percent of the total cost of rodent control opertions, with the Communicable Disease Center contributing 10 percent.

PLAGUE CONTROL AND SURVEILLANCE

There were no reported cases of human plague in the Territory during the fiscal year 1949, marking the fourth successive year that no human cases were reported. Four plague infections in rodents were reported, three from the Hamakua district on the island of Hawaii and one from the Makawao district on the island of Maui. Three of the plague infections were determined by mass flea inoculations and one by mass tissue inoculation. This total of four infections was six less than the number recorded for the fiscal year 1948.

The basic program for the detection, prevention, and control of plague infection remained unchanged during the year. In the Hamakua district, emphasis was placed on the control of rodent fleas by extensive application of DDT spray and dust in and adjacent to all structures throughout the area. The number of mass tissue and flea inoculations was increased in an effort to determine local foci of infection as a guide to control procedures during a quiescent period. On the island of Maui, 10 percent DDT dust was applied for the first time as a plague suppressive measure. In addition, a power sprayer was purchased for demonstration purposes and for use in connection with any outbreak of plague infection.

TYPHUS CONTROL IN HONOLULU

There were three cases of typhus fever reported for the city of Honolulu as against 14 for the previous year, an all-time low case rate of 1.1 per 100,000 population.

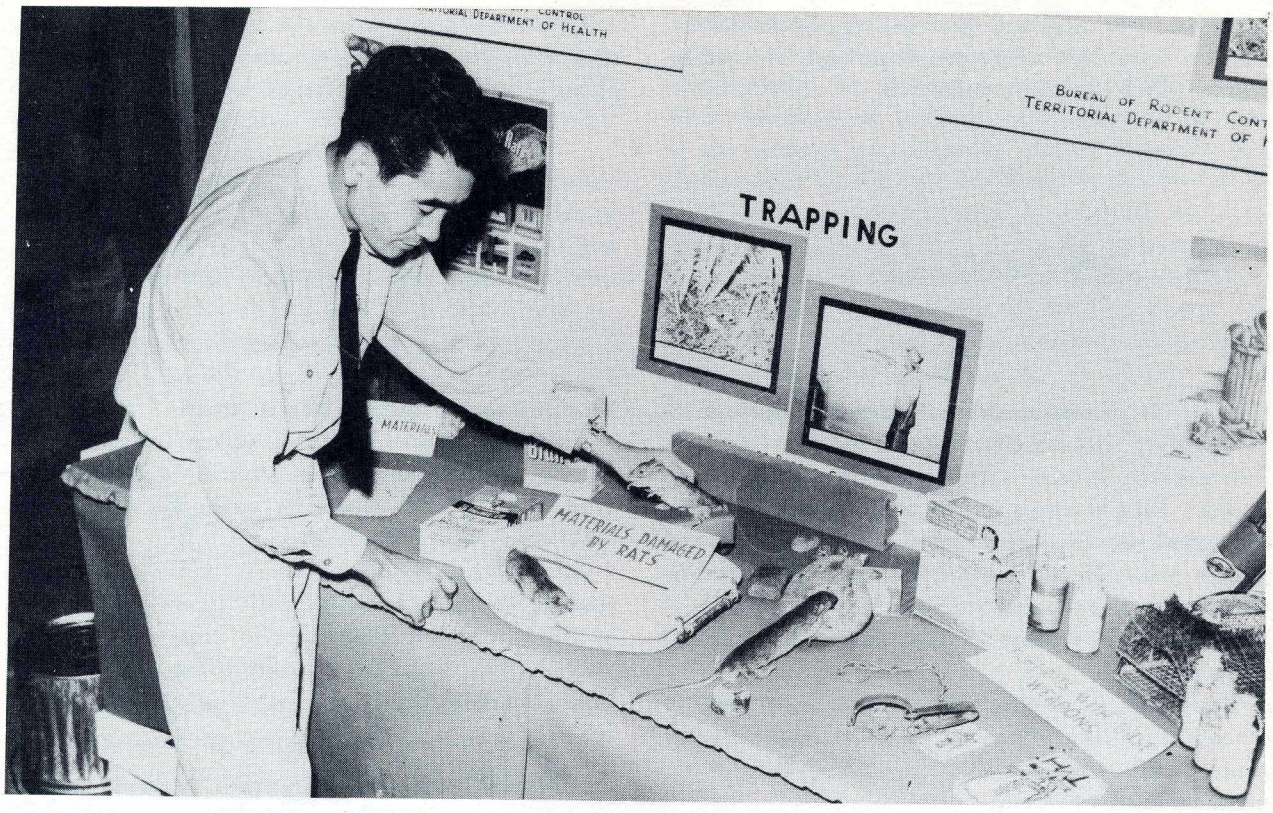
Ratproofing of business establishments and residences as an official activity was terminated on September 30, 1948, due to lack of contracts. This program had been carried on for 2 years with Communicable Disease Center assistance. Other

SUMMARY OF TYPHUS CONTROL ACTIVITIES FISCAL YEAR 1949*

DDT Dusting (Ectoparasite Control)		
Number of counties reporting		2
Number of premises dusted		7,551
Pounds of DDT per premises		3
Man-hour per premises		0.4
Ratproofing**		
Number of projects reporting		-
Number of establishments ratproofed		-
Man-hours per establishment		-
Rat Reduction***		
Number of counties reporting		3
Number of establishments poisoned (poison bait - food)		188
Man-hours per establishment		6
Number of establishments poisoned (poisoned water - 1080)		17
Man-hours per establishment		2.4
Evaluation Activities		
Man-hours expended		30,063
Total man-hours expended (all activities)	CDC 4,314	
	Other 35,736	40,050

*Data are from progress reports submitted to CDC Engineering Services by State health department.
**704 man-hours expended on maintenance.
***243 pounds of cyanogas used at expenditure of 149 man-hours.

Courtesy of the David J. Sencer CDC Museum



One of the several types of exhibits prepared for display at fairs and other widely attended attractions.

typhus control measures such as rodent eradication, DDT dusting, and sanitary inspection were practiced throughout the year. The program for the collection of rat sera for complement fixation tests was continued, bloods being forwarded to the Communicable Disease Center Laboratory for testing. A total of 359 blood samples was forwarded, 7.8 percent of which were found to be positive.

EDUCATIONAL

Educational activities consisted of presentation of talks and films to community organizations and student and professional groups; preparation and distribution of display materials to retail stores; exhibits for county fairs; and preparation of an electroscope series depicting the various activities of the plague and typhus control program.

Plague Suppressive Laboratory

During the five spring and summer months (March 16-August 15), field surveys were conducted to locate foci of wild rodent plague and to collect epidemiological information regarding the spread of this infection among wild animals in the western part of the United States. Specimens collected by field units of the laboratory as well as material from many other sources were examined for plague infection. The work of the laboratory (table 26) also included the bacteriological examination of water samples for the Federal Security Agency, Region X, and animal inoculation tests for the San Francisco Marine Hospital. During the period September through March, laboratory personnel engaged in the study of plague and Salmonella infection of fleas.

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FIELD ACTIVITIES

Eight field plague survey units were in operation during July and August 1948, but only seven units were sent into the field at the start of the 1949 survey season. During the 5½-month season (fiscal year 1949), field units shot and trapped 42,477 rodents in 78 counties in 10 States: namely, Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, Utah, and Wyoming. From these animals 80,621 ectoparasites (fleas, lice, and ticks) and tissue specimens were forwarded to the Plague Suppressive Laboratory for inoculation tests. The Laboratory also received specimens for plague examinations from field units operated by the State health departments of Oregon and Washington and units operated cooperatively by the States of Colorado and Utah and the Communicable Disease Center. These latter field units operated in 35 counties of their respective States and forwarded 24,033 fleas, lice, and ticks taken from 8,945 animals. Table 27 summarizes this activity.

Table 26

MISCELLANEOUS BACTERIOLOGICAL EXAMINATIONS FISCAL YEAR 1949

Month	Plague	Salmonella	Water	Miscellaneous
July	9	17	49	80
August	8	23	65	16
September	463	0	27	100
October	829	116	20	45
November	501	450	21	13
December	781	878	22	11
January	291	2,028	29	22
February	329	1,166	23	20
March	544	1,121	24	25
April	771	681	30	19
May	567	536	27	13
June	538	536	30	15
Total	5,636	7,552	367	379
GRAND TOTAL OF SPECIMEN TESTS: 13,934				

Table 27

SUMMARY SHOWING NUMBER RODENTS OBTAINED AND MATERIAL COLLECTED FOR LABORATORY TESTING BY FIELD UNITS OPERATING IN DIFFERENT STATES
July 1, 1948 - June 30, 1949

States	Number rodents	Number fleas	Number lice	Number ticks	Number tissue	Positive tests
Plague Suppressive Units						
Arizona - 3 counties	1,181	2,026	-	74	-	2
Colorado - 1 county	1,006	973	-	-	-	-
Idaho - 4 counties	1,543	6,762	599	282	2	-
Kansas -14 counties	8,178	10,280	986	24	-	-
Montana - 7 counties	2,808	7,148	1,629	89	3	10
Nebraska - 9 counties	6,973	8,544	203	6	2	-
Nevada - 4 counties	1,811	5,512	543	98	-	-
New Mexico-19 counties	12,692	22,507	713	775	2	32
Utah - 6 counties	1,745	3,280	119	149	-	1
Wyoming -11 counties	4,540	6,617	53	630	-	4
State Operated Units						
Oregon - 9 counties	504	909	78	52	-	-
Washington-13 counties	7,502	18,125	-	90	-	16
State and CDC Units						
Colorado -10 counties	247	1,111	5	117	3	2
Utah - 3 counties	692	2,853	576	117	3	3
12 States — 113 Counties	51,422	96,647	5,504	2,503	15	70*

*Positive Specimens - 56 flea inoculation, only tests positive; 2 specimens, both fleas and lice positive; 3 specimens, fleas were negative and lice positive; and 5 tissue specimens (3 from animals) found dead were positive. In three instances, fleas from the same source as tissue were positive.

Courtesy of the David J. Sencer CDC Museum

Table 28

WILD RODENT PLAGUE DEMONSTRATED DURING THE FISCAL YEAR 1949

State	County	Number of foci	Nature of positive specimens	Rodent Source
Arizona	Coconino*	2	Fleas 2	White-footed mice, *Peromyscus boylii*, 2
Colorado	Park	2	Fleas 2	Prairie dogs, *Cynomys gunnisoni*, 2
Montana	Beaverhead	3	Fleas 3, lice 4, tissue 3	Ground squirrels, *Citellus armatus*, 1 *Citellus richardsoni elegans*, *Citellus columbianus*
New Mexico	Colfax*	2	Fleas 2	Prairie dogs, *C. gunnisoni*, 2
New Mexico	Guadalupe	2	Fleas 4 Tissue 1	Wood rats, *Neotoma albigula*, 2 White-footed mice, *Peromyscus leucopus*, 1 Ground squirrels, *Citellus variegatus*, 2
New Mexico	Lincoln	3	Fleas 3	Wood rats, *N. albigula*, 2 White-footed mice, *P. boylii*, 1
New Mexico	McKinley*	2	Fleas 5	Wood rats, *N. albigula*, 1 White-footed mice, *P. boylii*, 1 *Peromyscus truei* Harvest mice, *Reithrodontomys megalotis*
New Mexico	Rio Arriba	5	Fleas 6 Lice 1	Prairie dogs, *C. gunnisoni*, 4 Marmots, *Marmota flaviventris*, 2 White-footed mice, *Peromyscus maniculatus*, 1
New Mexico	Sandoval	1	Fleas 1	Prairie dogs, *C. gunnisoni*, 1
New Mexico	San Juan*	1	Fleas 1	Grasshopper mice, *Onychomys leucogaster*
New Mexico	Socorro	2	Fleas 3 Tissue 1	Wood rats, *N. albigula*, 3 White-footed mice, *P. truei*, 1
New Mexico	Taos*	2	Fleas 2	Prairie dogs, *C. gunnisoni*, 2
New Mexico	Union	1	Fleas 2	Ground squirrels, *Citellus mexicanus*, 1 Grasshopper mice, *O. leucogaster*
Utah	Salt Lake*	2	Fleas 3	Ground squirrels, *C. variegatus*, 2 White-footed mice, *P. maniculatus*, 1
Utah	Sevier	1	Fleas 1	Ground squirrel, *C. armatus*, 1
Washington	Douglas	1	Fleas 1	Short-tailed meadow mice, *Lagurus curtatus*, 1

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Table 28 (continued)

State	County	Number of foci	Nature of positive specimens	Rodent Source
Washington	Grant	3	Fleas 4	Short-tailed meadow mice, *L. curtatus*, 2 Meadow mice, *Microtus montanus*, 1 White-footed mice, *P. maniculatus*, 1
Washington	Kittitas	1	Fleas 2	Short-tailed meadow mice, *L. curtatus*, 1 White-footed mice, *P. maniculatus*, 1
Washington	Yakima	3	Fleas 9	Short-tailed meadow mice, *L. curtatus*, 5 White-footed mice, *P. maniculatus*, 4
Washington	Albany	1	Fleas 1	Ground squirrel, *C. r. elegans*
Wyoming	Laramie	1	Fleas 1	Ground squirrels, *C. r. elegans*, 1
Wyoming	Lincoln	1	Fleas 2	Ground squirrels, *C. armatus*, *C. r. elegans*, 1

*Counties positive for the first time.

During the year, plague infection was demonstrated in 70 specimens collected from wild rodents in 22 counties of 7 States as follows: Arizona, 1 county; Colorado, 1; Montana, 1; New Mexico, 10; Utah, 2; Washington, 4; and Wyoming, 3.

Plague was discovered this year (fiscal year 1949) for the first time in Arizona, Coconino County; New Mexico, Colfax, McKinley, San Juan, and Taos Counties; and Utah, Salt Lake County (table 28).

Plague infection was demonstrated in 59 instances by the inoculation of fleas; twice by the inoculation of both fleas and lice; three times by the inoculation of lice alone, the fleas being negative; and five times by the inoculation of tissue. Three animals proved plague-infected by the inoculation of tissue were found dead. In one case, plague-infected fleas were obtained by flagging the openings of prairie dog burrows; and in another, infected fleas were obtained from a wood rat's nest. Plague-infected material was collected from 16 different species of wild rodents, only one of which, the ground squirrel species, *Citellus mexicanus*, was found involved in the dissemination of plague for the first time this year.

DOMESTIC RAT EXAMINATIONS

Rats (16,935) trapped by the San Francisco Health Department and other local agencies were examined macroscopically at autopsy. Over sixty-nine thousand ectoparasites taken from these and other rats trapped in various seaports were inoculated into 2,001 guinea pigs to determine whether or not they were plague-infected. No plague infection was discovered among domestic rats at the Plague Suppressive Laboratory, nor elsewhere in the United States during 1949. Details of this work are listed in table 29.

TULAREMIA

In testing tissue obtained by field survey units, tularemia is frequently encountered. This year, however, only one tularemia-infected specimen was encountered. It was a tissue from a sick rabbit caught in Conejos County, Colo.

SALMONELLA

This year for the first time, all guinea pigs which were sick or died following inoculation of material submitted for plague tests were cultured for Salmonella infection. *Salmonella typhimurium* (Loeffler) was encountered in six guinea pigs, all of which had been inoculated with an emulsion of fleas. The fleas came from the following sources: marmots shot in Caribou County, Idaho; prairie dogs shot in Richland County, Mont.; white-footed mice trapped in McKinley County, and prairie dogs shot

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in San Juan County, N. Mex; Norway rats trapped in Tacoma, Wash.; and white-footed mice trapped in Lincoln County, Wyo. From these findings, it would appear that fleas may harbor *S. typhimurium* and that the infection is widely distributed in the Western States.

FLEA INVESTIGATIONS

Investigations (September 1, 1948 – March 16, 1949) were instituted to determine (1) whether or not certain species of fleas are capable of transmitting plague, and (2) to study Salmonella infection of fleas.

Three species of fleas were obtained by field units operating in Nebraska: namely, *Epitedia wenmanni* (Rothschild) and *Monopsyllus exilis* spp., from field mice; and *Thrassis fotus* (Jordan), from gophers (ground squirrels). The first-named species refused to feed on human blood in the laboratory, indicating it is not likely to bite man. The other two species fed readily on human blood. It was possible to infect 47 percent of 135 *E. wenmanni* with plague, but only 6 or 9.4 percent of the infected were found capable of transmitting the infection by their bites. In the case of *T. fotus*, 76.2 percent of 21 were infected with plague by feeding on infected mice, but only 1 or 6.2 percent of the infected transmitted the disease. Of 19 *M. exilis* tested, 10 or 52.6 percent became plague-infected and 1 or 10 percent of the number infected transmitted plague by bite.

These results indicate that all three species of wild rodent fleas tested are capable of transmitting plague by their bites, but their efficiency as vectors is very low.

Studies regarding Salmonella infection were conducted with *Salmonella enteritidis* (Gaertner) and *S. typhimurium*. It was found that fleas could be infected with both types of *Salmonella* and that *S. enteritidis* could be transmitted to mice by the bites of infected fleas. The work with *S. typhimurium* was not satisfactory as the strains employed were not very virulent for mice.

Investigations carried out to determine the effects of *S. enteritidis* as a secondary infection of plague-infected fleas indicate that fleas are more or less impotent as vectors of plague when the Salmonella bacteria also are present in their stomachs.

Table 29

"RATTUS NORVEGICUS" AND "RATTUS RATTUS" EXAMINATIONS
FISCAL YEAR 1949

MACROSCOPICAL AUTOPSY EXAMINATIONS			
	"R. norvegicus"	"R. rattus"	Total
Trapped in San Francisco, Calif.	13,474	3,382	16,856
Recovered from vessels and military posts	3	76	79

ECTOPARASITE INOCULATION TESTS				
Collection area for rats	Fleas inoculated	Lice inoculated	Number inoculated	Plague infected
San Francisco	48,305	2	1,068	–
Rats from vessels and military posts	206	121	30	–
Bremerton, Wash.	507	–	14	–
Seattle, Wash.	8,879	–	424	–
Tacoma, Wash.	10,325	–	454	–
Charleston, S. C.	695	–	11	–
Total	68,917	123	2,001	0

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