EPIDEMIC AID

OPERATIONS

TRAINING

LABORATORY SERVICES

INVESTIGATIONS

CDC

ACTIVITIES 1949-1950

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

COMMUNICABLE DISEASE CENTER ACTIVITIES 1949-1950

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

Preface

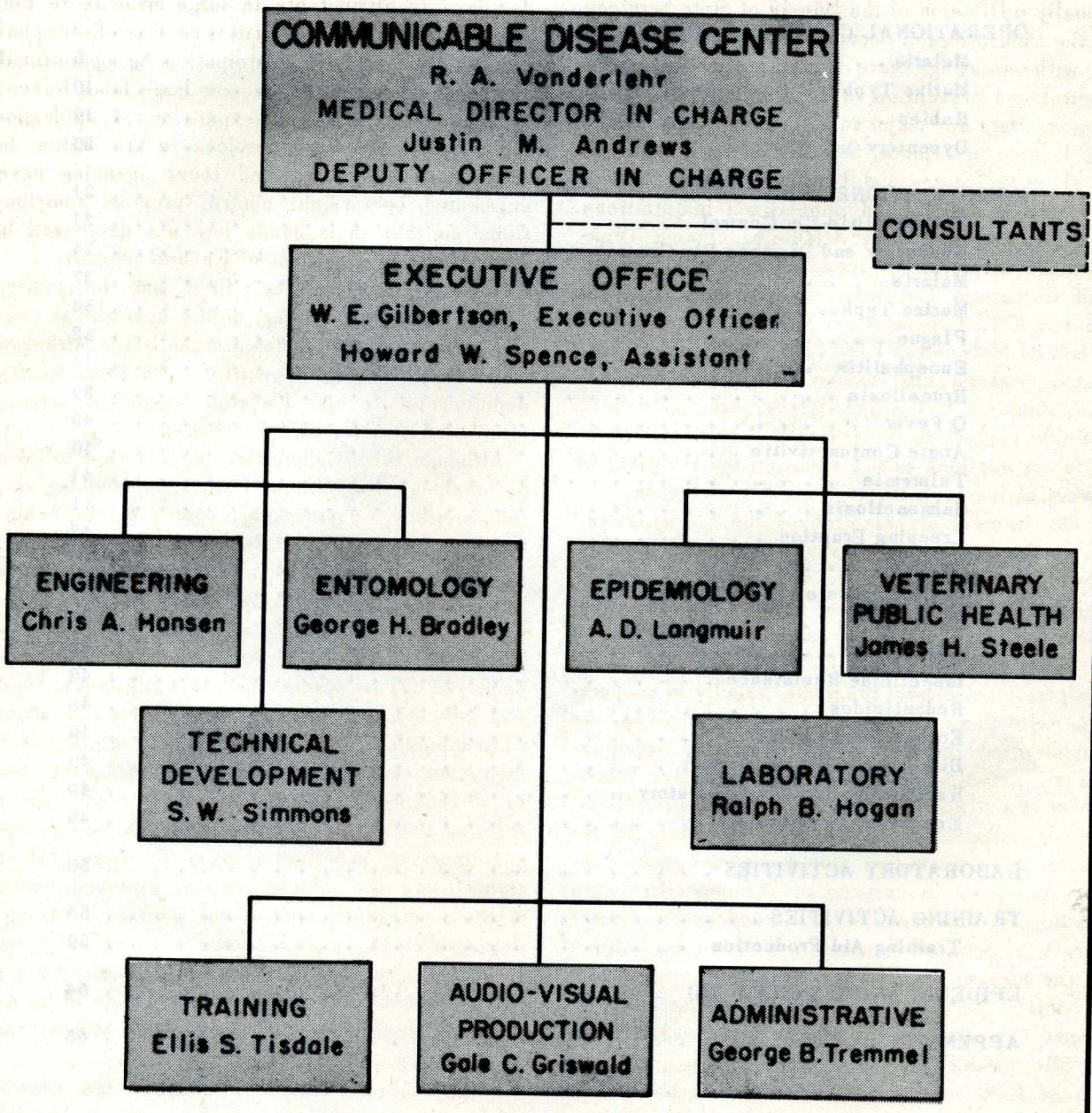
This report is a summary of accomplishments and undertakings and not a catalog of activities. Composite end results are emphasized and details concerned with their attainment are omitted or abbreviated. The absence of specific reference to cooperating State health departments, PHS Regional Offices, and other collaborating agencies entails no depreciation of the contribution of each to overall accomplishments. Reports of the activities of individual States and Regions, particularly malaria and typhus control in States, included in previous CDC Activities Reports have been ommitted this year in order to avoid burdensome repetition. Composite statistical summaries of malaria and typhus control operations reflect activities within the respective States. Failure to record the varied activities of administrative and management units does not mean that the contribution from that quarter was small or unimportant.

Information presented in this summary was abstracted from reports prepared by the component units of the Center, Regional CDC Representatives, and cooperating State health departments. The material has been organized as an integrated account of CDC operations, using the topical approach adopted in 1949.

Contents

FIGURE I

HEADQUARTERS ORGANIZATION



FSA-PHS CDC-ATLANTA, GA. FEB. 1951

INTRODUCTION

The Communicable Disease Center, organizationally a Division of the Bureau of State Services of the Public Health Service, primarily is concerned with assisting State health authorities in the control and prevention of communicable diseases. Headquarters and major installations of the Center are located in Atlanta, Ga., but operations extend to all of the States and Territorial possessions of the United States; and specialized installations are located outside of Atlanta, including Technical Development Services, Savannah, Ga.; Virus and Rickettsia Laboratories, Montgomery, Ala.; Western CDC Laboratories, San Francisco, Calif.; Office of Midwestern CDC Services, Kansas City, Kans.; malaria observation stations in Newton, Ga., Manning, S. C., and Helena, Ark.; nine field training centers in strategically located cities in different sections of the country; and a variety of investigative projects in a number of States.

The internal organization of the headquarters, as outlined in figure 1, is along professional discipline lines, and includes an administrative component which is designed to free professional personnel of management and other administrative routine.

Operational control programs, usually in cooperation with State and local health departments, are implemented through "CDC Activities organizations" established within the respective States under the direction of the State health officer. These organizations are supported jointly by the Center and cooperating States, and undertake control activities in accordance with specific plans previously approved by the cosponsors. Center personnel detailed to assist the States are subject to the supervision of State health officers.

Liaison with State health departments is maintained through CDC Representatives assigned to Public Health Service (FSA) Regional Offices. These CDC representatives provide consultative services to States, particularly in field training, in insect and rodent control, and in procuring training aids.

During the past year the Center staff, including professional, subprofessional, administrative, crafts, custodial, and protective, approximated 1,500 as compared with about 1,800 in 1949. This decrease is attributable in large measure to the reorientation of Center activities whereby emphasis is shifted from participation in operational control programs, which require large labor forces, to improvement of and expansion of epidemiological and laboratory services to the States. In many instances State and local agencies have augmented operational control program contributions so that their scope has not decreased in proportion to curtailment of Federal support.

Investigative projects, field and laboratory, carried on by the Center, unlike operational control programs, are under Center aegis although often they are in cooperation with State health departments, other Federal agencies, private foundations, and medical schools.

Although the headquarters organization follows professional disciplines, Center epidemiologists, laboratorians, physicians, entomologists, engineers, and other specialists are welded into teams and their combined skills untilized in providing the answers to questions State health officers encounter in combating communicable diseases. These teams, each in its respective field, are employed (1) in studies and investigations, field and laboratory, in quest of new information about communicable diseases and their control; (2) in improving control techniques and equipment, and in developing new ones where needed; (3) in refining new techniques and methods, and reducing them to practical control formulas; (4) in transmitting new information and improved control methods to State operational personnel through demonstrations, manuals, and training aids; and (5) in providing training opportunities in communicable disease control and the production of training aids, including films, filmstrips, slides, and manuals, for use in training programs.

Thus, Center activities embrace the general fields of operational control programs, investigations and studies, laboratory services, and training services. Since all are directed toward the over-all objective of providing the States with information and tools that will help them do a better job of coping with communicable disease

problems, the closest coordination is practiced both in the planning and in the execution of the several projects. And as problems to be met change, techniques for meeting them are changed.

The Center also is the component of the Public Health Service responsible for assisting States in handling the public health aspects of nonmilitary catastrophies such as hurricanes and earthquakes, and in dealing with epidemics that exceed the facilities of individual States.

OPERATIONAL CONTROL PROGRAM

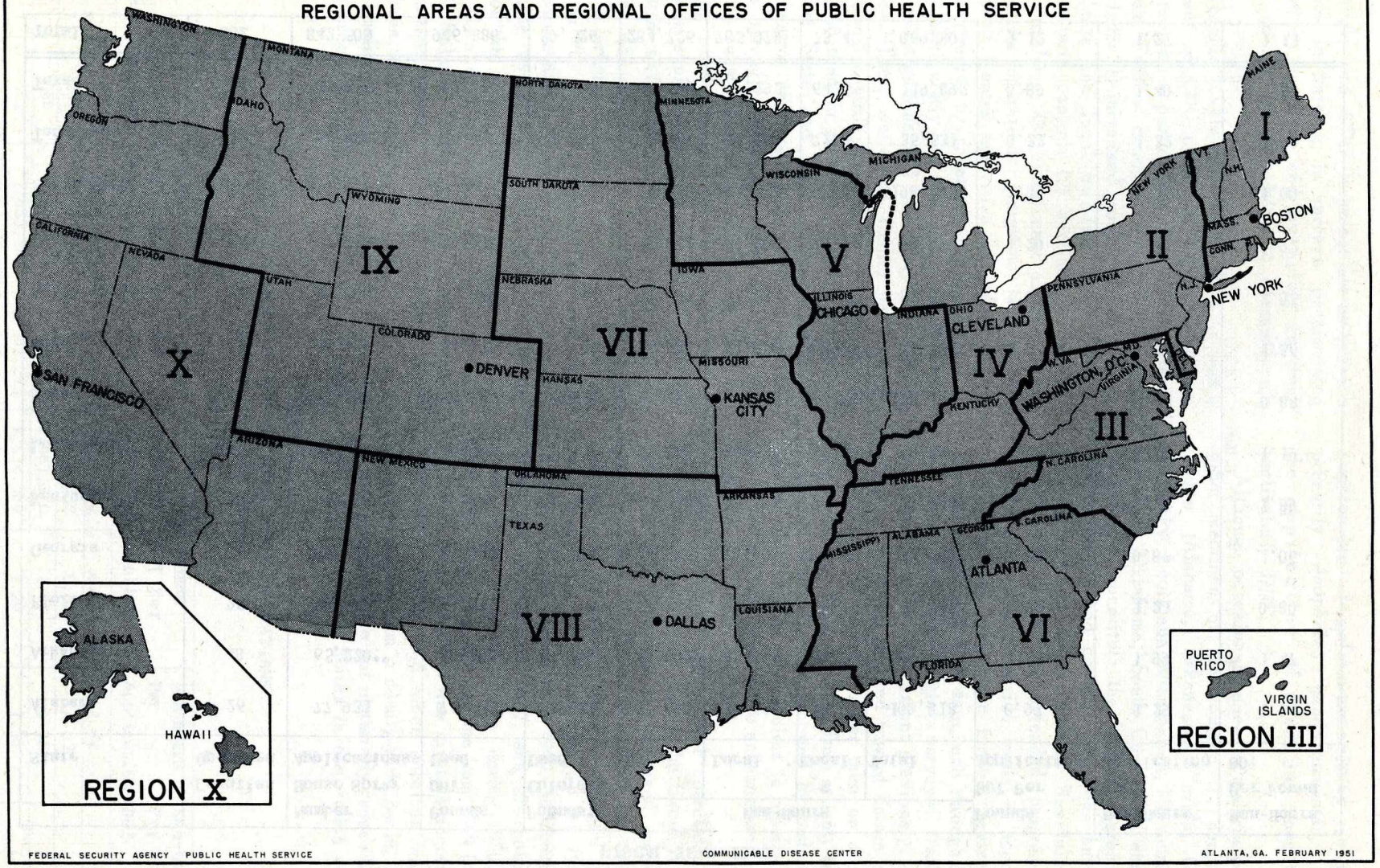
Control activities herein reported were carried on jointly by the Communicable Disease Center and the cooperating State health departments in accordance with predetermined policies and techniques. In malaria and murine typhus control, the two major operational programs in which the Center participated, control activities were administered through "CDC Activities" organizations established in State health departments under the supervision of the State health officer. In general, CDC provided trained personnel, equipment, assistance in training State and local operational personnel, and laboratory diagnostic services. State and local agencies provided labor, materials, office and warehouse space, and incidental items. In malaria control, the Center's contribution amounted to about 50 percent of the aggregate cost and in typhus control a smaller percentage. Method of financing and operational details varied from State to State. In some States, householders receiving residual spray treatment for malaria control were charged a fee to provide local contributions, while in others local bodies appropriated the necessary funds. Other operational control programs of a less extensive nature were supported by the Center through the contribution of personnel, specialized equipment, training services, and laboratory diagnostic services.

In areas where communicable disease control activities were not of sufficient import to require the establishment of "CDC Activities" organizations in State health departments or where the nature of operations did not fit into the "CDC Activities" pattern, cooperation with the States was handled through CDC Representatives stationed at Public Health Service Regional Offices. During the past year CDC Representatives were in most of the Regional Offices throughout the year, but in some instances liaison was maintained through the Regional Medical Director and requests for assistance to State health departments were handled through the Atlanta headquarters. CDC Representatives in Regional Offices provide consultation services, organize and conduct training courses for State operational personnel, process requests by States for particular types of assistances, keep State and local health authorities abreast of facilities available through CDC, and conduct surveys and studies in support of State health department programs. Figure 2 shows the location and boundaries of the 10 Regional Offices. Since the problems vary from Region to Region, activities of CDC Regional Representatives vary. In Region VI, for example, each State embraced is within the traditionally malarious area and malaria and typhus control operations are carried on through "CDC Activities" organization at the State level. Region VII, on the other hand, embraces the Missouri River Basin where extensive water development projects are under way and where investigative studies are being made of encephalitis problems. Thus, in Region VII problems are of a nature that prompted the establishment of the Office of Midwestern CDC Services with functions far different from those of the CDC Representative in Region VI. Likewise, because the problems in communicable disease control are different, the CDC Representative in Regions I and II are different from those in Region VIII. However, in all Regions there is need for training of personnel at the State and

953873 O—51——2

FIGURE 2

REGIONAL AREAS AND REGIONAL OFFICES OF PUBLIC HEALTH SERVICE



FEDERAL SECURITY AGENCY PUBLIC HEALTH SERVICE — COMMUNICABLE DISEASE CENTER — ATLANTA, GA. FEBRUARY 1951

Table 1

SUMMARY OF DDT RESIDUAL SPRAY OPERATIONS
FISCAL YEAR 1950

State	Counties Operated	Number House Spray Applications	Pounds DDT Used	Pounds* Chlordan Used	Man-Hours				Pounds DDT Per Application	Man-Hours Per Application	Man-Hours Per Pound DDT
					CDC	Local	% Local	Total			
Alabama	26	77,931	75,359†	2,507	67,678	33,135	32.9	100,813	0.97	1.29	1.34
Arkansas	48	65,220**	88,406	10,288	45,902	83,772	64.6	129,674	1.36	1.99	1.47
Florida	22	40,344	61,252	0	5,781	42,966	88.1	48,747	1.52	1.21	0.80
Georgia	34	109,227***	89,310	4,496	24,165	70,803	74.6	94,968	0.82	0.87	1.06
Kentucky	10	5,984	10,371	1,790	4,120	15,524	79.0	19,644	1.73	3.28	1.89
Louisiana	15	38,584	49,275	0	19,436	39,331	66.9	58,767	1.28	1.52	1.19
Mississippi	24	109,233	138,642	5,366	24,288	97,911	80.1	122,199	1.27	1.12	0.88
Missouri	12	24,029	29,873	0	14,683	31,828	68.4	46,511	1.24	1.94	1.56
North Carolina	34	53,664	53,864	345	8,809	47,884	84.5	56,693	1.00	1.06	1.05
Oklahoma	14	34,334	41,270	0	3,864	34,206	89.9	38,070	1.20	1.11	0.92
South Carolina	46	171,716	197,577	337	13,750	184,546	93.1	198,296	1.15	1.15	1.00
Tennessee	13	26,888	35,417††	5,397	9,651	25,880	72.8	35,531	1.32	1.32	1.00
Texas	34	85,355	75,770	0	42,599	77,293	64.5	119,892	0.89	1.40	1.58
Total	332	842,509	946,386	30,526	284,726	785,079	73.4	1,069,805	1.12	1.27	1.13

*Experimental projects included.
**Excluding 1,760 premises treated with chlordan.
***Excluding 2,560 nonresidential premises treated with chlordan.
†Excluding 19,293 lb. rosin-based DDT.
††Excluding 1,854 lb. methoxychlor

local levels and CDC Representatives provide assistance in training, in surveys, by providing consultation services, and by acting as coordinators in matters pertaining to communicable disease control.

A noticeable development during the year was a curtailment of CDC participation in operational control programs, particularly in malaria control operations. Factors contributing to this development include: (1) increased proficiency and capacity of State and local health departments to handle malaria control; (2) decline in the incidence of malaria; (3) curtailment of CDC funds available for operational programs; and (4) redirection of Center activities in order to give added emphasis to research and investigative studies, particularly in the areas of epidemiological investigations and laboratory performance evaluation. Thus, while the Center participated in operational control programs to a lesser degree during 1950 than in previous years, it continued to support State and local health departments in the control and prevention of communicable diseases through consultation services, by accumulating more information about them, and by developing more effective control measures and making them available to State and local agencies.

MALARIA AND MOSQUITO CONTROL: Fiscal year 1950 was the third of a projected 5–year program to eradicate malaria as a public health problem in the United States. The eradication program was conceived as a cooperative enterprise of the State health departments of the malarious section of the country and of the Communicable Disease Center, and is a projection of the Extended Malaria Control Program inaugurated by the wartime agency, Office of Malaria Control in War Areas, and continued by CDC.

In the malaria eradication program, as in the extended program, chief reliance has been upon suppression of malaria-transmitting mosquitoes, primarily *Anopheles quadrimaculatus*, through the application of residual insecticides, particularly DDT.

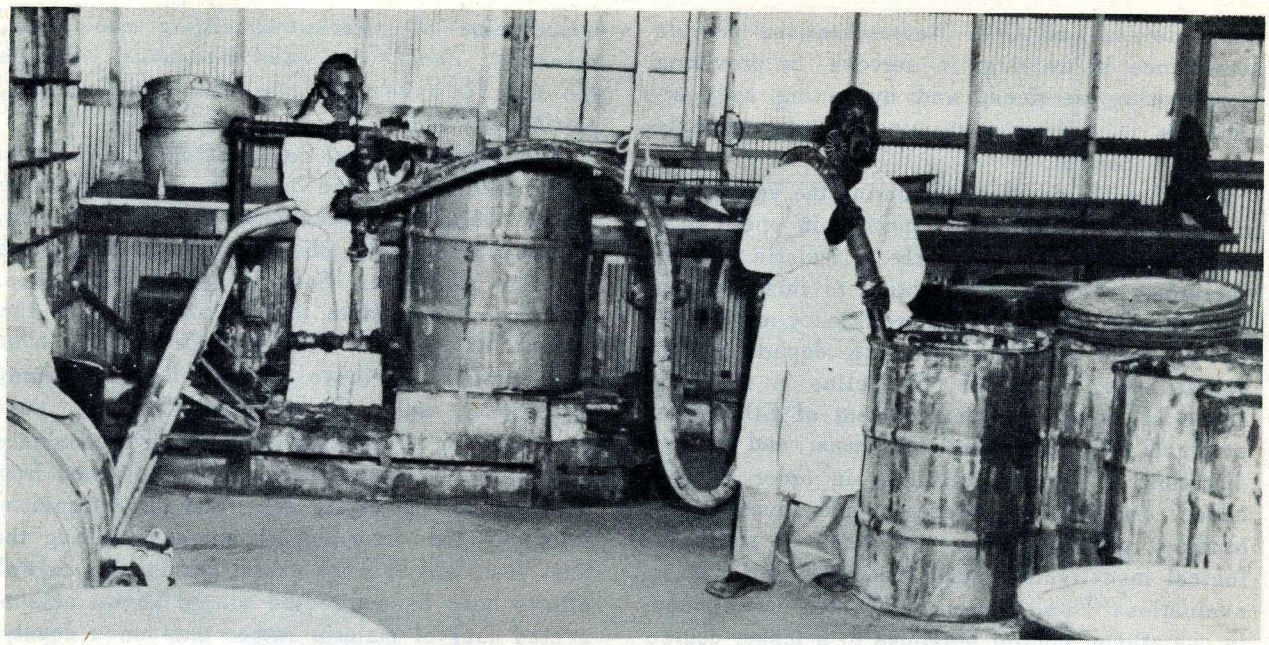
Although occasional cases of malaria occur in other sections of the country, 13 southeastern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas) constitute the malarious area of the United States and control operations have been concentrated in these States. Residual spray operations, under the extended program, were practiced on a county-wide basis in accordance with a malaria prevalence formula devised from mortality and morbidity data, and through epidemiological and entomologial surveys. During the past year, and to some extent previously, control efforts have been directed toward known or suspected foci of malaria rather than on a county-wide basis. This change from county-wide to selective spraying was dictated by budget limitations and because of a decline in reported malaria permitted coverage of the endemic area without sacrificing effectiveness.

Table 1 summarizes control operations in the 13 southeastern States during the fiscal year 1950 and table 2 presents a condensed summary of operations in the same States for the period 1946-49. As indicated (table 1) residual spraying was carried on in 332 counties in 1950, and (table 2) in 361 counties in 1949, 360 counties in 1948, 297 counties in 1947, and 274 counties in 1946. Spray applications during 1950 totaled 842,509, a considerable decline from 1949 (table 2). However, more attention was given to nonresidence treatment in 1950 and since spraying was on a selective rather than a county-wide basis, over-all control results were not materially reduced. Chlordan was used in 6 States in connection with the

Table 2

CONDENSED SUMMARY OF DDT RESIDUAL SPRAY OPERATIONS IN 13 SOUTHEASTERN STATES 1946-1949

FY Year	Counties Operated	Number House Spray Applications	Pounds DDT Used	Man-hours Expended	Pounds DDT Per Application	Man-hours Per Application	Man-hours Per Pound DDT
1946	274	1,061,806	721,655	1,104,172	0.68	1.04	1.53
1947	297	1,277,989	1,046,000	2,070,342	0.82	1.62	1.89
1948	360	1,363,799	1,405,813	1,861,370	1.03	1.36	1.32
1949	361	1,055,503	1,262,283	1,434,084	1.20	1.36	1.14



In most operational States spray materials are formulated at the State level in a centrally located warehouse. Above is the Greenwood, Miss., DDT and chlordan mixing plant which prepares concentrates for all Mississippi spray projects.

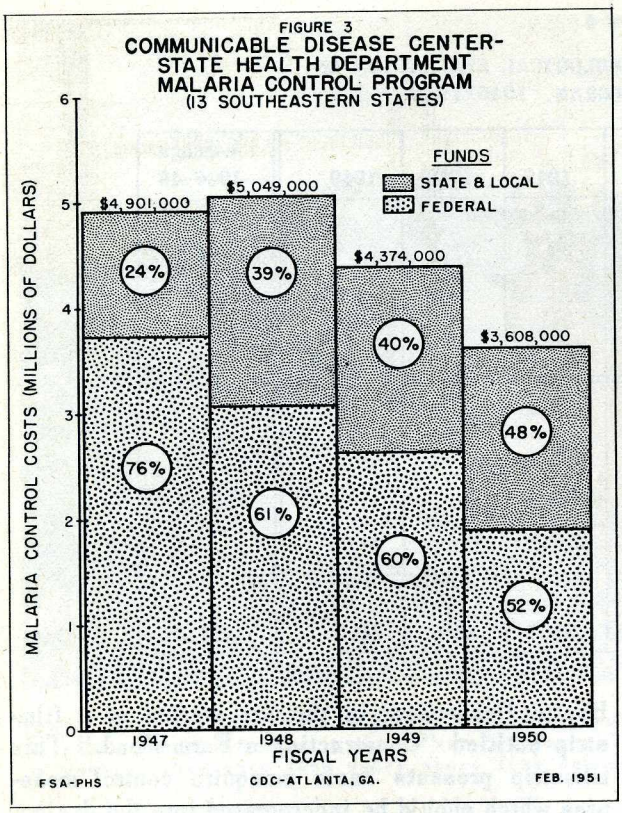
regular DDT spray operations and also in certain instances in other areas where DDT-resistant house flies were encountered. Chlordan was used primarily as an outdoor spray, but in some instances was applied in portions of kitchens and porches.

Spray operations in each of the 13 States were administered through "CDC Activities" organizations established by and under the jurisdiction of the State health officer and supported jointly by CDC and the cooperating State and local units. Figure 3 shows the ratio of Federal contributions to State and local contributions for the period 1947-50. As indicated, Federal funds accounted for 76 percent of the total cost in 1947, whereas in 1950 the ratio was Federal funds 52 percent and State and local 48 percent. It is interesting to note that the State and local contribution has increased as Federal contribution has declined so as to maintain a total budget sufficient to support effective operations. This development is in keeping with the basic concept which envisions the role of CDC as one of helping State and local units develop the capacity and competence to cope with communicable disease problems, and then gradually withdrawing from operational programs as the States are able to carry on alone.

Epidemiological reports indicate that malaria transmission within the control area during 1950 was negligible in historically hyperendemic areas, and the malaria appraisal program* sponsored by CDC produced substantial evidence that currently malaria is grossly overreported and that primary malaria is rare in the United States today.

Entomological Evaluation: Since malaria control efforts have been directed specifically against malaria-transmitting mosquitoes which enter houses occupied by humans, effectiveness of control operations is measured by the extent to which houses in the control area are kept free of malarial mosquitoes. In practice, measurement of effectiveness is by inspection of randomly selected sprayed and unsprayed houses to determine the presence or absence of *A. quadrimaculatus*, the principal malaria-transmitting mosquito in the control area. Thus, table 3 shows by years and months after treatment the results of entomological evaluation of control operations in 13 southeastern States for the 4-year period 1946-49. As indicated, the percentage of sprayed houses maintained free of *A. quadrimaculatus* was 99 in 1946, 98.8 in 1947, 97.2 in 1948, and 98.9 in 1949, whereas percentage for unsprayed houses was 87.3 in 1946, 72 in 1947, 83.3 in 1948, and 91.2 in 1949. It is interesting to observe that although control was slightly more effective 1 month after spraying, the indicated control 5 months after spraying was very satis-

*See malaria appraisal, page 30.



factory. Table 4 presents a condensed summary of evaluation data for the same period showing by years the ratio of the number of sprayed and unsprayed houses in which *A. quadrimaculatus* were found to the total number of sprayed and unsprayed houses. Comparison of percentages of sprayed houses maintained free of *A. quadrimaculatus* for the 1946-49 period shows a small but significant difference from year to year. A like comparison shows a more marked variation with respect to unsprayed houses. The latter is believed to reflect the annual variation which occurred in mosquito abundance in the southeastern States during the period covered. It is indicated, for example, that in 1947, when only 72 percent of unsprayed houses were free of *A. quadrimaculatus*, the mosquito abundance was considerably larger than in 1949 when 91.2 percent of unsprayed houses were free of *A. quadrimaculatus*. The magnitude of this variation may be shown more dramatically by comparing the annual ratios of the number of unsprayed houses inspected in which mosquitoes were found to the total number of unsprayed houses inspected. These ratios, as shown, are: 1949, 1:11; 1948, 1:6; 1947, 1:4; and 1946, 1:8. Thus in 1947, when mosquitoes were considered to have been most abundant, they were found in 1 house in every 4 inspected while in 1949, when mosquitoes were much less numerous, they were found in 1 house in every 11 inspected. Determined ratios for sprayed houses for the same period show by comparison the high degree of control realized through the residual spray program. These ratios are: 1949, 1:91; 1948, 1:36; 1947, 1:80; and 1946, 1:100. The 1948 ratio of 1:36 is clearly out of line and so is the calculated percentage of control (83.2 percent) for that year. This deviation probably is associated with the fact that in 1948 a certain amount of difficulty was experienced through the use of substandard spray formulations in some parts of the control area.

On the basis of evaluation data, it is considered

Table 3

SUMMARY OF ENTOMOLOGICAL EVALUATION OF RESIDUAL SPRAY PROGRAM IN 13 SOUTHEASTERN STATES, 1946-1949, BASED ON 51,878 INSPECTIONS OF SPRAYED AND UNSPRAYED HOUSES

Months After Spraying	Number of Houses Inspected					Percentage of Houses Free of "A Quad." in p. m.			
	1946	1947	1948	1949	Total	1946	1947	1948	1949
SPRAYED HOUSES									
0-1	6,018	1,546	699	1,069	9,332	99.2	99.2	96.9	99.6
1-2	6,739	2,690	1,354	1,999	12,782	99.0	98.5	98.2	98.8
2-3	5,321	2,538	2,093	2,583	12,535	99.1	98.7	98.2	98.7
3-4	2,974	1,578	2,102	1,977	8,631	98.7	98.7	97.3	98.8
4-5	899	442	1,231	885	3,457	98.2	98.9	94.6	99.1
Total	21,951	8,794	7,479	8,513	46,737	99.0	98.8	97.2	98.9
UNSPRAYED HOUSES									
	1,639	1,170	1,021	1,311	5,141	87.3	72.0	83.3	91.2

Table 4

CONDENSED SUMMARY OF ENTOMOLOGICAL EVALUATION OF RESIDUAL SPRAY PROGRAM, 1946-1949

Sprayed (46,737 inspections)	1946	1947	1948	1949	Average 1946-49
Percentage of Houses Free of *A. quadrimaculatus*	99.0	98.8	97.2	98.9	98.7
Ratio of: No. Houses with *A. quadrimaculatus* to No. Houses Inspected	1:100	1:80	1:36	1:91	1:74
Unsprayed (5,141 inspections)					
Percentage of Houses Free of *A. quadrimaculatus*	87.3	72.0	83.3	91.2	84.0
Ratio of: No. Houses with *A. quadrimaculatus* to No. Houses Inspected	1:8	1:4	1:6	1:11	1:6
Indicated Percentage of Control	92.1	95.7	83.2	88.5	91.9

a reasonable conclusion that the program of suppressing malaria-transmitting mosquitoes through residual spraying was effective in the 13 southeastern States during the period 1946-49. And although admittedly malaria case reporting was faulty during the period and changes in the reporting system were introduced by some of the States, all evidence indicates that a considerable degree of malaria control attended the control of malarial mosquitoes. Indeed, the malaria appraisal program*, not yet operative in all of the 13 States, indicates that malaria is near extinction in areas that formerly were hyperendemic.

Water Impoundments: The proper construction and management of water impoundments, ranging in size from private ponds to major developments, enters into effective control of malaria and other mosquito-borne diseases, since improperly designed and operated water impoundments promote mosquito breeding. The Center, in cooperation with State health departments, collaborates with the Department of the Army Corps of Engineers by providing guidance and technical consultative services designed to minimize mosquito production associated with impoundments. At the request of the Corps of Engineers, surveys and reports were made on 19 projects located in 15 States during fiscal year 1950.

Assistance was rendered the Alabama State Health Department in the preparation of a filmstrip entitled "Constructing a Farm Pond." This filmstrip presents basic mosquito control measures which should be incorporated into the design, construction, and plans for management of small ponds.

A survey of legislation bearing on public health aspects of water impoundments revealed that in most instances justification for such legislation is based almost exclusively on malaria prevention. In view of the decreasing incidence of malaria and the increasing possibility that mosquitoes are vectors of other diseases of prime public health importance, the Center during 1950 recommended to States that legislation regarding water impoundments be revised to place emphasis on "safeguarding public health" rather than just on malaria. South Carolina and Virginia amended their laws by substituting this broader concept.

IRRIGATION MOSQUITO PROBLEMS: During the fiscal year the Public Health Service and the Bureau of Reclamation entered into an agreement whereby the two agencies cooperate to the end that proper steps are taken to incorporate health safeguards into the construction and operation of irrigation projects. This is of particular importance in States west of the Mississippi River where extensive irrigation projects are under way and where encephalitis, suspected of being spread by *Culex tarsalis* mosquitoes, is endemic.

Through the office of Midwestern CDC Services

*See malaria appraisal, page 30.

Proper construction and management of water impoundments includes the maintenance of a clean shoreline as shown above. If this is done, wave action will lessen mosquito breeding by stranding mosquito larvae or washing them into deep water where fish can destroy them.

in Kansas City, Kans., preirrigation surveys and studies initiated in 1949 were continued. The reduction of mosquito breeding associated with irrigation projects is recognized as a major problem requiring the cooperation of all agencies concerned with water development programs, including the Bureau of Reclamation, Corps of Engineers, Soil Conservation Service, Fish and Wildlife Service, Public Health Service, State and local health agencies, State water control commissions, and county agricultural agents. Multiple cooperation already exists in considerable degree and progress is being made in reducing the hazard of mosquito-borne diseases.

INSECT AND PEST CONTROL ABATEMENT STUDIES: In view of the numerous requests from States for information on enabling laws and insect abatement districts, an extensive study was made of existing State laws which establish the procedure for creating and operating abatement districts. A detailed review of such legislation revealed (1) a general lack of uniformity in the content of the various laws, and (2) frequent omission in the statutes of certain powers or provisions which are usually considered to be essential features. This study also revealed that the majority of laws limit abatement to mosquitoes; whereas laws are generally more adaptable when they authorize the control of additional pests, such as flies, ticks, rats, and other vermin which affect the public health. Based on this study, the Center prepared a paper which enumerated provisions that should, in its opinion, be considered in developing legislation on insect and pest control districts. It is visualized that this guide will be useful to States interested in formulating abatement legislation or modifying existing statutes.

Concurrent Fly Control: While designed for controlling malarial mosquitoes, the residual spray program has yielded a high degree of fly control from its inception, a factor which has been important in maintaining favorable public interest in the program. This, in part at least, accounts for the introduction of sticking agents to extend the life of the residual in outdoor areas, for expansion of spray coverage to include entire premises, and for experimental application of newer insecticides in areas infested with DDT-resistant flies. During the past year, for example, chlordan was used for spot spraying in some instances in attempts to improve the level of fly control. However, the residual spray program is operated as a malaria control measure, and although fly control continues to be an important by-product it has not been as

Table 5

RESIDUAL SPRAY PROGRAM
SUMMARY OF INSIDE HOUSE FLY COUNTS

Density Group	Average Precentages of Inspections by Fly Density Groups 0-5 Months after Spraying, 1948 and 1949*				
	0 Flies	1-10 Flies	11-50 Flies	51-100 Flies	Over 100 Flies
SPRAYED HOUSES					
1948	25	55	17	2	1
1949	13	47	32	5	3
UNSPRAYED HOUSES					
1948	13	42	31	7	7
1949	9	31	38	13	9

*June 1 to October 31

pronounced in recent years as in the initial period.

Table 5 summarizes available information on the effect of the malaria control spray program in reducing fly counts inside of houses during the years 1948 and 1949. Twenty-five percent of sprayed houses inspected in 1948 were free of flies during the period 0-5 months after spraying. In 1949, 13 percent of sprayed houses were free of flies. Thirteen percent of unsprayed houses inspected in 1948 were free of flies while only 9 percent of those inspected in 1949 were without flies. This would seem to indicate that the over-all fly population was higher in 1949 than in 1948, a conclusion supported by other data in table 5 which shows a lower percentage of inspected houses in the 51-100 and 100+ fly density groups in 1948 than in 1949 in both sprayed and unsprayed houses. In 1949, 3 percent of sprayed houses inspected had 100 or more flies compared with 1 percent in 1948, and for unsprayed houses the percentage was 9 in 1949 and 7 in 1948. In short, the residual spray program has yielded appreciable fly control though it cannot be considered a satisfactory fly control measure.

MURINE TYPHUS: The decline in the number of reported cases of human typhus, which began in 1945 with the initiation of intensive control operations in the more endemic areas, continued during 1950. Reports for the first 11 months of the calendar year list 638 cases compared with 913 for the same period in 1949. However, the infection continues to exist among rats throughout the areas where human cases were widespread and, since rats are the principal reservoir of the disease, typhus remains a major public health problem wherever the rat population is high.

Inasmuch as it has been demonstrated that the most effective approach to typhus control is suppression of rat ectoparasites, particularly the oriental rat flea (*Xenopsylla cheopis*), principal vector of the disease, control activities supported jointly by CDC and cooperating States have included (1) DDT dusting of rat runs, burrows, and harborages to reduce flea infestation among rats; (2) antirat sanitation to starve and disperse rat populations by making it more difficult for them to obtain food and harborage; (3) rat reduction through poisoning, trapping, and gassing to reduce the over-all rat population; and (4) ratproofing of buildings to keep rats away from the normal human environment and to exclude rats from food and shelter.

Bubonic plague, more deadly than murine typhus but much less prevalent in the United States, also is associated with rats and their ectoparasites, again primarily the oriental rat flea. Thus typhus control activities, particularly in areas adjacent to foci of plague, insure protection against the spread of plague by lessening the likelihood of it being transmitted from wild rodents, principal reservoir of the disease in this country, to domestic rats and thence to humans.

As indicated in table 6, cooperative typhus control operations are concentrated in 11 southern States which embrace the commonly considered endemic part of the United States. A condensed summary of operations in the same 11 States during the period 1946-49 is presented in table 7. Control operations in each instance (fiscal year 1950 and 1946-49) encompassed DDT dusting, ratproofing, harborage removal, rat reduction, and antirat sanitation. During the earlier years of the program, DDT dusting was practiced on a county-wide basis in those counties of high typhus incidence as measured by morbidity and mortality data. Counties qualifying for control under the standard formula were designated "preapproved counties" and eligible for CDC aid in typhus control operations. The basic formula remains operative, but in recent years DDT dusting has been practiced more on a selective than on a county-wide basis. In this approach, control efforts are directed toward known or suspected foci of infection and effective over-all control is obtained

953873 O—51——3

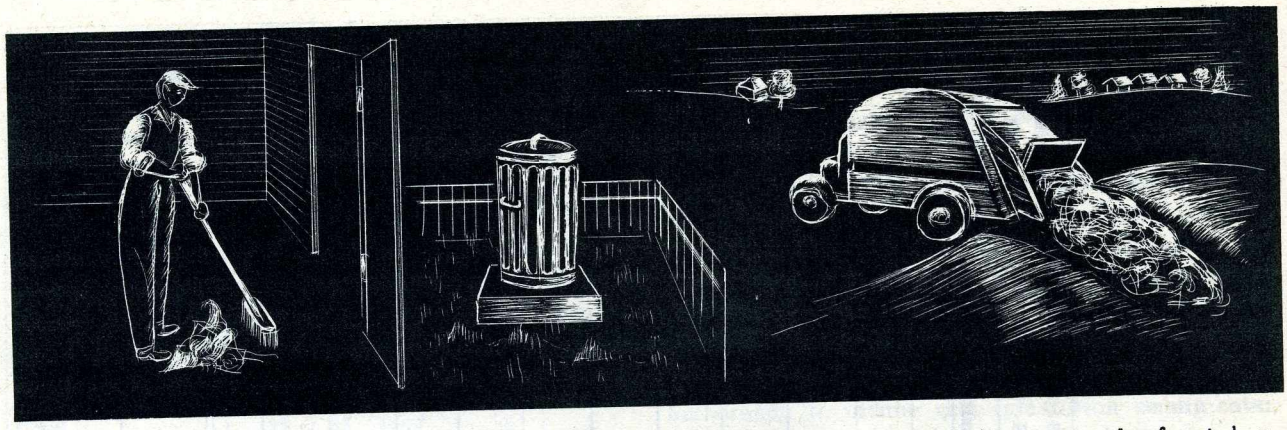
Table 6

SUMMARY OF TYPHUS CONTROL ACTIVITIES IN 11 SOUTHERN STATES

FISCAL YEAR 1950

STATE	Ectoparasite Control (DDT Dusting)		Ratproofing		Rat Reduction		Supervision, Education Training, Evaluation		Man-Hours All Activities**	
	Counties Reporting	Premises Dusted*	Projects Reporting	No. of Establishments	Poison Bait*	Poison Water*	Man-Hours Expended			
					No. Premises	No. Premises	CDC	Other	CDC	Other
Alabama	9	95,559	-	-	64,753	14,658	7,962	3,694	18,054	65,646
Arkansas	-	-	3	143	6,150	-	2,168	-	4,434	14,222
Florida	15	46,322	4	457	8,177	2,436	13,260	8,241	27,330	61,309
Georgia	31	72,158	7	299	77,400	3,681	38,783	3,428	56,719	97,326
Louisiana	4	23,271	2	156	2,508	1,375	6,868	5,172	16,468	17,740
Mississippi	10	19,746	-	-	82,934	6,163	15,779	2,155	19,971	32,742
North Carolina	8	27,257	6	619	33,082	1,328	5,209	3,335	13,288	41,625
South Carolina	5	1,518	5	324	46	347	12,281	1,129	17,553	11,052
Tennessee	1	4,128	4	532	1,054	-	1,626	1,420	11,236	28,069
Texas	13	26,457	8	1,043	407	14,513	34,993	4,156	69,759	82,650
Virginia	2	2,964	1	213	216	2,897	6,768	3,713	6,768	5,254
Total	98	319,382	40	3,786	279,727	47,398	143,716	39,443	261,580	457,635

*Average pounds DDT per premises 3.3; poison bait 0.8 lb. per premises; and poison water 1.1 pt. per premises.
**Include inspections and surveys pertaining to garbage storage, collection, and disposal; other sanitation activities; and maintenance of ratproofing.



One of the most effective rat control measures is antirat sanitation, including removal of rat harborages, proper on-the-premises storage of garbage, adequate garbage collection, and sanitary garbage disposal procedures.

within reduced budget limits. Antirat sanitation measures have been stressed in recent operations, particularly in connection with ratproofing.

In general, State and local units contributed labor, poison bait material, office space, and in some instances DDT dust, while CDC provided technical personnel, specialized equipment, training opportunities for State and local operational personnel, and consultation services. On the average, State and local contributions amounted to 64 percent of aggregate man-hours expended in direct typhus control during 1950. Control operations in the 11 cooperating southern States were administered through "CDC Activities" organizations parallel with malaria control programs. CDC Representatives in Public Health Service Regional Offices collaborated in the program, particularly in relation to training and technical supervision in the field.

Entomological Evaluation: Since rat ectoparasites, *X. cheopis* in particular, and *Nosopsyllus fasciatus* and *Leptopsylla segnis* in a much less degree, transmit typhus from rat to man, and *X. cheopis* and probably several other species of rat ectoparasites, including lice and mites as well as fleas, may be instrumental in transmitting typhus from rat to rat, the incidence of human typhus is directly related to the abundance of rat ectoparasites, especially *X. cheopis*. The effectiveness of typhus control efforts, therefore, may be evaluated by comparing the natural abundance of rat ectoparasites involved with their abundance following the application of control measures.

The natural seasonal abundance of the three common species of rat ectoparasites (*X. cheopis*, *L. segnis*, and *N. fasciatus*) in the 11 southern States (1946-49) is shown in figure 4. It will be observed that *X. cheopis* is four times as numerous as the other two fleas, *L. segnis* and *N. fasciatus*, taken together, and that there is considerable deviation in the seasonal cycle of the different ectoparasites. This seasonal cycle of abundance is of importance in the timing of DDT dusting for maximum control. Also there is a correlation of time of dusting and duration of control effectiveness, since the effectiveness of DDT decreases with the length of time after application (table 8). Reference to the *X. cheopis* curve in figure 4 shows a gradual rise of abundance from February through July and a decline from the peak to about the February level in December. Data in table 8 show that in order to obtain satisfactory control of *X. cheopis* over an entire 12-month period through a single application, dust should be applied during the months of February through May inclusive. That is, for maximum results over a maximum period of time, dust should be applied before the seasonal abundance curve peaks.

Table 7

Condensed Summary of Typhus Control Operations in 11 Southern States 1946-1949

Fiscal Year	Premises Dusted	Premises Ratproofed	Premises Poisoned
1946	450,667	3,998	115,111
1947	580,067	7,399	278,362
1948	410,067	4,558	228,476
1949	374,465	4,244	296,963

Although the seasonal abundance cycle in the case of *L. segnis* (figure 4) is earlier than that of *X. cheopis* and DDT dust does not yield as great a percentage of reduction of *L. segnis* as of *X. cheopis*, due to the relatively small number of *L. segnis* only a slight reduction in abundance yields satisfactory control. *N. fasciatus* is the least numerous of the three species of rat fleas involved and is quite susceptible to DDT dust, which means that dust applied at any season yields satisfactory control for at least 12 months.

Data presented in figures 5, 6, and 7 indicate the effectiveness of DDT dusting in typhus control in the 11 southern States during the period 1946-49.

During the calendar year of 1949, 15,778 rats were caught alive and examined for ectoparasites. Over 15,000 of this number came from the 11 southern States in the direct typhus control program area, of which 8,363 were taken from the 10 percent DDT dusting area (5 percent dust and 5 percent DDT spray were used experimentally in some areas). Table 9 shows a tabulation of rats examined, by States and by quarters. A more detailed tabulation of ectoparasite data from the 8,363 rats caught in the 10 percent DDT dusting area is recorded in table 10. The over-all results for the eight major species of rat ectoparasites, as will be noted, were: control of *X. cheopis*, very good during first 6 months; control of *N. fasciatus*, excellent during all periods; control of *L. segnis* and sticktight flea, *Echidnophaga gallinacea*, and the mites *Liponyssus bacoti* and *Echinolaelaps echidninus*, poor for the first 6 months and insignificant thereafter; control of the mite *Laelaps nuttalli*, good during all periods; and control of rat louse, *Polyplax spinulosa* of little or no value.

Comparative studies indicate that 5 percent DDT dust is about two-thirds as effective as 10 percent, in terms of reductions in percentage of rats infested with *X. cheopis*.

The over-all natural rate of typhus infection in rats in 1949 from undusted premises was 12.8 percent compared with 16.7 percent in 1948, 21 percent in 1947, and 32 percent in 1946. Examination of rat serums from dusted areas (10 percent and 5 percent projects) show the average percentage positive in 1949 was 9 percent compared with 12.8 percent from undusted areas, or a reduction of about 30 percent in dusted areas. Thus, while DDT dusting reduces typhus among rats within the dusted area the reduction is not as large as might be expected in view of the excellent rat flea control obtained through dusting.

A compilation of available data on the incidence of typhus in rats, by counties, is presented in figure 8. Reference to the map indicates that the distribution of typhus in rats is fairly closely correlated to climatic factors, notably temperature. There is a decreasing infection rate, for example, northward from the Gulf and northwestward from the South Atlantic coastal region. West of central Texas, which is an area of lowered warm-season humidity, a sharp reduction in typhus in rats is noted. These climatic factors, temperature and

FIGURE 4

NATURAL SEASONAL ABUNDANCE OF THE THREE COMMON SPECIES OF NON STICKTIGHT RAT FLEAS IN THE SOUTHERN UNITED STATES. NON DUSTED AREAS.
IN 11 SOUTHERN STATES 1946-1949.
BASED ON 27,979 RATS. 3-MONTH MOVING AVERAGE.

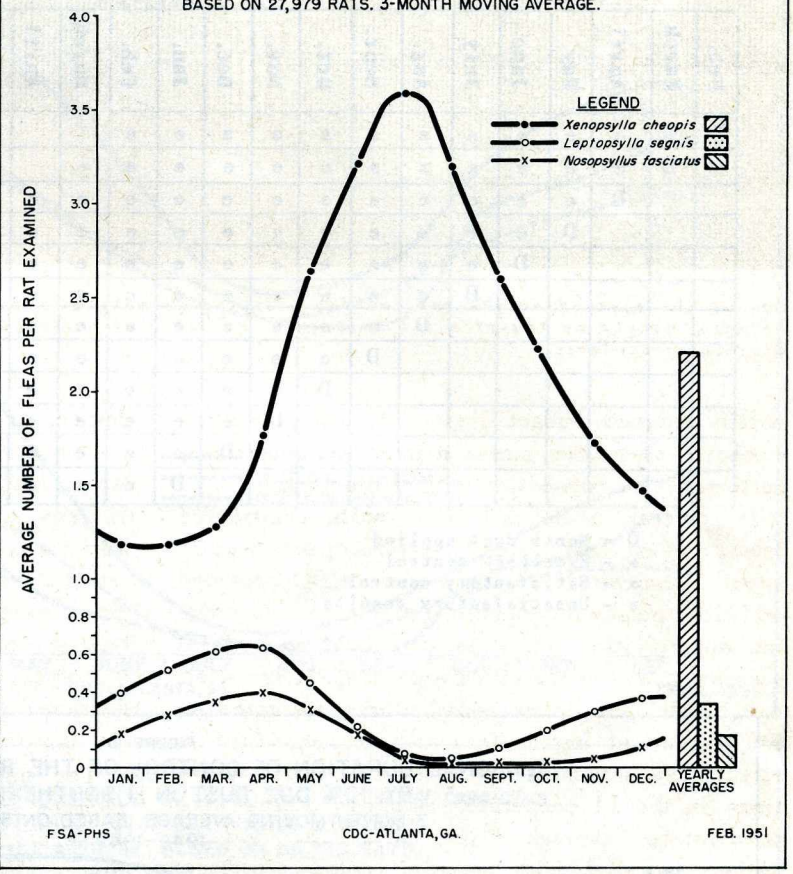


Table 8

CORRELATION OF TIME OF DUSTING (10% DDT), WITH DURATION AND DEGREE OF CONTROL OF THE ORIENTAL RAT FLEA, "X. CHEOPIS," DURING THE FIRST 12 MONTHS AFTER DUSTING IN 11 SOUTHERN STATES, 1946-1949

Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
D	e	e	e	e	s	s	s	s	e	e	e	e											
	D	e	e	e	s	s	s	s	e	e	e	e	e										
		D	e	e	e	e	e	e	e	e	e	e	e	e									
			D	e	e	e	e	e	e	e	e	e	e	e	s								
				D	e	e	e	e	e	e	e	e	e	e	s	u							
					D	e	e	e	e	e	e	e	e	e	s	u	u						
						D	e	e	e	e	e	e	e	e	s	u	u	u					
							D	e	e	e	e	e	e	e	s	u	u	u	u				
								D	e	e	e	e	e	e	s	u	u	u	u	s			
									D	e	e	e	e	e	s	u	u	u	s	s	s		
										D	e	e	e	e	s	s	u	u	s	s	s	e	
											D	e	e	e	e	s	u	u	s	s	s	e	e

D - Month dust applied
e - Excellent control
s - Satisfactory control
u - Unsatisfactory results

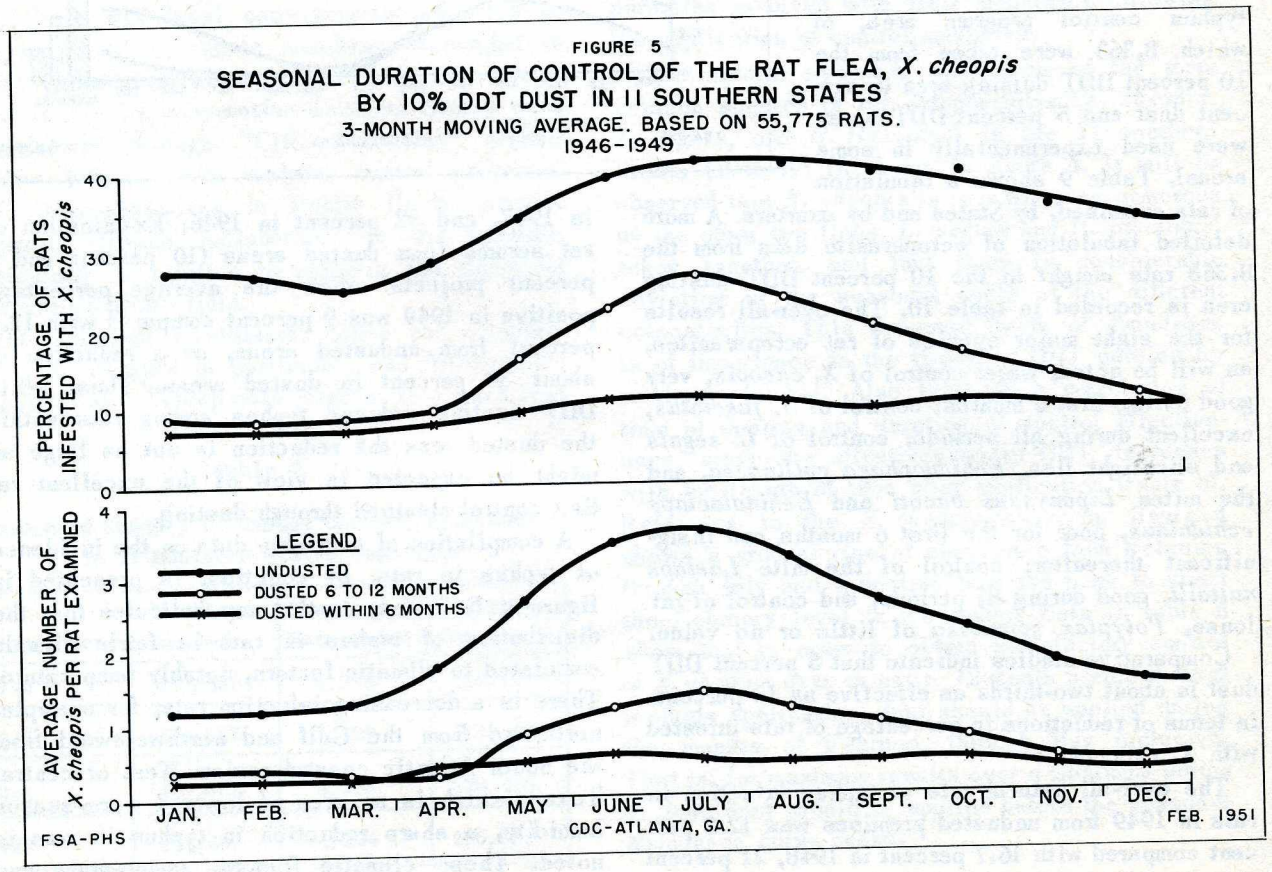
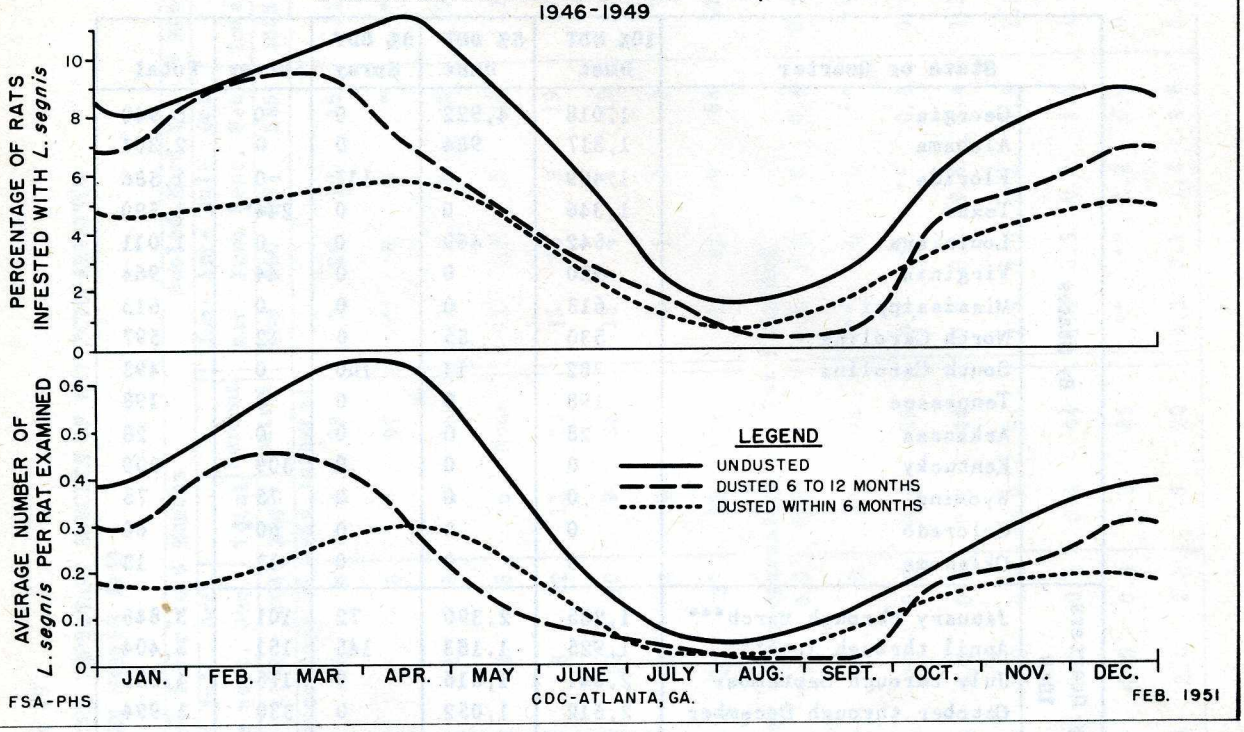


FIGURE 6

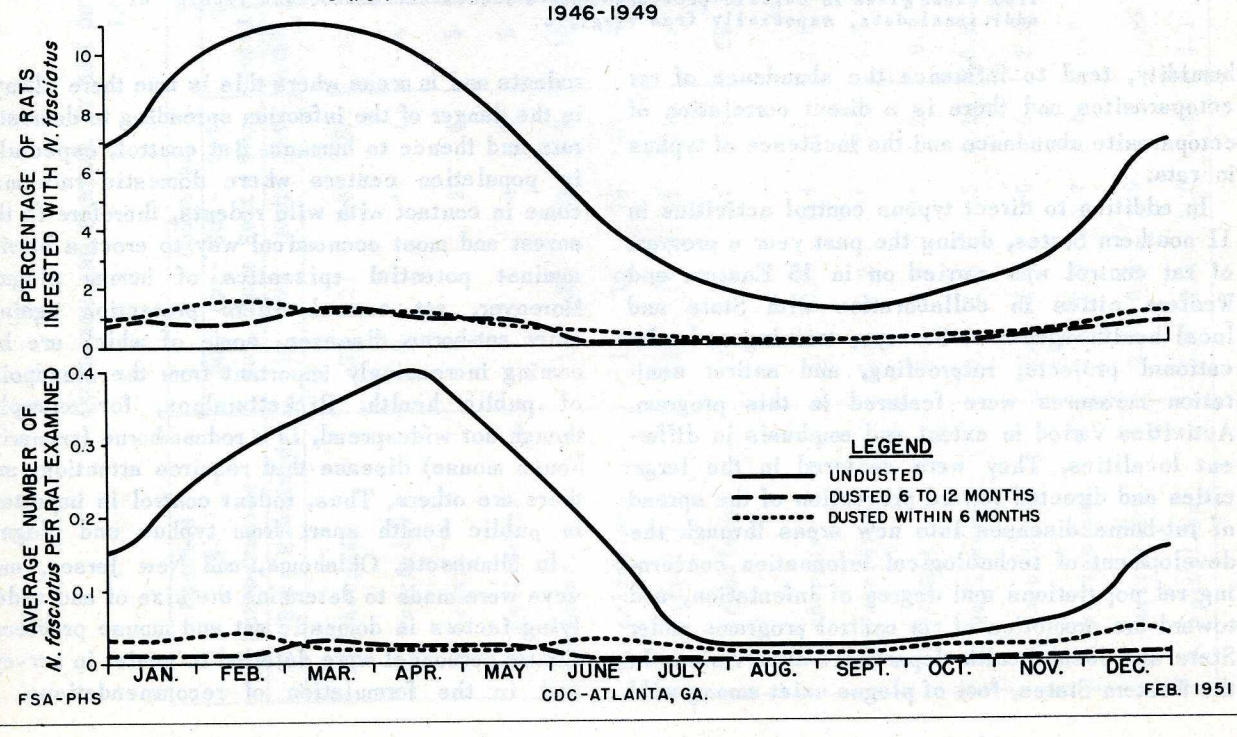
SEASONAL DURATION OF CONTROL OF THE RAT FLEA, *L. segnis*
BY 10% DDT DUST IN 11 SOUTHERN STATES
3-MONTH MOVING AVERAGE. BASED ON 55,775 RATS.
1946-1949



FSA-PHS CDC-ATLANTA, GA. FEB. 1951

FIGURE 7

SEASONAL DURATION OF CONTROL OF THE RAT FLEA, *N. fasciatus*
BY 10% DDT DUST IN 11 SOUTHERN STATES
3-MONTH MOVING AVERAGE. BASED ON 55,775 RATS.
1946-1949



FSA-PHS CDC-ATLANTA, GA. FEB. 1951

Table 9

NUMBER OF RATS CAUGHT ALIVE AND EXAMINED
JANUARY 1 TO DECEMBER 31, 1949

	State or Quarter	10% DDT Dust	5% DDT Dust	5% DDT Spray	Survey	Total
By States	Georgia	1,018	4,922	0	0	5,940
	Alabama	1,317	984	0	0	2,301
	Florida	1,469	0	117	0	1,586
	Texas	1,346	0	0	244*	1,590
	Louisiana	542	469	0	0	1,011
	Virginia	920	0	0	44	964
	Mississippi	613	0	0	0	613
	North Carolina	530	55	0	12	597
	South Carolina	382	11	100	0	493
	Tennessee	198	0	0	0	198
	Arkansas	28	0	0	0	28
	Kentucky	0	0	0	309	309
	Wyoming	0	0	0	75	75
	Colorado	0	0	0	60**	60
	Oklahoma	0	0	0	13	13
By Quarters 1949	January through March***	1,285	2,390	72	101	3,848
	April through June***	1,925	1,183	145	151	3,404
	July through September	2,541	1,816	0	175	4,532
	October through December	2,612	1,052	0	330	3,994
	TOTAL	8,363	6,441	217	757	15,778

*From Brownfield, Tex., Plague Typhus investigation project.
**From Denver plague ecology investigations project.
***Figures for the periods January through March and April through June differ from those given in certain previous reports due to the subsequent receipt of additional data, especially from Virginia.

humidity, tend to influence the abundance of rat ectoparasites and there is a direct correlation of ectoparasite abundance and the incidence of typhus in rats.

In addition to direct typhus control activities in 11 southern States, during the past year a program of rat control was carried on in 15 Eastern and Western cities in collaboration with State and local health agencies. Surveys, training and educational projects, ratproofing, and antirat sanitation measures were featured in this program. Activities varied in extent and emphasis in different localities. They were centered in the larger cities and directed toward prevention of the spread of rat-borne diseases into new areas through the development of technological information concerning rat populations and degree of infestation, and toward the promotion of rat control programs under State and local health department supervision. In the Western States, foci of plague exist among wild rodents and in areas where this is true there always is the danger of the infection spreading to domestic rats and thence to humans. Rat control, especially in population centers where domestic rats may come in contact with wild rodents, therefore is the surest and most economical way to erect a barrier against potential epizootics of human plague. Moreover, rat control offers protection against other rat-borne diseases, some of which are becoming increasingly important from the standpoint of public health. Rickettsialpox, for example, though not widespread, is a rodent-borne (primarily house mouse) disease that requires attention; and there are others. Thus, rodent control is important in public health apart from typhus and plague.

In Minnesota, Oklahoma, and New Jersey, surveys were made to determine the size of and underlying factors in domestic rat and mouse problems. Center personnel were detailed to assist in surveys and in the formulation of recommendations. In

Table 10

ABUNDANCE AND CONTROL BY 10% DDT DUST OF THE IMPORTANT SPECIES OF RAT ECTOPARASITES IN 11 SOUTHERN STATES 1949

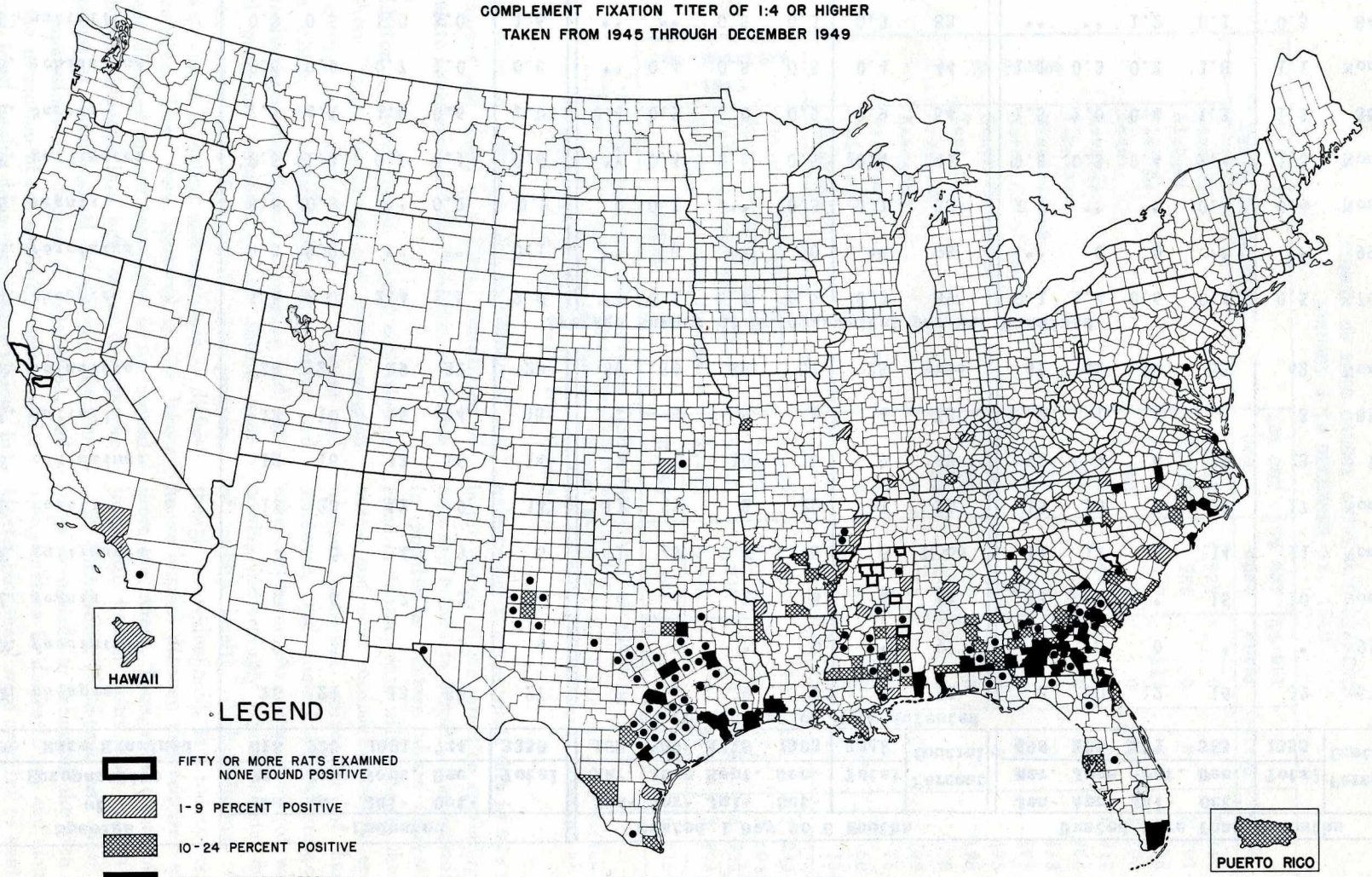
Species of Ectoparasite	Undusted					Dusted 1 Day to 6 Months						Dusted More Than 6 Months					
	Jan-Mar.	Apr-June	Jul-Sept.	Oct-Dec.	Total	Jan-Mar.	Apr-June	Jul-Sept.	Oct-Dec.	Total	Percent Control	Jan-Mar.	Apr-June	Jul-Sept.	Oct-Dec.	Total	Percent Control
No. Rats Examined	618	926	1091	724	3359	168	799	1179	1303	3449		499	200	271	585	1555	
	Percentage of Rats Infested																
X. cheopis	23	21	33	30	27	3	4	9	8	7	73	3	20	12	16	12	57
N. fasciatus	9	7	*	1	4	1	0	*	0	*	97	*	0	0	*	*	95
L. segnis	8	8	2	5	5	0	4	1	8	4	16	13	2	*	15	10	None
E. gallinacea	7	6	4	3	5	1	5	4	8	6	None	11	12	3	14	11	None
L. bacoti	13	20	12	9	14	11	13	8	12	11	20	15	28	9	19	17	None
E. echidninus	12	16	13	16	14	2	7	10	10	9	38	15	4	4	19	13	9
L. nuttalli	12	10	15	24	15	2	3	5	4	4	73	2	1	4	3	3	83
P. spinulosa	28	27	29	32	29	39	34	32	37	35	None	41	42	19	53	42	None
	Average Number of Ectoparasites per Rat Examined																
X. cheopis	1.8	2.0	2.4	1.5	2.0	**	0.1	0.4	0.2	0.2	89	0.1	1.4	0.6	0.4	0.5	76
N. fasciatus	0.3	0.2	**	**	0.1	**	0	**	0	**	98	**	0	0	**	**	99
L. segnis	0.6	0.3	**	0.2	0.2	0	0.1	**	0.3	0.1	39	0.7	**	**	0.4	0.4	None
E. gallinacea	0.5	1.3	0.5	0.1	0.6	**	0.4	0.2	0.5	0.4	44	0.8	0.3	0.4	2.4	1.3	None
L. bacoti	2.1	4.1	1.0	0.6	2.0	0.4	0.9	1.0	0.9	0.9	54	1.5	2.0	0.4	1.3	1.3	36
E. echidninus	0.6	0.9	0.7	1.0	0.8	**	0.4	0.5	0.5	0.4	44	1.1	0.3	0.3	1.8	1.1	None
L. nuttalli	0.9	0.5	1.9	3.0	1.6	**	**	0.5	0.3	0.3	83	**	**	1.2	0.1	0.3	84
P. spinulosa	5.9	2.4	3.0	1.6	3.1	3.0	2.8	2.0	2.6	2.5	20	4.1	3.7	1.4	4.8	3.8	None

* - less than 0.5
** - less than 0.05

FIGURE 8

INCIDENCE OF MURINE TYPHUS FEVER ANTIBODIES IN NORWAY AND ROOF RATS

COMPLEMENT FIXATION TITER OF 1:4 OR HIGHER
TAKEN FROM 1945 THROUGH DECEMBER 1949



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

When outbreaks of rabies in dogs occur mass immunization of dogs in the area yields control within a relatively short period. **Above:** One of the cooperative clinics the Memphis-Shelby County, Tenn., Health Department operated during a mass immunization program in that area. **Right:** Veterinarians assisting in the immunization of dogs at a Denver, Colo., clinic during rabies epizootic there.

Illinois, especially in the Chicago area, stress was placed on training sanitarians and building inspectors. In Columbus, Ohio, a program of block-by-block ratproofing of business establishments was begun. Training opportunities were afforded 47 Ohio sanitarians, most of them in the Columbus area. Rat control programs were initiated in Wichita, Kans.; Des Moines, Iowa; Omaha, Nebr.; and Grand Forks, Minot, Bismarck, Rapid City, and Deadwood, N. Dak. Ratproofing and attendant antirat sanitation programs were carried on in Salt Lake City, Utah; Denver, Colo.; and Spokane, Wash.

In these operations Center personnel rendered consultation services, assisted in training and other educational activities, and served in supervisory capacity. Control activities, encompassing antirat sanitation, rat reduction, ratproofing, surveys, and training, were conducted in varying degree in the following areas: California, Colorado, Idaho, Illinois, Kentucky, Minnesota, Montana, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Utah, Washington, Midwest, District of Columbia, and Hawaii. Man-hours expended, State, local and CDC, totaled 236,457 with State and local agencies contributing 80 percent and CDC 20 percent.

RABIES: The Center's role in rabies control is one of assisting States in the several activities involved, through the assignment of personnel for training purposes, providing professional and technical services in connection with surveys, coordinating activities and formulating a national pattern for rabies control, developing technological information concerning rabies and its control, cooperating in the investigation of outbreaks and their suppression, supporting educational programs, and in rendering diagnostic and other laboratory services.

Twenty States now operate rabies control programs. Ten other States have requested CDC assistance in inaugurating long range control programs.

Fifteen States reported no rabies in 1949 while the highest incidences reported were in Indiana, Kentucky, Ohio, Texas, and Georgia, in that order. The number of reported cases in animals in the United States declined from 8,508 in 1948 to 7,597 in 1949. Over 3,000,000 doses of canine rabies vaccine were used during the past year.

In response to requests from the respective health authorities, the Center assisted in dealing with epizootics in northern Louisiana; Denver,

Colo.; and Charleston, W. Va. In each instance comprehensive dog vaccination programs were organized utilizing local veterinarians, local health department personnel, and available State health department facilities and personnel. In Denver, 32,000 dogs were immunized; in Louisiana, 3,000; and in Charleston, 20,000. While mass immunization in the epizootic area yields control within a relatively short period and is employed widely in such situations, it has been demonstrated that effective rabies control is best obtained through a well-organized program directed from the State level with active participation by local health officials and practicing veterinarians. This is the approach recommenced by CDC and supported through a national case reporting system. Early in 1950 Puerto Rico, which had been free of rabies for many years, reported animal cases. A control program supported by CDC was inaugurated immediately and the outbreak in domestic animals quickly brought under control. The mongoose problem has persisted.

Upon request of the Pan American Sanitary Bureau, assistance was extended Mexico in conducting rabies surveys and establishing control programs. Laboratory facilities were evaluated, field problems surveyed, and a course in laboratory diagnostic methods held for veterinarians and technicians.

In laboratory studies, progress was made during the year in the evaluation of dog vaccines. Four groups of dogs, aggregating 249, were vaccinated with the four experimental rabies vaccines. Serum neutralization tests on prevaccination serums from the dogs have been completed and serums collected for postvaccinal titrations.

DYSENTERY AND DIARRHEA: On the basis of knowledge accumulated from previous projects, particularly in Hidalgo County, Tex., (Pub. Health Rep. 63:1319-1334 (1948)) a program of fly control operations for the specific purpose of reducing mortality, morbidity, and infection from dysentery and diarrheal diseases has been initiated in certain areas of high endemicity. A study of dysentery and diarrhea mortality in the nation among children under 2 years of age was made with the view of determining areas suitable for this type of operation. Data available consisted of mortality by counties for the years 1946 and 1947. Counties with significantly high mortality and a summer peak in incidence were identified in Arizona, New Mexico, Texas, and Kentucky. A few counties in other States were found to have significantly increased rates, but the level of rates was not as high as in the four States mentioned.

By the end of the fiscal year 1950 control operations had been inaugurated in four of eight cities tenatively selected for operation. Two of the four activated projects are in Arizona and two in Texas. Preliminary plans were drafted for the activation early in 1951 of three other projects, two in New Mexico and one in Kentucky.

The projects are Federal-State cooperative undertakings and are administered by State health departments in accordance with the formula employed in joint malaria and typhus control operations. In general, Federal participation (roughly 60 percent of total cost) includes technical and supervisory personnel, spraying equipment, and necessary automotive equipment, while State and local contributions cover sanitation activities, spray labor, insecticides, and similar items.

The established projects are operated in accordance with procedures adopted on the Fly-Poliomyelitis investigations projects; namely, a sound program of environmental sanitation supported by the application of chemicals. The four cardinal points of the sanitation program for the elimination of fly breeding are: (1) Sanitary handling of garbage and other refuse. (2) Improved sanitation of domestic animal shelters. (3) Sanitary disposal of putrescible industrial wastes. (4) Elimination of insanitary privies. Supportive chemical measures consist of the application of larvicides, residual type sprays, and space sprays as local conditions warrant. It is planned to continue the projects over a 3-year period.

Although the projects have not been in operation over a sufficient period of time to produce evaluative data, public response has been favorable in each instance and indications are that they are effective in reducing fly abundance.

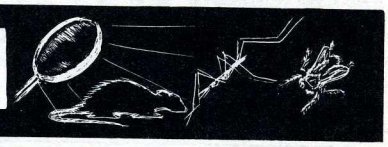
Collateral Activities: Nearly every problem in communicable disease control involves the collection, analysis, interpretation, and utilization of statistics. Hence the Center maintains a headquarters staff of persons with advanced training in either biological or mathematical statistics. This staff not only provides comprehensive statistical services in support of CDC activities, but extends diversified consultative services to State and local health agencies, other agencies engaged in public health work, Federal and non-Federal; and cooperates with the National Office

of Vital Statistics in improving systems for reporting morbidity and mortality.

During the past year statistical services of the Center were expanded, reorganized, and improved so as to provide better guidance to the various Center programs and to render greater service to operational and investigative personnel. Steps were taken to establish procedures for regular statistical consultation to CDC field stations. Through interservice conferences, statistical problems in interpretation of fly density measurements were reviewed and agreement reached on the use of a comparable method for sampling fly populations on all CDC projects. Sampling procedures for reduction in time expended in entomological determination of fly trap catches were developed in collaboration with field personnel. In every activity involving the collection and utilization of statistics, which is almost every Center activity, specialists in the statistical field provided valuable services.

Through arrangements with the National Office of Vital Statistics current monthly morbidity data for diseases of interest to the Center, by State and county, were received, tabulated, analyzed, and made available to Center personnel in the field and laboratory. Diseases involved included poliomyelitis, malaria, typhus, diphtheria, brucellosis, encephalitis, rabies in animals, rabies in humans, anthrax, psittacosis, and trichinosis.

INVESTIGATIONS AND STUDIES



FLY CONTROL-POLIOMYELITIS: While the primary purpose of the projected 5-year program is to determine the value, if any, of fly control in the transmission of poliomyelitis, it is visualized that the collection of basic information on all aspects of the epidemiology of the infection will contribute to the discovery of new methods for detection and control of the disease.

In 1949, fly control operations, encompassing improved sanitary practices and the application of chemicals (space and residual spraying), were inaugurated in five representative cities – Charleston, W. Va.; Muskegon, Mich.; Phoenix, Ariz.; Topeka, Kans.; and Troy, N. Y. Throughout the fly-breeding season fly populations in all project cities except Phoenix were held at the general level of five per grill count. DDT was used predominantly, in residual and space spraying, but tests were made in Phoenix with dieldrin in the fall of 1949. Single residual applications of dieldrin at the rate of 25 and 50 mg./sq. ft. yielded satisfactory control for 8 to 10 weeks. However, duplication of these tests in the spring of 1950 produced no appreciable control. Results of the two tests are shown graphically in figure 9. At Phoenix the 8- to 9-months fly breeding season and the presence of extensive areas of substandard housing made it difficult to accomplish satisfactory control by chemical means with available city-wide spray power. In an effort to alleviate this situation, control efforts were concentrated in certain areas of the city. This maneuver, as indicated in figure 10, resulted in a precipitous decline in fly populations by early June.

Evaluation data from all projects indicate, as has been true in previous operations, that the degree of fly control obtained and the effort required to attain it is directly correlated with the level of sanitation practiced in the areas under treatment. Satisfactory fly density levels can be maintained in the better class residential sections with minimum application of chemical measures. In areas of moderate sanitation levels chemical treatment at frequent intervals produces satisfactory control, whereas in areas of low sanitation levels the cost of control by chemical means is prohibitive because of the intensive treatment required. Accordingly, in all projects added emphasis has been placed upon improved sanitary practices. Considerable progress in this direction has been made, particularly with respect to garbage storage, collection, and disposal. In some

FIGURE 9

The effects of a single outdoor residual spray application of a 1.25 percent dieldrin-rosin-xylene emulsion (50 mg. per sq. ft.) in the fall of 1949 (left graph) versus a similar application of 0.625 percent dieldrin-Triton-xylene emulsion (25 mg. per sq. ft.) in the spring of 1950 (right graph) upon fly densities in Phoenix, Ariz., (22 blocks) in relation to untreated Mesa (10 blocks). Based on 3-week moving average.

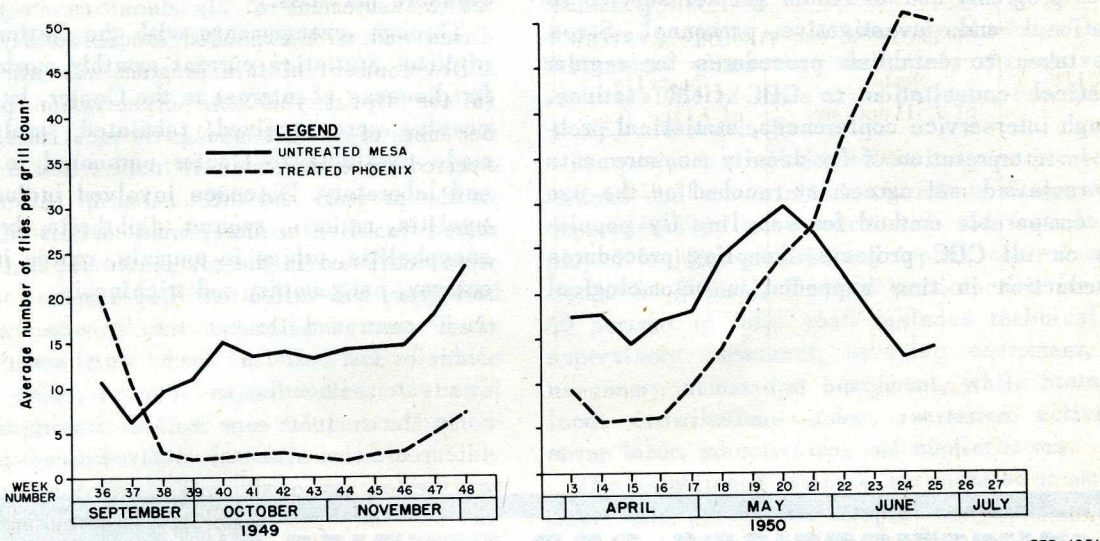
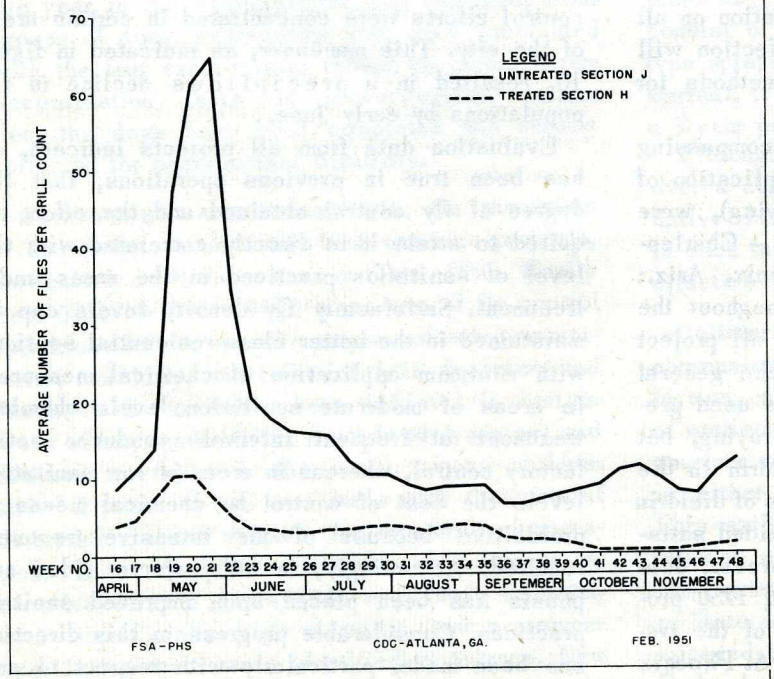


FIGURE 10

THE AVERAGE NUMBER OF FLIES PER GRILL COUNT IN THE TREATED BUSINESS SECTION (H) OF PHOENIX, ARIZONA AS COMPARED TO THE UNTREATED BUSINESS SECTION (J) OF MESA
BASED ON A 3-WEEK MOVING AVERAGE
1949



cities the adequacy of garbage storage has been raised from 20 to 90 percent during the past year. Charleston has adopted the sanitary landfill method of garbage disposal and increased the frequency of collection. Phoenix has appropriated funds for conversion to the landfill method of disposal.

The Yale University Poliomyelitis Study Unit, grantee of the National Foundation for Infantile Paralysis, is cooperating in the fly control-poliomyelitis investigations by assisting Center laboratories in analyses of adult flies and sewage samples and other materials collected from the study areas. The objective of this phase of the investigation is to determine the natural infection of flies with poliomyelitis virus during the pre-epidemic, epidemic, and postepidemic periods, and to study the course of the infection in time and space as it relates to the spread of the disease through a community. Sewage

Table 11

Number of Collections and Quantity of Flies Obtained in Trapping Operations at the Five Poliomyelitis - Fly Control Cities, 1949, for the Purpose of Virological Studies

CITY	COLLECTIONS FOR VIROLOGICAL STUDY	
	Number of Collections	Quantity of Flies (cc.)
Troy	296	27,446
Muskegon	282	12,052
Charleston	343	23,417
Topeka	372	28,931
Phoenix	659	17,528
Total	2,003	109,374

samples are processed and injected into monkeys to test for the presence of the poliomyelitis virus. Specimens of adult flies obtained for virus determination are tabulated in table 11.

Epidemiological Studies: Early in the fiscal year arrangements were made to record essential diagnostic information concerning all reported poliomyelitis cases in the five cities under study. During the summer of 1949, poliomyelitis occurred in each of the cities as follows:

City	Total Cases	Paralytic	Nonparalytic	Unknown
Charleston	13	13	-	-
Muskegon	67	45	13	9
Phoenix	40	13	27	-
Topeka	31	23	8	8
Troy	28	12	14	2

It became evident that a simple count of reported cases of poliomyelitis in the cities where fly control operations were being practiced was unlikely to answer the question as to the relative importance of the fly as a vector of the causative virus. Accordingly, a major reorganization and redefinition of the objectives of the epidemiological aspects of the program were decided upon early in the year. The new plan provided for the detailed investigation of all reported and suspected cases of poliomyelitis occurring within the study cities, the objective being to verify diagnosis, to obtain consistent case counting of recognized cases, and to trace insofar as possible the source and spread of the disease. In addition, the plan contemplates the establishment of morbidity survey teams in selected areas of the study cities to measure the incidence of minor illnesses and to develop case counting mechanisms for measuring nonparalytic and abortive forms of poliomyelitis. The plan also provides for the integration of the more intensive epidemiological investigation with the measurement of fly densities in the study cities and with expanded studies of fly biology.

Development of this program was started early in the fiscal year. As organization proceeded, because of budget and personnel limitations, it seemed more desirable to reduce the dimensions of the program and the number of cities was reduced from five to three. Limited control measures were continued in the eliminated cities (Muskegon and Troy) and collection of specimens for virology study continued through the fly season; but epidemiological efforts were concentrated in Charleston, Phoenix, and Topeka.

By March 1950 enumeration of morbidity in the selected blocks of the study cities was begun, and by the end of the fiscal year four enumeration periods had been completed. Approximately 3,000 households involving over 10,000 persons were under observation in the three cities as follows:

City	No. Households	No. Persons
Charleston	950	3,100
Phoenix	1,300	5,100
Topeka	830	2,600

The data collected on illnesses reported and on environmental and socioeconomic characteristics are being coded. Preliminary tabulations give an indication of the kind of pattern this method of enumeration produces but are too fragmentary for interpretative analysis.

Inasmuch as the basic technique necessary to the accomplishment of the ends of the redefined poliomyelitis studies is one entailing the collection of accurate clinical data in defined population groups, automatically such information will be collected on other illnesses which may simulate poliomyelitis. Thus, many opportunities will arise for the carrying on of other epidemiological investigations concomitantly with the poliomyelitis program. Furthermore, with the development of a basic morbidity survey unit it should be possible to design additional studies of a wide variety of diseases which may be carried on with only moderate cost.

Laboratory studies of human specimens and bacteriological studies related to the morbidity

Operating in areas considered comparable and representative with respect to basic environmental and socioeconomic characteristics, trained morbidity enumerators collected through personal interviews accurate clinical and related environmental data on defined population groups in each study city. Enumerations were made at established intervals.

survey are part of the program but had not progressed beyond preliminary stages by end of the fiscal year.

DYSENTERY AND DIARRHEA-FLY CONTROL: Activities in this area during 1950 consisted, in the main, of a cooperative project with the Microbiological Institute headquartered in New Orleans, La., and field investigations and studies headquartered at Thomasville, Ga.

New Orleans: This project, long range in nature, primarily is concerned with environmental studies and statistical services concerned with diarrheal diseases, with emphasis on the role of flies. Considerable progress has been made in detailed analyses of data accumulated through field studies in Hidalgo County, Tex., in New Mexico, and in Thomasville, Ga.

Environmental studies, initiated as part of this project during the past fiscal year, include air sampling in the nursery for premature infants at Charity Hospital. Plans were made for the construction of laboratory facilities for this study in the hospital of the Quarantine Station at New Orleans and it is anticipated that the laboratory will be in operation early in 1951. Special attention is being given to the possible role of air-borne infection in the spread of diarrheal disease among the new born.

Thomasville, Ga.: Insecticidal and environmental sanitation studies in terms of their relation to fly control and dysentery and diarrhea infection are being pursued in this project. Nine towns, six of them small rural communities of 500 to 3,000 population and three of them in the 5,000 to 16,000 range, comprise the study area. A characteristic of all of the towns is the presence of animal enclosures (livestock for meat and milk products, and chickens for eggs). These enclosures constitute the largest and most widespread single production source of house flies. In the smaller towns, household garbage is used widely in feeding hogs. This tends to limit the production of flies of the genus *Phaenicia* but is favorable for the breeding of house flies, which is the dominant species present in the towns and the abundance of which is directly correlated with the number of domestic animal enclosures.

Three of the small towns (Boston, Ochlochnee, and Pavo) are under treatment in connection with insecticidal studies, and three others (Barwick,

Coolidge, and Meigs) are used as controls. Until retreatment was necessary in late May 1950, 5 percent DDT emulsion was used for all residual spraying operations in the three towns and 5 percent DDT solution in kerosene was used when aerosol application was necessary. Initially, both of these measures were used, inside and outside of houses, in order to reduce fly populations quickly. Some space spraying also was practiced.

In two towns (Ochlochnee and Pavo) treatment included outdoor and routine indoor spraying, while in the third (Boston) only outdoor spraying was practiced. Indoor fly counts in Boston, where only outdoor spraying was practiced, were comparable to those in Pavo and Ochlochnee. Figure 11 shows the results of this work in terms of outdoor grill counts and in comparison with untreated towns. Figure 12 shows a comparison of over-all fly indices in treated and untreated towns. In general, the reduction in indoor fly densities was comparable to that obtained outdoors. Figures 11 and 12 also show the dramatic effect of dieldrin* and chlordan (in varying concentrations) on fly indices when these materials were used instead of DDT in May 1950. Whereas weekly applications of DDT had been necessary in nearly all areas of each town, no retreatments were required over an 8-week period in the dieldrin treated town. Over a similar 8-week period in the chlordan treated town, two to four retreatments were required on weather-exposed surfaces in about one-third of the area and one retreatment in the remaining two-thirds.

In planning the insecticidal studies, considerable effort was devoted to working out a system for obtaining fly density indices for purposes of reliable comparison. However, no single system was found suitable and evaluations were made by three methods – stationary block, random block, and visual or reconnaissance surveys. In the stationary block and random block methods, the standard Scudder-type fly grill was used. The visual or reconnaissance survey method, in general, consists of the inspector cruising the area and estimating the fly population by observation. This method has the advantage of rapid coverage of large areas but is not, however, as reliable as the relatively accurate grill count method which is time consuming.

In determining the effect of fly control measures on dysentery prevalence, from 850 to 1,100 rectal

*See dieldrin and fly control, pages 43 and 48.

FIGURE 11

COMPARISON OF OUTDOOR FLY INDICES OF TREATED AND UNTREATED TOWNS

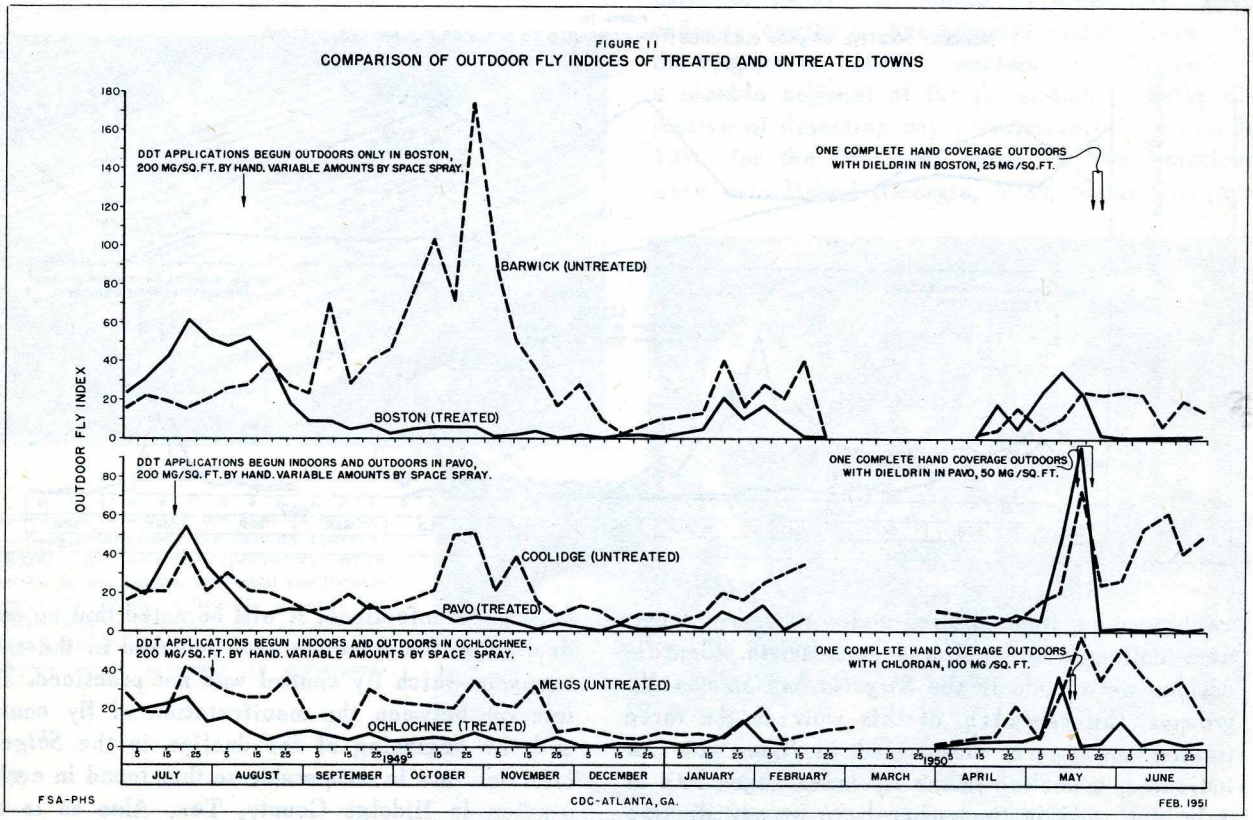


FIGURE 12

COMPARISON OF INDOOR FLY INDICES OF TREATED AND UNTREATED TOWNS

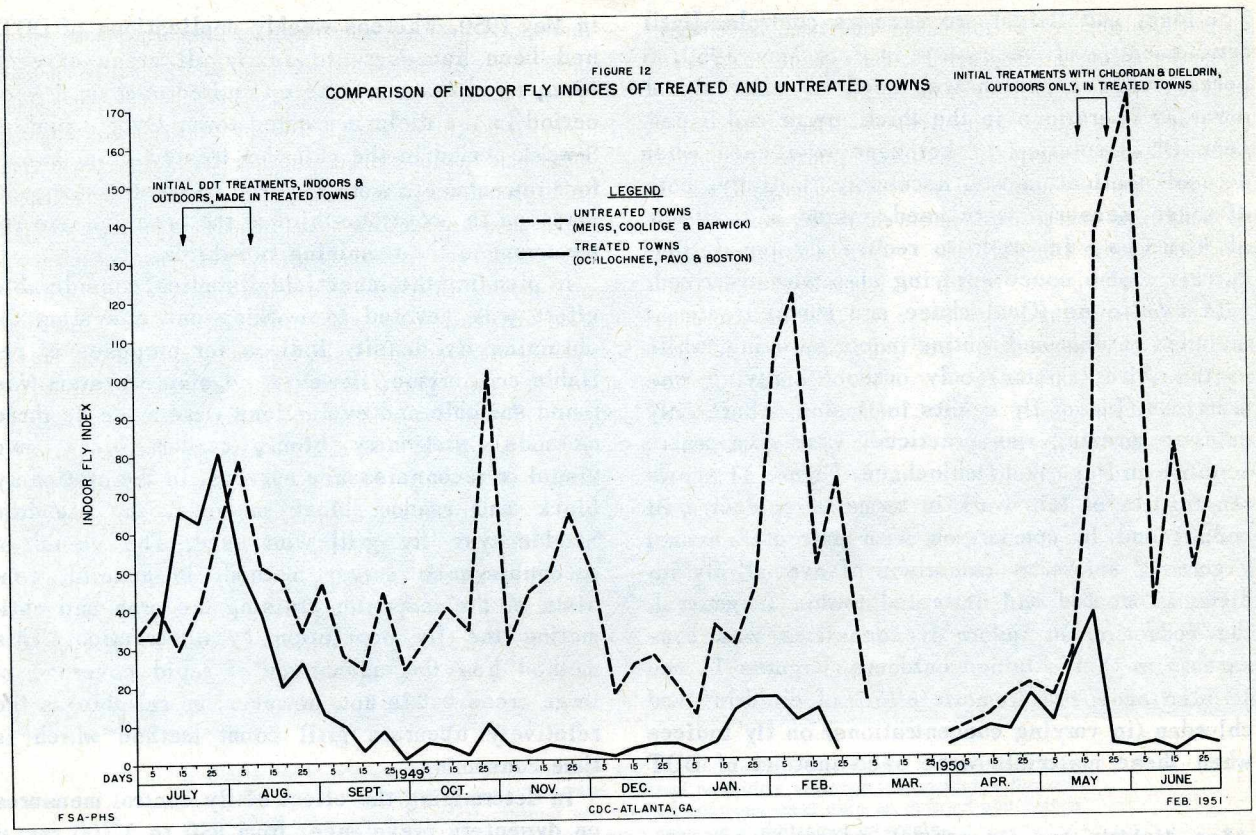
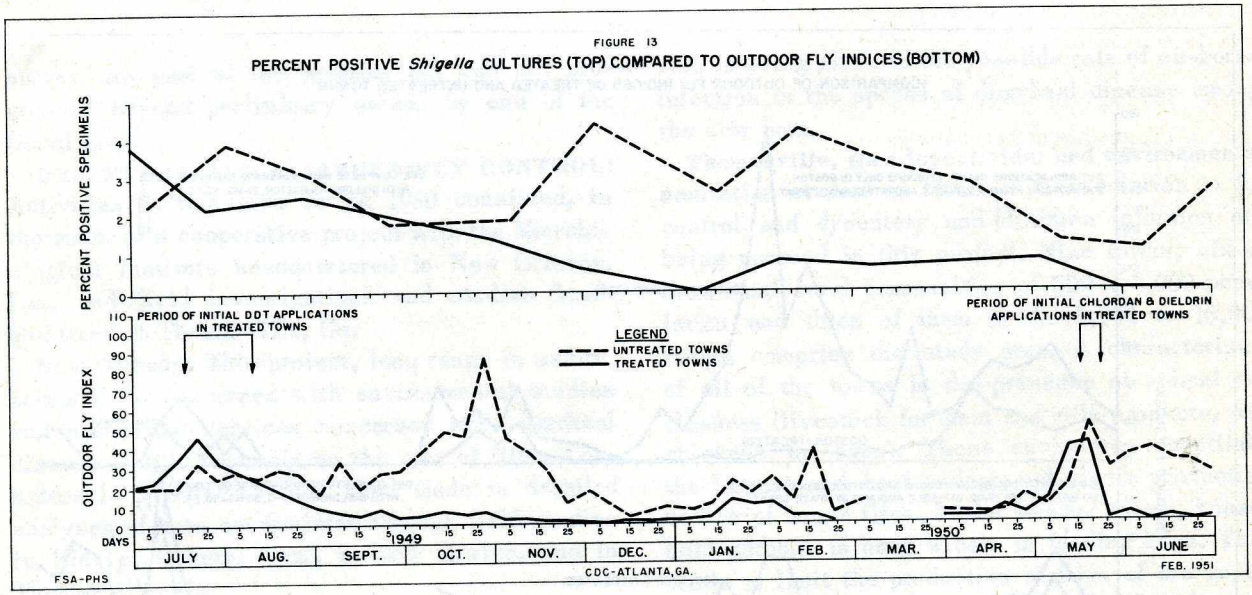


FIGURE 13

PERCENT POSITIVE *Shigella* CULTURES (TOP) COMPARED TO OUTDOOR FLY INDICES (BOTTOM)



swab samples from children under 10 years of age were collected and cultured each month. Identifications were made in the *Shigella* and *Salmonella* groups. The results of this work in the three treated towns are summarized in figure 13. As indicated, a decline in the fly index began late in July, followed in September by a steady decline in *Shigella* infections. It will be noted that no such decline in the infection rate occurred in the three towns in which fly control was not practiced. The interval between the manifestation of fly control and the beginning of the decline in the *Shigella* infection rate is comparable to that found in earlier studies in Hidalgo County, Tex. Also as in the

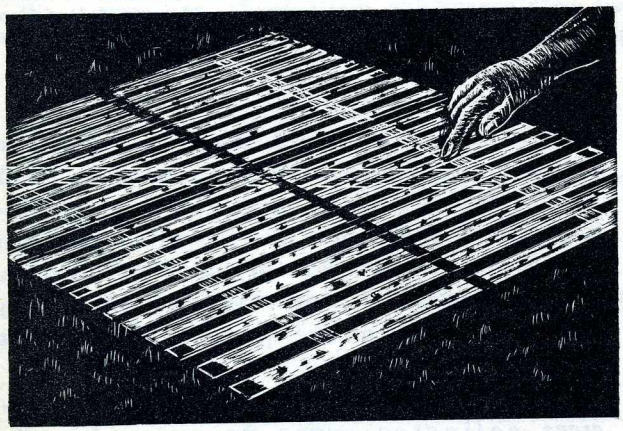
Texas studies, the *Salmonella* infection rates for children did not vary significantly between treated and untreated towns and were relatively low, whereas the *Shigella* rates were materially lower in the treated towns than in the untreated towns.

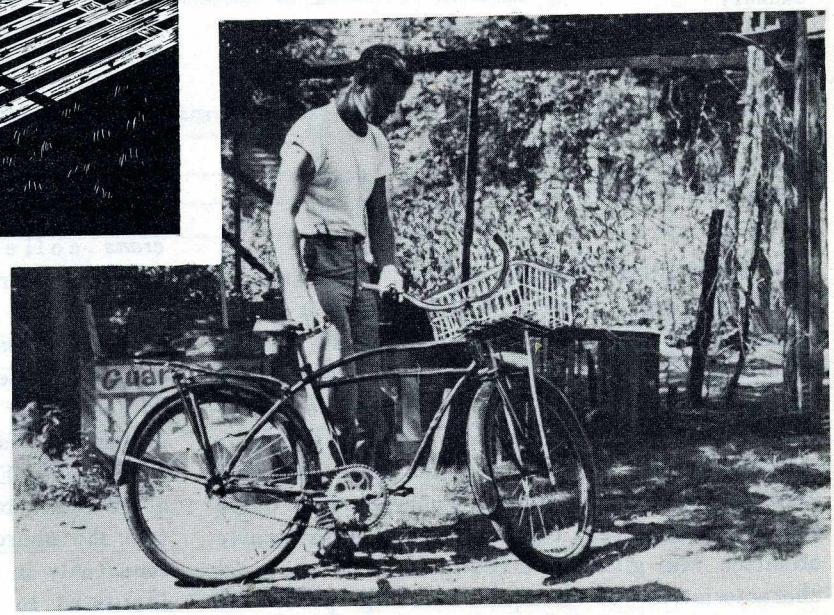
In the environmental sanitation studies, one city was selected in which garbage collections were increased from one to three per week, a sanitary landfill for garbage disposal was started, and the cooperation of town officials was obtained in enforcement of ordinances regulating the handling of garbage, industrial wastes, and control of domestic animal enclosures. In a second city, intended as a control, it was planned that no improved sanitation or fly control would be inaugurated during the study period. However, officials of the control city inaugurated a three times per week garbage collection schedule and DDT was dispersed both as residual spray and as mist throughout the fly season. However, the open dump method of garbage disposal was not altered.

Because of the disturbance of the status of the control town, it is difficult to compare the degree of fly control obtained. However, it is indicated that in the absence of other fly control measures accelerated garbage collection schedules will not reduce fly populations sufficiently to bring about appreciable reduction in the transmission of diarheal diseases by flies. Substitution of sanitary landfills for the open dump method of garbage materially reduced fly populations as did accelerated garbage collection schedules but, unsupplemented, these measures do not yield effective fly control in areas of high populations and without effective fly control, transmission of diarrheal disease is not diminished significantly.

MALARIA: Major activities in this sphere during 1950 included: (1) studies, investigations, and research to obtain data on malaria occurrence, malaria transmission, natural history of malaria parasites, and malaria-carrying mosquitoes, conducted through three field observation stations; and (2) critical appraisal of reported cases of malaria to evaluate progress of the malaria eradication program being carried on in 13 traditionally malarious States.

The three malaria observation stations are located in selected areas of Georgia, South Carolina, and Arkansas, where malaria formerly was highly endemic. It is reasoned that should malaria recur or materially increase, the initial evidence of recurrence likely will appear in previously hyperendemic territory. Accordingly, malariologists at the respective stations maintain surveillance over a sizable segment of the population with the objective of detecting any resurgence of malaria. In 1950, for the first time since the three stations were established (Georgia, 1939; South Carolina,





Speed and accuracy are factors of concern in determining fly density indices. **Right:** An effective procedure when speed is paramount is visual reconnaissance by riding a bicycle through the area and observing fly prevalence. **Above:** The Scudder-type fly grill is preferable when accuracy is paramount.

953873 O—51——5

1944; Arkansas, 1948) no confirmed case of malaria was observed during an entire fiscal year.

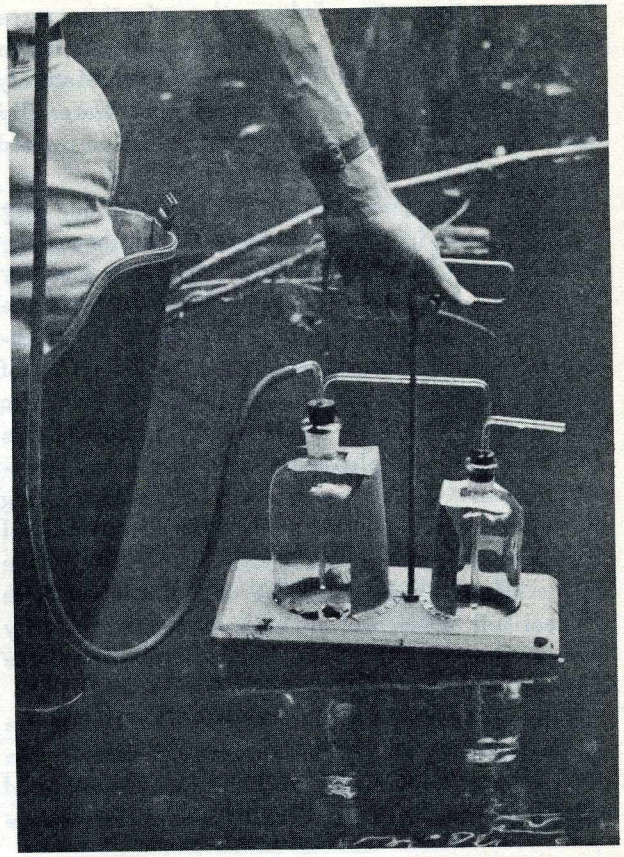
Newton, Ga., Station: In this study area two procedures are used for determining malaria morbidity indices. Blood film surveys are made of school children and of representative samples of other age groups of the population, and nurses make regular visits to approximately 1,000 residents of an experimental section where high malaria rates previously have been experienced. Any illness detected through visits of nurses is evaluated, and blood films are collected if malaria is suspected. Table 12 shows, by months, the number of persons with malaria-like symptoms and the number of blood films collected in surveys. No positive blood films have been obtained from this area since 1944.

Table 12

Number of Persons with Malaria-like Symptoms and Number of Blood Films Obtained in Surveys at the Georgia Malaria Investigations Station July 1949 through June 1950

Month	Number persons with symptoms of malaria	Number blood films collected in surveys
July	22	90
August	23	11
September	–	717
October	1	1,011
November	–	353
December	–	–
January	4	–
February	2	–
March	–	–
April	2	8
May	7	14
June	3	13
Total	64	2,217

In anophelism studies, regular collections of larval and adult *Anopheles* were made at established index stations and for the second year *A. quadrimaculatus* were found to be active throughout the winter. Analyses of data on the time for development from eggs to adult show that the results obtained for any series of rearings were extremely variable, and emphasize the importance of using standard procedures. During the year considerable attention was given to investigations of chemical characteristics of mosquito-breeding places in



Mosquito breeding is influenced by the presence of certain chemicals in water in which eggs are deposited. Apparatus shown above is used in obtaining water samples for determination of composition through laboratory analysis.

various parts of the world. Some studies suggest that there are correlations between mosquito breeding and various chemical conditions of the environment, while others show that mosquito breeding is inhibited by the presence of specific compounds. In September 1949 a project was launched to study waters in representative ponds in southwestern Georgia.

Dissection of 381 adult female *Anopheles crucians* collected during the summer from the premises of rural residences in the Newton area showed that 12 percent had salivary glands infected with small sporozoite-like bodies. Identity of these bodies has not been determined, but they do not appear to be identical with the intermediate stages of *Plasmodium* in man. No stomach cysts were found. Examinations were made of a variety of mammals, birds, reptiles, and amphibia to ascertain the source of the infection. *Plasmodia* were found only in birds and lizards. Studies have been instituted to determine if local species of

Table 13

RESULTS OF DISSECTIONS OF WILD-CAUGHT "ANOPHELES" AT MALARIA INVESTIGATIONS STATION, MANNING, S. C.

	Cumulative Total - FY-1950	Cumulative Total - FY-1949
No. *crucians* dissected	9,755	12,970
No. *crucians* with sporozoites	8	10
Percentage *crucians* with sporozoites	0.08	0.08
No. *quadrimaculatus* dissected	5,307	6,867
No. *quadrimaculatus* with sporozoites	4	3
Percentage *quadrimaculatus* with sporozoites	0.08	0.04
No. *punctipennis* dissected	76	175
No. *punctipennis* with sporozoites	0	0

Anopheles can acquire and transmit the malaria parasite of wild animals.

Manning, S. C. Station: No laboratory confirmed case of malaria has been detected in this area since 1949. During the past year 21,763 blood films were collected in the course of monthly surveys and of 18,028 examined all were found negative. Anopheline density indices show that fewer mosquitoes were present in the area during the spring and summer. Results of dissection of wild-caught *Anopheles* are shown in table 13. Although the percentage of positive *quadrimaculatus* for fiscal year 1950 was 0.08 as compared with 0.04 in 1949, it is doubtful that the difference is significant. Of the few *Anopheles punctipennis* dissected, none were positive in either 1950 or 1949.

Because of the continued finding of sporozoites in wild-caught *crucians* and *quadrimaculatus*, in the absence of human blood-positive cases of malaria, a non-human blood parasite survey was undertaken to find the souce of infection. Blood samples were collected from 1,630 equine, bovine, porcine, and avian animals. As indicated in table 14, microscopic examination of 1,000 of these bloods disclosed no *Plasmodium*. Blood parasites noted include microfilaria, trypanosomes, and

Table 14

BLOOD PARASITE SURVEY OF DOMESTIC ANIMALS

Type of Animal	Total Animals Sampled to Date	Cumulative Microscopic Examinations	Microfilaria	Trypanosome	Leucocytozoon	Negative
Mammalian						
Equine	300	300	4*	-	-	296
Bovine	400	400	8**	3***	-	389
Canine	400	150	49†	-	-	101
Porcine	106	50	-	-	-	50
Avian						
Chicken	392	98	-	-	12	86
Duck	13	-	-	-	-	-
Goose	7	-	-	-	-	-
Guinea	2	-	-	-	-	-
Turkey	10	2	-	-	2††	0
Total	1,630	1,000	61	3	14	922

**Setaria equina* (?)
***Setaria cervi* (?)
****Trypanosoma theileri*
†*Dirofilaria immitis*
††*Leucocytozoon smithi*

Leucocytozoon, the latter being detected in chickens and turkeys. The *Leucocytozoon* in the chicken does not appear to be the same as that in the turkey. To date literature available does not list this parasite in the domestic chicken in this part of the world.

Helena, Ark., Station: Malaria morbidity studies are being conducted in a selected area located in Phillips County. Approximately 1,000 persons are kept under surveillance by nurses through visits at monthly intervals. In addition, special surveys are conducted in the area and in the schools in other sections of the county. No malaria cases were detected during 1950. Anophelism is being determined by regular counts of adults and larvae at established stations. Density indices in the spring and summer of 1950 were much lower than those in the previous year.

Malaria Case Appraisal: A program of critical appraisal of reported cases of malaria to evaluate the progress toward eradication of the disease was initiated by the Communicable Disease Center in 1947. Medical and nurse epidemiologists were assigned to States to appraise individual cases and deaths attributed to malaria, to investigate reported outbreaks of the disease, and to promote better diagnosis and treatment. The number of reported cases was so large and the available personnel so limited that complete coverage of individual case reports was impossible. During the first 2 years of the program, therefore, activities were directed toward the interviewing of the relatively few physicians whose reports accounted for the majority of reported cases and deaths, with the idea of collecting data concerning the validity of reported diagnoses. Efforts to confirm cases rarely were successful.

In 1949, when stress was upon individual case appraisal, progress was made in assembling reasonably adequate data. Public Health Service personnel were assigned continuously in Mississippi and South Carolina, and for part of the year in Georgia, Alabama, Arkansas, and Texas. As many reported cases and deaths from malaria as possible were investigated with emphasis upon collecting all pertinent facts of epidemiological significance. Particular attention was given to the history of malaria attacks, trips by the victims out of the country into malarious areas of the world, recent blood transfusions, and malarial treatment. Findings were submitted to State epidemiologists for review and appraisal as to confirmation and source of infection.

Table 15 (Andrews, Quinby, and Langmuir, table 1, Am. J. Pub. Health Vol. 40, No. 11, November 1950) summarizes appraisals through July 31, 1950 of cases reported or known to have occurred in 1949. As indicated, 494 cases of 4,012 reported in the 13 southeastern States were appraised and 55 confirmed as positive. Of the 55 positive, 19 were classified as indigenous primary malarias, since they could not be wholly and adequately explained as being relapses, transfusions, or imported cases. However, some of these cases occurred under epidemiologic circumstances which raise serious doubts as to their proper designation as indigenous primary malarias. In other words, evidence from field investigations and appraisal of reported malaria cases and deaths indicate clearly that more malaria is being reported than actually exists, and that endemic malaria has been reduced to a much lower level than reported mortality and morbidity suggest.

MURINE TYPHUS (Thomasville, Ga.): Investigative studies inaugurated in three southwestern Georgia counties (Brooks, Thomas, and Grady) in 1945 to determine the effectiveness of DDT dusting as a typhus control measure are being continued. During the past year activities consisted, in the main, of observations and collection of data bearing on the incidence of typhus among humans and among the rat populations in the study area.

In two of the three counties, Brooks and Thomas, five applications of 10 percent DDT dust in pyrophyllite were applied to rat runs, burrows, and harborages in and near buildings during the period April 1946-September 1947. No dust has been applied in the area since September 1947. Undusted Grady County serves as a control.

Figure 14 shows the incidence of human typhus by month of onset in the three counties (1) prior to the initial application of DDT dust, (2) during the approximately 18 months Brooks and Thomas Counties were under treatment, and (3) during the 2 years subsequent to cessation of dusting in Brooks and Thomas Counties. It will be observed that during the 2 years immediately following the discontinuance of dusting, the incidence of human typhus was minimal in the dusted counties (4 cases in each) as compared with 53 confirmed cases in the undusted county for the same period. Preliminary records for the first half of calendar year 1950 indicate that 11 confirmed cases occurred in untreated Grady County compared with 1 "probable" in Brooks County and one in Thomas County.

Table 15

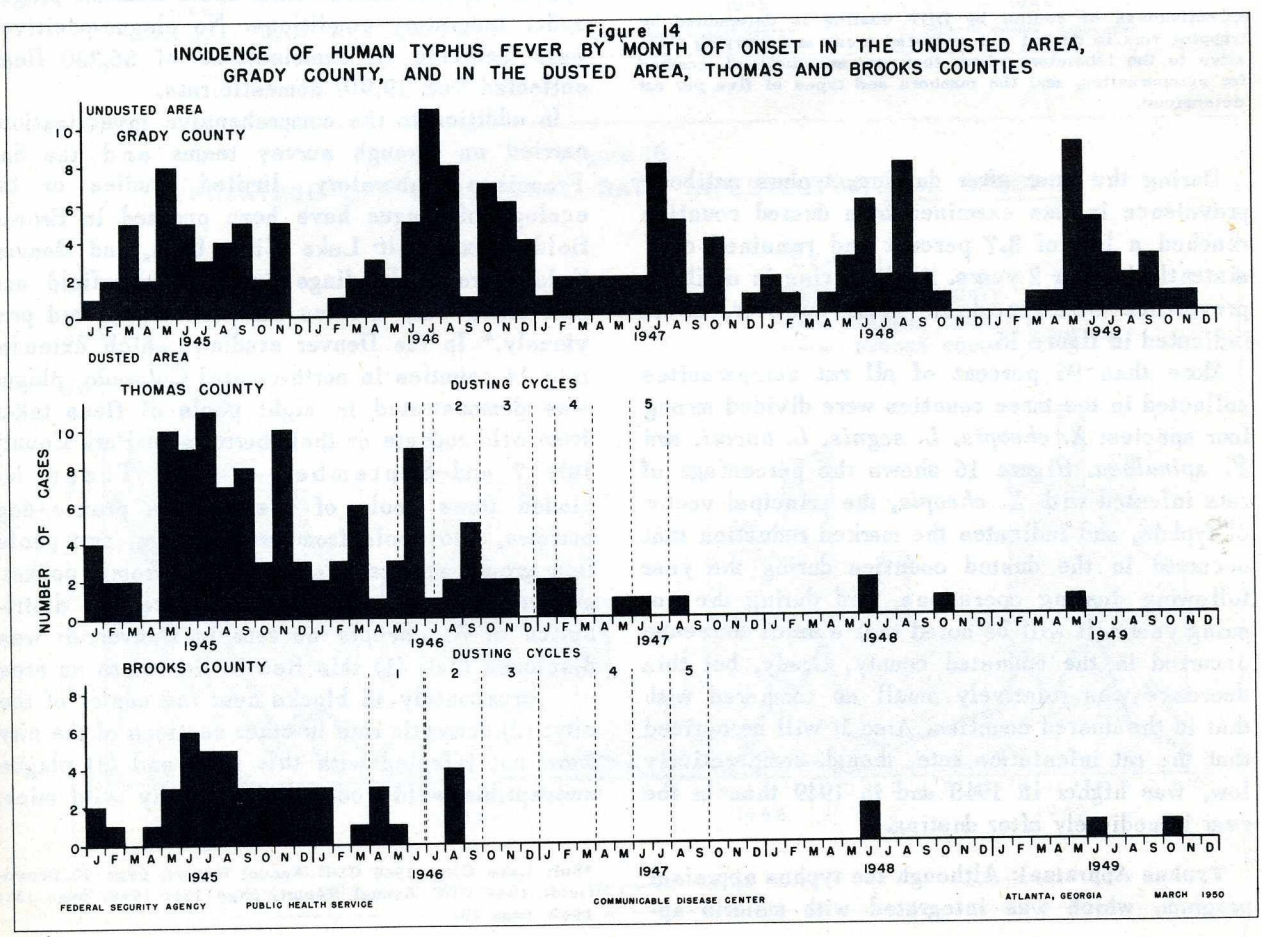
APPRAISAL* OF MALARIA CASES REPORTED OR KNOWN TO HAVE OCCURRED IN 1949

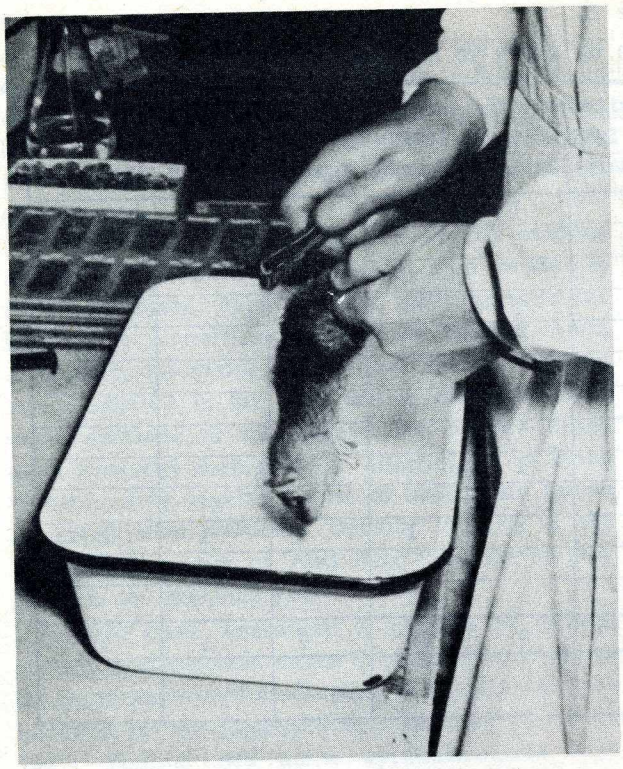
State	Reported in 1949	Cases Appraised	Parasite-positive in state approved laboratory						
			Total	Indigenous		Introduced	Transfusion	Induced	Source Unknown
				Primary	Relapse				
Alabama	134	27	3		1	2			
Arkansas	323	116	2	1			1		
Florida	43								
Georgia	91	89	19		2	14			3
Kentucky	21								
Louisiana	21	1	1	1					
Mississippi	72	96	4	3		1			
Missouri	4								
North Carolina	53	2	2	1	1				
Oklahoma	92								
South Carolina	242	153	18	9	4	1	1	1	2
Tennessee	35	2	0						
Texas	2,881	8	6	4		2			
Total	4,012	494	55	19	8	20	2	1	5
Other States and D. C.	229	4	0						

*Through July 31, 1950

Figure 14

INCIDENCE OF HUMAN TYPHUS FEVER BY MONTH OF ONSET IN THE UNDUSTED AREA, GRADY COUNTY, AND IN THE DUSTED AREA, THOMAS AND BROOKS COUNTIES





Effectiveness of control by DDT dusting is determined by trapping rats in dusted and undusted areas and carrying them alive to the laboratory where they are anesthetized, combed for ectoparasites, and the numbers and types of flea per rat determined.

During the year after dusting, typhus antibody prevalence in rats examined from dusted counties reached a low of 3.7 percent and remained consistently low for 2 years. A slight rise in antibody prevalence occurred in 1949, however, as is indicated in figure 15.

More than 96 percent of all rat ectoparasites collected in the three counties were divided among four species: *X. cheopis*, *L. segnis*, *L. bacoti*, and *P. spinulosa*. Figure 16 shows the percentage of rats infested with *X. cheopis*, the principal vector of typhus, and indicates the marked reduction that occurred in the dusted counties during the year following dusting operations, and during the ensuing years. It will be noted that a small decrease occurred in the undusted county, Grady, but this decrease was relatively small as compared with that in the dusted counties. Also it will be noticed that the rat infestation rate, though comparatively low, was higher in 1948 and in 1949 than in the year immediately after dusting.

Typhus Appraisal: Although the typhus appraisal program, which was integrated with malaria appraisal during fiscal year 1950, has not been in operation long enough to yield firm data, it has become apparent that a fairly substantial proportion of reported typhus cases fail to be confirmed when subjected to thorough investigation and laboratory diagnosis.

PLAGUE: In New Mexico, where four cases of human bubonic plague occurred during the past year, the pocket gopher was proven to be a plague reservoir. Also in New Mexico, an active epizootic among cottontail rabbits was observed. Plague was demonstrated in Colorado, Kansas, Nevada, New Mexico, Oklahoma, Washington, and Wyoming. New foci recorded were in Thomas County, Kans.; Lea, Eddy, and Bernalillo Counties, N. Mex. Other than a single case reported in Hawaii, no human case of plague was ascribed to domestic rats.

During 1950 four field survey teams operated along the margin of known plague areas, roughly from North Dakota to Texas. Seven such teams were in the field in 1949. The 1950 survey teams caught 33,068 wild rodents from which 67,202 fleas were collected. It was shown that five species of wild rodent fleas could transmit plague under laboratory conditions. No plague-positives were detected in examinations of 56,330 fleas collected from 19,907 domestic rats.

In addition to the comprehensive investigations carried on through survey teams and the San Francisco Laboratory, limited studies on the ecology of plague have been pursued in Brownfield, Tex., Salt Lake City, Utah, and Denver, Colo., areas. Findings in the Brownfield and Salt Lake City studies have been reported previously.* In the Denver studies, which extended into 14 counties in north-central Colorado, plague was demonstrated in eight pools of fleas taken from wild rodents or their burrows in Park County July 7 and September 1, 1949. These included three pools of fleas from prairie dog burrows, two pools from prairie dogs, two pools from ground squirrels, and one pool from a pocket gopher. In studies of the abundance and distribution of *X. cheopis* on rats in Denver, it was disclosed that: (1) this flea is limited to an area of approximately 45 blocks near the center of the city; (2) domestic rats in other sections of the city were not infested with this flea; and (3) plague susceptible wild rodents, especially wild mice,

*Salt Lake City: 1949 CDC Annual Report, page 20. Brownfield: 1947 CDC Annual Report, page 151; 1948, page 131; 1949, page 20.

Figure 15

PERCENTAGE OF RATS POSITIVE TO THE MURINE TYPHUS COMPLEMENT FIXATION TEST

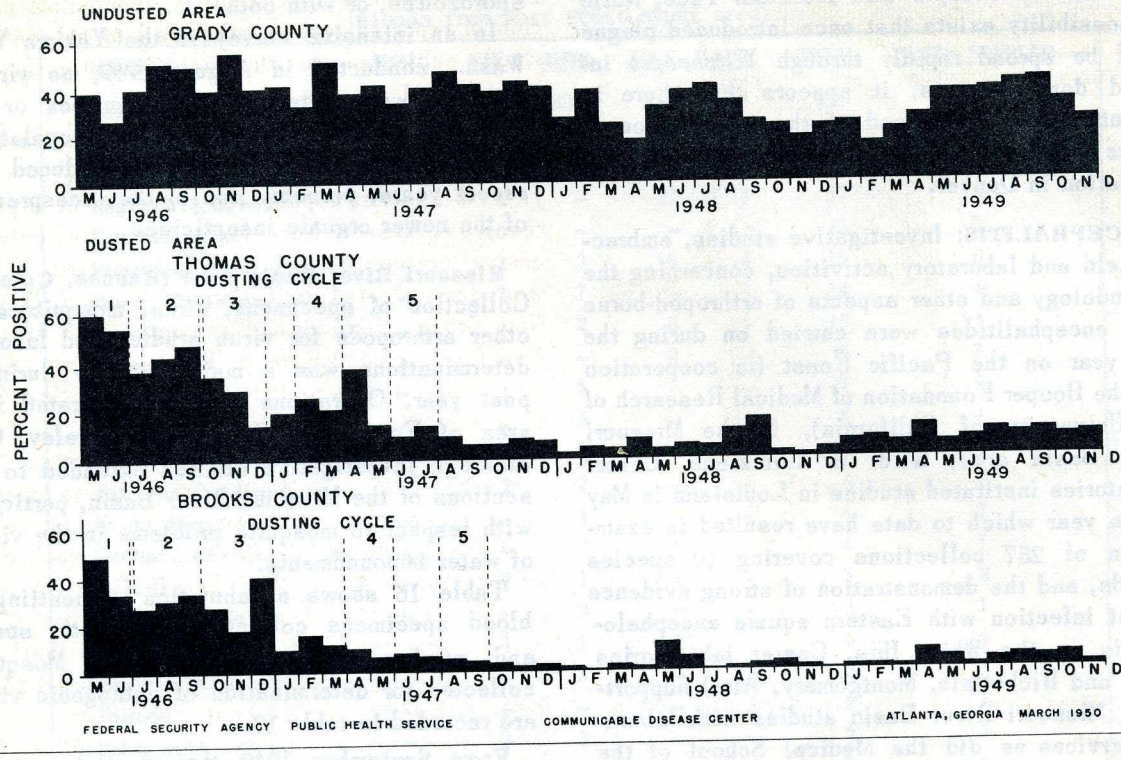
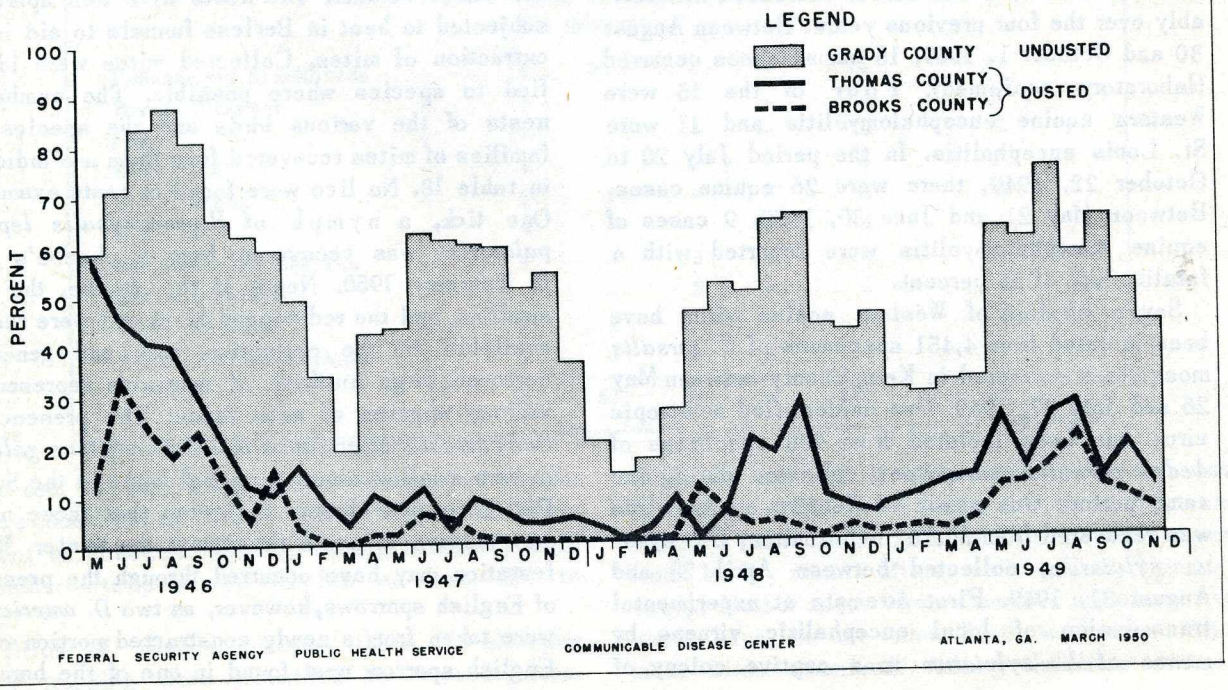


Figure 16

PERCENTAGE OF COMMENSAL RATS INFESTED WITH X. CHEOPIS



come in contact with domestic rats in many sections of the Denver area but not in the 45-block area where *X. cheopis* was detected. Thus, while the possibility exists that once introduced plague could be spread rapidly through *X. cheopis* infested domestic rats, it appears that there is currently little likelihood of the introduction of plague from wild rodents into the domestic rat population in Denver.

ENCEPHALITIS: Investigative studies, embracing field and laboratory activities, concerning the epidemiology and other aspects of arthropod-borne virus encephalitides were carried on during the past year on the Pacific Coast (in cooperation with the Hooper Foundation of Medical Research of the University of California), in the Missouri River Basin area, and in Louisiana. Center laboratories instituted studies in Louisiana in May of this year which to date have resulted in examination of 257 collections covering 10 species of birds, and the demonstration of strong evidence of past infection with Eastern equine encephalomyelitis in the White Ibis. Center laboratories (Virus and Rickettsia, Montgomery, Ala.) supported the Missouri River Basin studies with laboratory services as did the Medical School of the University of Kansas and the Public Health Service Hamilton (Mont.) Laboratory.

Kern County: During the past year it was found that the incidence of clinical cases of encephalitis in both humans and horses increased considerably over the four previous years. Between August 30 and October 1, 1949, 15 human cases occurred (laboratory confirmed). Four of the 15 were Western equine encephalomyelitis and 11 were St. Louis encephalitis. In the period July 20 to October 22, 1949, there were 26 equine cases. Between May 21 and June 30, 1950, 9 cases of equine encephalomyelitis were reported with a fatality rate of 55 percent.

Seven strains of Western equine virus have been isolated from 4,451 specimens of *C. tarsalis* mosquitoes collected in Kern County between May 26 and July 27, 1949. One unidentified neurtropic virus has been isolated from 908 specimens of *Aedes dorsalis* mosquitoes collected during the same period. One strain of Western equine virus was recovered from 30,767 avian mites, *Liponyssus sylviarum*, collected between April 28 and August 31, 1949. First attempts at experimental transmission of local encephalitic viruses by means of *L. sylviarum* in a captive colony of doves failed. Of 441 *C. tarsalis* dissected, 10.2 percent were infected with either oocysts or sporozoites, or with both.

In an intensive survey in the Yakima Valley, Wash., conducted in August 1949, no virus infections were detected in mosquitoes or mites collected. It was found that the population of mosquitoes had been considerably reduced within recent years, probably due to the widespread use of the newer organic insecticides.

Missouri River Basin Area (Kansas, Colorado): Collection of specimens, birds, mosquitoes, and other arthropods for virus studies and laboratory determinations was a major activity during the past year. Operations were concentrated in the area of Fort Scott, Kans., and Greeley, Colo., although investigative studies extended to other sections of the Missouri River Basin, particularly with respect to mosquito problems in the vicinity of water impoundments.

Table 16 shows a tabulation of nestling bird blood specimens collected, by month, species, and number of nests involved. Mosquitoes collected for determination of pathogenic viruses are recorded in table 17.

From September 1949 through February 1950, bird nests were collected in the vicinity of Kansas City, Mo., and from Bourbon County, Kans., and examined for mites with the objective of gaining knowledge concerning the mite population during the winter season. The nests were torn apart and subjected to heat in Berlese funnels to aid in the extraction of mites. Collected mites were identified to species where possible. The number of nests of the various birds and the species and families of mites recovered from them are indicated in table 18. No lice were found in nests examined. One tick, a nymph of *Haemaphysalis leporis-palustris*, was recovered from a phoebe's nest in February 1950. Nests of the phoebe, the barn swallow, and the red-winged blackbird were readily available in the collection area and generally harbored large numbers of acarinids representing various species of mite fauna. The presence of *Dermanyssus americanus* and *Dermanyssus gallinae* in barn swallow nests in animal barns at the Swope Park Zoo in February indicates that these mites may survive in nests throughout the winter. Reinfestation may have occurred through the presence of English sparrows, however, as two *D. americanus* were taken from a newly constructed portion of an English sparrow nest found in one of the barns at

Table 17

MOSQUITOES COLLECTED IN THE TRI-COUNTY AREA (KANSAS) DURING 1949 FOR DETERMINATION OF PATHOGENIC VIRUSES

SPECIES	MAY			JUNE			JULY			AUGUST			SEPTEMBER		
	No. Lots	Total Mosquitoes	County*	No. Lots	Total Mosquitoes	County*	No. Lots	Total Mosquitoes	County*	No. Lots	Total Mosquitoes	County*	No. Lots	Total Mosquitoes	County*
Aedes															
nigromaculatus	1	6	1*	4	29	1	1	10	1	0			0		
trivittatus	0			1	3	3	7	64	1, 2, 3, 4	3	26	1, 4, 5	0		
vexans	12	99	1, 3	54	582	1, 2, 3	13	271	1, 3	8	113	1, 2, 4, 5, 7	1	12	5
Aedes & Psorophora	0			2	35	1	4	211	1, 3, 4	3	28	7	0		
Anopheles															
punctipennis	7	–	3	13	59	1, 3	5	30	1, 3, 4	11	58	1, 3, 4, 7	1	17	5
quadrimaculatus	2	2	3	13	55	1, 3	8	117	1, 3	15	236	1, 3, 5, 6, 7	1	13	5
walkeri	0			0			0			3	72	1, 3	0		
Culex															
(culex) sp.	5	38	1, 3	41	312	1, 3	11	74	1, 2, 3, 4	12	75	1, 3, 5	2	135	3, 5
erraticus	0			0			2	100	1	15	420	1, 3, 4, 5	1	8	5
restuans	8	18	1, 3	2	6	1, 3	0			1	2	6	0		
salinarius	5	31	3	17	62	1, 3	3	10	1, 3	3	42	1, 3	0		
tarsalis	2	4	1	4	8	1, 3	1	4	1, 4	0			0		
Psorophora															
ciliata	0			21	64	1, 3	13	323	1, 2, 3	3	216	1, 5	0		
confinnis	0			46	384	1, 2, 3	18	938	1, 3, 4	9	325	1, 3, 5	0		
cyanescens	0			0			4	24	1, 3	3	6	4, 5	0		
discolor	0			8	14	1, 2, 3	5	93	1, 2, 3	5	60	1, 3, 5	0		
ferox	0			1	18	3	3	15	3, 4	3	87	3, 4, 5	0		
horrida	–	–	–	3	14	3	2	12	3	1	29	7	–	–	–

*CODE - Kansas
1 Allen
2 Anderson
3 Bourbon
4 Neosho

Missouri
5 Bates
6 Jasper
7 Vernon

species, *Degeeriella vulgata* infested English sparrows in relatively large numbers, and also occurred on five other passerine birds.

Correlation, evaluation, and interpretation of this mass of material is time-consuming and firm conclusions are not yet feasible.

Field activities in the Greeley, Colo., area during the period May 15 to June 30, 1950 resulted in the collection of considerable material, as indicated in table 19.

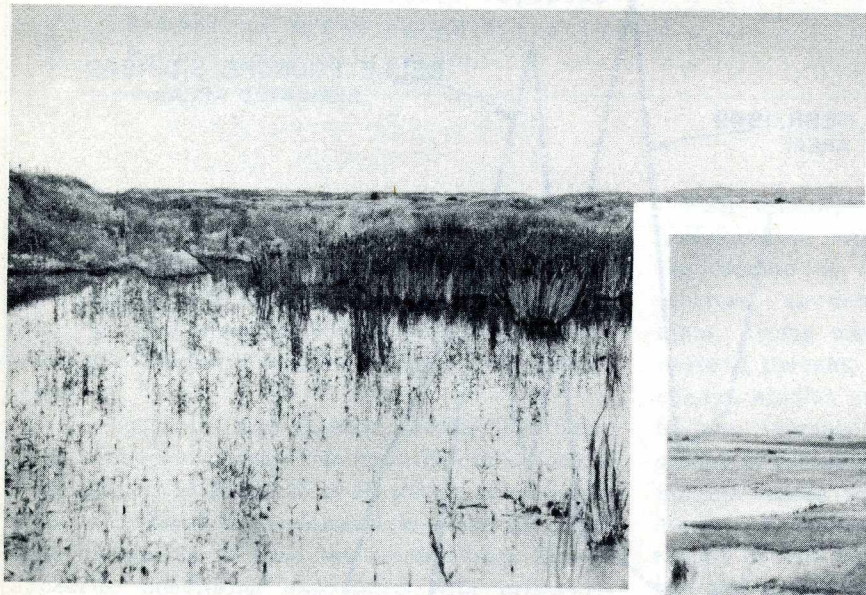
Field investigations and studies on a number of irrigation projects in the Missouri River Basin, although not complete, have pointed up certain conditions considered responsible for the acceleration of mosquito breeding in irrigation areas. And since *C. tarsalis* mosquitoes are believed to be vectors of encephalitis and abound in the Missouri River Basin, factors influencing densities of this species are of particular concern.

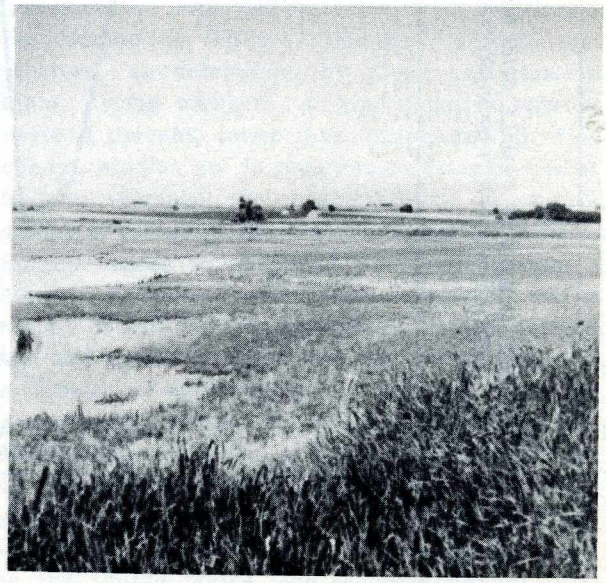
Figures 17 and 18 present data concerning the density of *C. tarsalis*, based on light trap catches, in irrigated and nonirrigated areas in Nebraska in 1942, 1943, and 1949. Figure 18 shows a comparison of the take by three light traps operated

Table 18

BIRDS NESTS EXAMINED AND THE MITES RECOVERED FROM THEM, SEPTEMBER 1949 THROUGH FEBRUARY 1950

	Total Nests Examined	*Liponyssus sylviarum*	*Liponyssus bursa*	*Dermanyssus americanus*	*Dermanyssus gallinae*	*Dermanyssus* Sp.	*Haemolaelaps megaventralis*	Laelaptidae Sp.	*Pteronyssus* Sp.	Acaridae Sp.	Cheylotidae Sp.	Tetranychidae	Oribatidae Sp.	Nothridae	Hypochthonidae Sp.	Bdellidae Sp.	Eupodidae Sp.
Eastern Phoebe	33	x							x			x	x	x	x		x
Barn Swallow	31	x		x	x		x		x		x						
Red-winged Blackbird	57	x	x	x				x	x	x		x		x		x	
English Sparrow	6	x		x		x	x	x	x	x	x			x	x		
Mourning Dove	3	x						x									
Bells Vireo	3							x									
Catbird	3													x			
Dickcissel	2					x								x			
Cardinal	2							x				x					
Goldfinch	2																
Baltimore Oriole	1	x															
Robin	1										x						
Rough-winged Swallow	1												x				
Eastern Kingbird	1																
Cuckoo	1																
TOTAL	**146**																



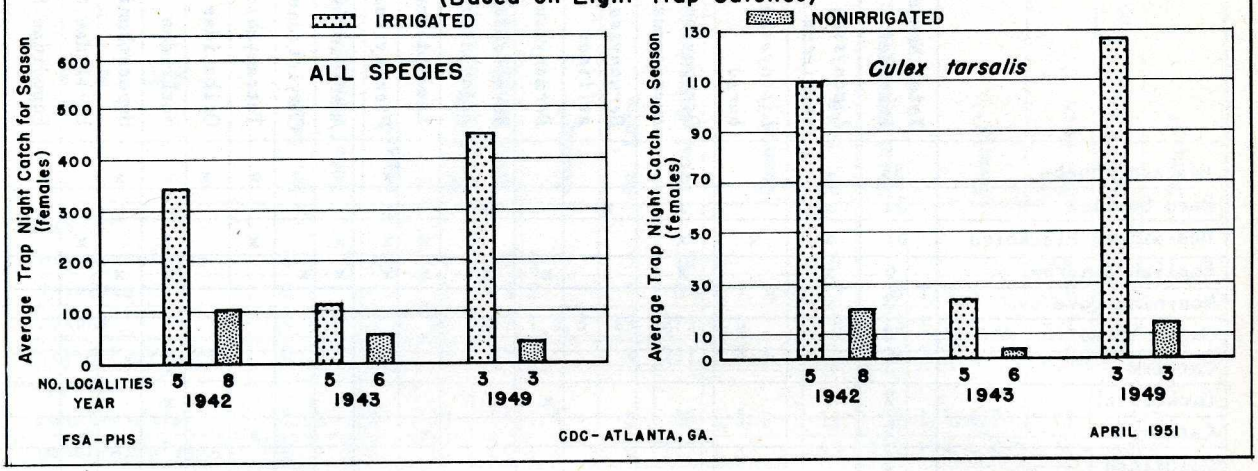


Above: Favorable mosquito-breeding situation created by seepage from an adjacent irrigation canal in the Yellowstone Project. **Right:** Example of residual pools which are common in irrigated bottomland pastures when they are not properly prepared prior to irrigation

FIGURE 17

MOSQUITO DENSITIES IN IRRIGATED AND NONIRRIGATED AREAS IN NEBRASKA

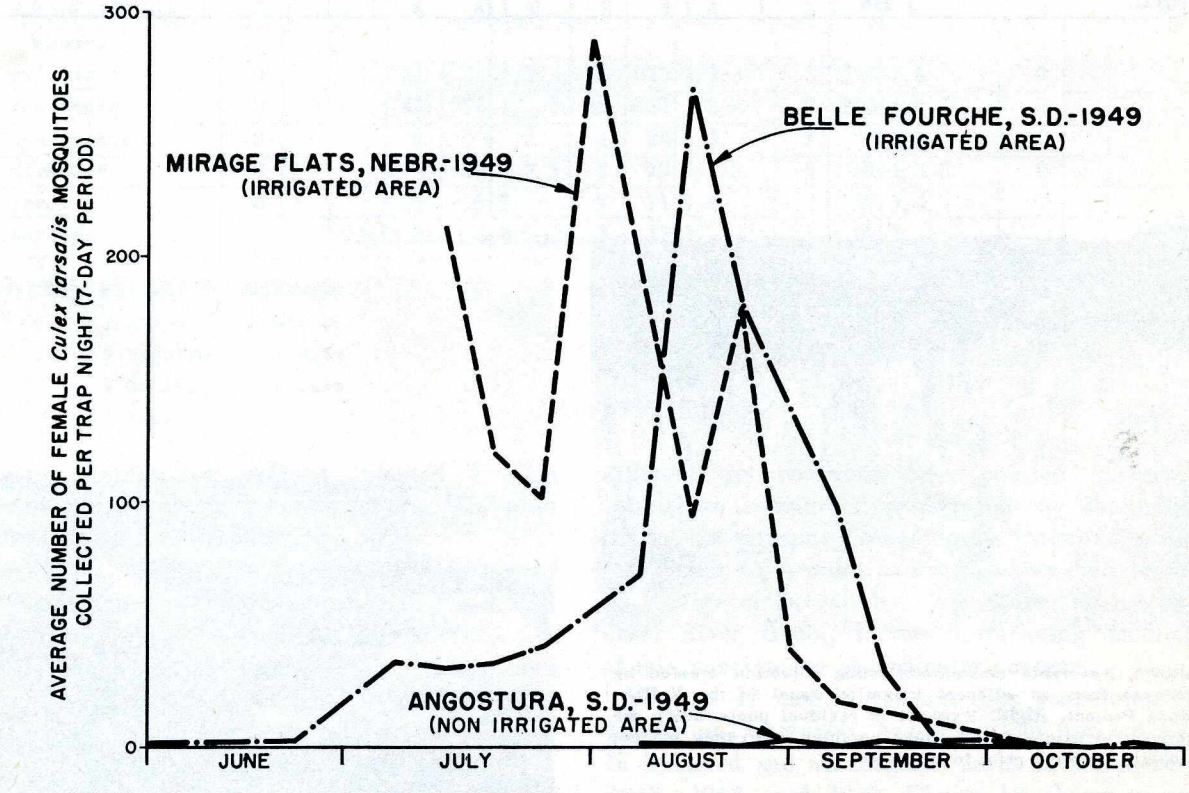
(Based on Light Trap Catches)



FSA-PHS CDC-ATLANTA, GA. APRIL 1951

FIGURE 18

COMPARISON BETWEEN LIGHT TRAP COLLECTIONS OF FEMALE *Culex tarsalis* MOSQUITOES ON IRRIGATED AND NON IRRIGATED LAND (1949)



FSA-PHS CDC-ATLANTA, GA. FEB. 1951

Table 19

SPECIMENS COLLECTED IN FIELD OPERATIONS IN GREELEY STUDY AREAS MAY 15 THROUGH JUNE 30, 1950

Mosquitoes	
Number of traps in operation	8
Number of lots from natural resting places (sealed)	2
Number of lots from hand automobile light catches (sealed)	2
Number of lots from other methods (sealed)	78
Approximate number of specimens in all sealed lots	2,437
Mites	
Number of birds nests examined	193
Number of lots from nests (sealed)	27
Number of lots of poultry material examined	43
Birds	
Number of nests under routine observation	465
Number of routinely observed nests with nestlings	274
Number of bloods from nestlings (30 species)	602
Number of serums (from 13 species)	49
Number of nests obtained for examination	215
Number of birds obtained for examination	8
Domestic and Other Animals	
Number of equine cases reported	2
Number of horse serums	49
Number of domestic fowl serums	91
Human	
Number of human cases reported	1
Number of human cases investigated	1
Number of human serums	50

during 1949 in the same general geographical area – two on irrigated land (Belle Fourche, S. Dak.; Mirage Flats, Nebr.) and the third on dry land (Angostura, S. Dak.) being prepared for irrigation. In each instance, it will be observed, the *C. tarsalis* density is strikingly higher in irrigated localities.

In the course of investigative studies of a number of suspected cases of encephalitis in Colorado in the summer of 1949, 17 of 18 proven or probable cases were found to be located in areas irrigated either by canals or from the South Platte River.

Specific conditions associated with irrigation projects which have been found to be favorable for increasing the production of mosquitoes include: (1) shallow margins of storage reservoirs containing vegetation or flotage; (2) seepage from dams and canals; (3) weedy borders of canals and ditches; (4) excess use of water on irrigated lands; and (5) improper preparation of irrigated fields.

BRUCELLOSIS: Studies carried on in Indiana in collaboration with the State board of health and the Bureau of Animal Industry indicate that reactors, as determined by blood agglutination tests, among members of rural families approximate 2 percent, lower than anticipated. In Wisconsin, studies are in progress to determine what factors increase the susceptibility of certain groups of humans. Fifty-five percent of all positive humans cases investigated in Wisconsin had a history of contact with infected animals and a record of raw milk consumption. Twelve percent had had animal contact only, and 33 percent had a history of consumption of raw milk but no contact with animals. The latter group (33 percent) were mainly children and young females living on farms but usually not having close association with domestic animals.

The first isolation of *Brucella abortus* in sheep in the United States was recorded during 1950.

Q FEVER: In cooperation with the Virus and Rickettsial Disease Laboratory of the California Department of Health and the Rocky Mountain Laboratory, broad investigative studies concerning various aspects of Q fever are proceeding. Identification and study of naturally occurring human infections, the epizootiology of naturally occurring infection in sheep and cows, the pathogens of induced infection in sheep, and environmental studies with particular emphasis on the possible role of airborne infection are some of the problems under investigation.

Human cases are recognized through voluntary case reporting by practicing physicians and through the reference diagnostic services offered by the Center and cooperating laboratories. Sporadic cases are fairly common and several epidemics have been studied in some detail. Usually epidemics fall into two groups: (1) Epidemics occurring among individuals having close association with sheep or cattle as at the University of California Veterinary College in Davis, Calif., or among goat handlers transporting animals to the Orient. (2) Among individuals with no direct contact with animals.

By cooperative arrangements with owners of large sheep herds, surveys of the extent of Q fever infection have been made. A station has been established at Davis, Calif., to facilitate studies of these field animals and arrangements have been made for the transfer of certain sheep from special ranches to Davis where closer and more frequent observations can be made.

An air sampling device for use in the field has been developed and placed in pens where experimentally infected animals are kept. While no recoveries of rickettsia from these pens have been successful as yet, guinea pigs kept in cages in the same pens have become infected. Some of the findings at Hamilton, Mont. Laboratories during the year are: (1) Lactating cows with normal mammary glands failed to become infected after repeated exposure of the teat orifice to infectious milk, indicating that it is improbable that hand milking is a factor in the spread of Q fever among cows free of mastitis. (2) Lactating cows and nonpregnant heifers became infected following inhalation of an infectious aerosol spray. (3) Q fever in dairy cattle is a chronic disease of variable duration. (4) Lactating cows and calves can be infected readily by intradermal inoculation.

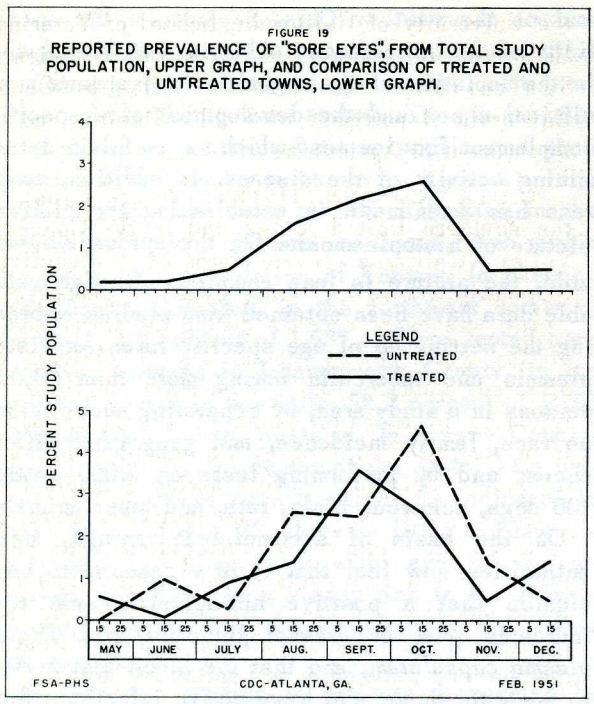
Pasteurization studies to determine the efficacy of heat treatment of milk have been inaugurated at the University of California, School of Veterinary Medicine, in cooperation with the Division of Sanitation, Environmental Health Center, California Department of Public Health, and the Department of Agriculture.

ACUTE CONJUNCTIVITIS: (Sore Eyes): In the southern United States and in the Coachella Valley, Calif., a severe form of conjunctivitis (popularly known as "sore eyes", "pink eyes", "gnat sore eyes") exists during the warm months of the year. Many thousands of children are affected annually, and in certain sections the infection is a major cause of school absences. In a survey (1932) of 8,090 school children in six south Georgia counties during 1 month (September) 1,633 cases of conjunctivitis were detected. The disease is associated with heavy infestations of eye gnats of the genus *Hippelates*. It appears that the gnats become infected by feeding around the eyes of children suffering from the disease and transmit it to healthy children.

In cooperation with the National Institutes of Health, investigations are under way to determine the identity of the pathogenic agents involved; to determine whether or not eye gnats are essential hosts of the pathogens or merely serve as agents in the mechanical transfer of the infection; to study the biology of the gnat in order to obtain data for devising control measures; and to determine to what levels of abundance gnats must be reduced in order to prevent spread of the disease.

In studies to determine the prevalence of conjunctivitis, five cultures were taken from each individual sampled; namely, one from the conjunctiva of each eye, one from each nostril, and one from the throat. A total of 1,889 individuals have been cultured in this manner thus far, including 1,200 school children, 495 persons from households with symptomatic conjunctivitis, and 194 from asymptomatic controls. Preliminary evaluation of the accumulated data indicates that 138 of the 1,200 school children cultured positive for *Hemophilus* organisms, compared with 149 of the 495 from households with symptomatic conjunctivitis and 24 from the 194 controls.

A review of data collected in the study area (records of "sore eyes" by reported date of onset of illness have been gathered since May 1949 by dysentery study unit) shows prevalence rates of "sore eyes" rising to a peak in the fall of the year. Figure 19 represents in two ways the data taken during the period May through December



1949: (1) the top graph depicts the percent of "sore eyes" cases based upon the 8,000 individuals covered in the study area; and (2) the bottom graph compares the percentage of reported cases from three towns chemically treated for fly control with that from three comparable untreated towns. It will be observed that the fly control measures had little or no effect on the prevalence of reported "sore eyes" cases in the treated towns. *Hippelates* trapping records for the same area also indicate that normal fly control measures are ineffectual against gnats. In this connection, it is of interest that presently used methods for obtaining *Hippelates* population indices are not satisfactory.

TULAREMIA (Tick): The Center is cooperating with the Arkansas Health Department in a study of transmission of tularemia by ticks. This disease is of considerable public health importance in Arkansas where studies extending over 10 years have shown that 56 percent of human cases investigated have a history of tick bite. Analyses of reported cases show that a great majority of cases occur in the mountainous or hilly regions of the northwestern and west central section of the State, and that cases associated with tick bites are even more definitely delimited by the mountainous regions whereas those associated with rabbit contact are generally distributed over the State.

During the period April 11 through June 30, a total of 1,131 ticks were collected by dragging. Forty-nine were taken from 4 of 10 dogs examined, 15 from 2 of 4 cows, 110 from 1 wild pig, 9 adult ticks and several hundred nymphs and larvae were found on 2 deer, and a total of 28 ticks were taken (on 2 occasions) from man. Most of the ticks (88 percent) taken by dragging proved to be adults and nymphs of the lone-star tick, *Amblyomma americanum*. This species was found in 20 of 26 counties in which surveys were made, while the American dog tick, *Dermacentor variabilis*, was found in 14 counties, and the black-legged tick, *Ixodes scapularis*, was taken in 4 counties.

SALMONELLOSIS: Investigative studies, inaugurated in 1949, have been broadened and are being carried forward in conjunction with the Army Epidemiological Board.

The development of an enriched medium with sulfathiozole in a concentration of 0.125 mg. per 100 ml. of tetrathionate brillant bile broth aided in the inhibition of *Proteus* organisms and increased *Salmonella* isolations 38 percent.

During the year investigations were made of a disease among racing greyhounds which commonly had been referred to as "kennel sickness." In each outbreak *Salmonella* was isolated. A similar infection was reported among handlers of the dogs. It has not been determined definitely if *Salmonella* is the sole etiological agent or if there is another factor present which combines with the *Salmonella* organism to cause clinical illness.

The following table shows the results of examinations of 4,474 dogs:

Type	No. of Specimens Examined	No. Positive	Percent Positive
Pound dogs	342	40	11.6
Hospitalized dogs	1,558	305	19.5
Greyhounds	2,149	653	30.3
Private kennels	33	12	36.3
Normal dogs (out-patient)	91	19	20.8
Normal dogs (rabies clinics)	301	39	12.9
TOTAL	4,474	1,068	23.8

Studies of *Salmonella* in chickens revealed that in addition to *Salmonella pullorum* (the common cause of a fatal septicemia in chickens), *Salmonella bredeney* and *Salmonella give* may be detected.

CREEPING ERUPTION: Surveys in Florida revealed that 386 of 438 dogs examined were infected with hookworm. The percentage of *Ancylostoma braziliense* ranged from 72.9 in the Miami area to 4.5 in Leon County. All areas in Florida that were sampled showed evidence of infection. Investigations to date indicate that control of the disease in man embraces dog control and soil larviciding to destroy the hookworm larvae.

LEPROSY: The groundwork has been accomplished for a leprosy control program on a Nationwide basis. Studies have been launched, in collaboration with the Leonard Wood Memorial Foundation, to ascertain the extent of the leprosy problem, both according to States and to particular areas within the respective States. Information has been obtained from records of the Carville Leprosarium, State and local health departments, and through field surveys in Florida and Texas. These data indicate that although California, Florida, Louisiana, and Texas are considered the endemic States with respect to leprosy, over the past 30 years approximately one-third of the patients admitted to Carville were from other States. Accumulated data also indicate that the incidence of leprosy in the United States during this period remained rather constant.

HISTOPLASMOSIS: In 1945 the Tuberculosis Control Division of the Public Health Service inaugurated investigative studies concerning diseases which simulate tuberculosis, particularly with respect to clinical and epidemiological factors which might be of value in differentiating these diseases from tuberculosis. These studies were transferred to the Communicable Disease Center in January 1950 and are being continued.

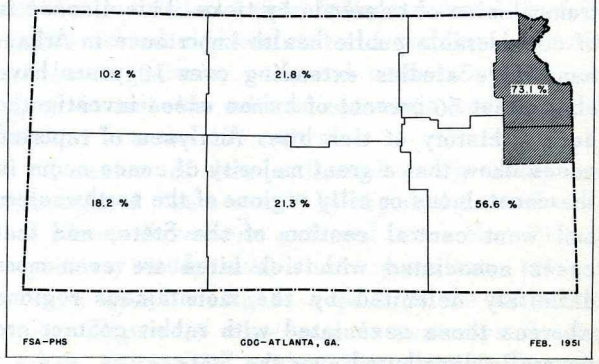
When the studies were initiated, on the basis of histoplasmin skin tests, it was thought that most of the nontuberculosis calcifications observed were caused by histoplasmosis. However, at that time the idea was far from being accepted and had not been confirmed. During the past 4 years great strides have been made in this field. Continual absence of tuberculin reactions among persons not having tuberculosis and the continual finding of positive tuberculin skin tests among persons who have tuberculosis has established the value of the tuberculin test as a diagnostic tool. It has been established, too, that histoplasmosis or some other closely allied disease is responsible for a very large percentage of lung infections in the geographical area bounded on the west by Kansas and on the east by Ohio. Support for the specificity of the histoplasmin skin test has been found in the isolation of the organism from a number of clinical cases and the development of a specific complement fixation test which is useful in determining activity of the disease. In addition, progress has been made in establishing the clinical picture of histoplasmosis. On the epidemiological side, the picture is less complete although valuable data have been obtained from studies embracing the setting up of age specific rates for histoplasmin and tuberculin among more than 60,000 persons in a study area, by separating such factors as race, family incidence, and geographic differences; and by performing tests on 2,000 cattle, 100 dogs, numerous birds, rats, and other animals.

On the basis of accumulated findings, many authorities now feel that it is a reasonable conclusion that a positive histoplasmin skin test indicates past or present infection with *Histoplasma capsulatum*, and that the blood test serves to separate those who have active infections from those who have inactive or healed infections.

During the past year emphasis was given to studies of the epidemiology of histoplasmin sensitivity in Kansas. Skin tests and x-rays were made of large numbers of students (8,202) in various colleges and universities throughout the State. Sensitivity areas of different parts of the State were made up by allocating the tested students back to their respective home counties. The geographic distribution of histoplasmin sensitivity derived from the application of this procedure is shown in figure 20. In the northwest corner of the State, it will be observed, only 10 percent of lifetime residents reacted whereas in the northeast

FIGURE 20

MAP OF KANSAS DIVIDED INTO SIXTHS SHOWING PERCENT POSITIVE REACTORS TO HISTOPLASMIN AMOUNG 8,208 UNIVERSITY STUDENTS



corner 73 percent reacted. In addition to studies of university students, 11,451 grade and high school students, representing counties in all sections of the State, were tested. The distribution of the home counties of these pupils and their distance from Topeka is shown in figure 21. It is evident that there is a marked difference in the reaction rate when children are tested, even within the geographic boundaries of Kansas. In Sherman and Thomas Counties, in the northwest corner of the State, 1.2 percent of 1,637 children tested were positive, whereas in Leavenworth County, in the northeast corner of the State, 58.2 percent of 1,705 children tested were positive. In Harvey County, approximately in the center of the State, 11.6 percent of 179 tested were positive. As indicated in table 20 and figure 22, there is little evidence of increased infection rates with age in western Kansas, but there is a steady rise in the rate in eastern Kansas from the youngest to the oldest age group.

In follow-up studies of patients discovered by previous surveys or referred by family physicians, 1,121 patients were tested, x-rayed, and blood obtained for histoplasmosis complement fixation tests. Ordinarily, tests were made for tuberculin and histoplasmin but frequently tests for blastomycin and coccidioidin also were made. In addition, 1,440 serums were tested by the complement fixation test which proved to be a very useful tool in the diagnosis of histoplasmosis activity.

Laboratory studies pursued during the year included investigations relative to the requirements for natural infection with *H. capsulatum*, particularly the influence of such factors as humidity and temperature. Differences were found in the growth and physical requirements of the organism which may have marked effect upon the epidemiology of the disease.

In the veterinary field, progress was made in attempts to determine whether animals are vectors in histoplasmosis, whether they constitute a reservoir, or whether they are simply infected from the same sources as humans. Tests were carried out on sheep, cattle, swine, and dogs. One significant revelation from the tests of domestic animals was that histoplasmin sensitivity among cattle and sheep is extremely high. Over 50 percent of both cattle and sheep 6 years of age and older were found to have positive histoplasmin skin test reactions. Results of tests of domestic animals conducted in cooperation with the University of Missouri, Department of Agriculture, are shown in table 21. Wild animals trapped and cultured for *H. capsulatum* are tabulated in table 22.

During the period January through February 1950, a survey was conducted at a Kansas City, Kans., packing plant to observe the pathology in cattle slaughtered in the plant. Of 17,400 cattle slaughtered during the period, 2,095 (12.03 percent) showed evidence of disease or pathological condition. Liver specimens (46) were obtained from various pathological conditions in cattle observed on post-mortem inspection. *H. capsulatum* was not isolated, but several fungi were identified when the specimens were cultured. Forty-nine cattle blood specimens obtained from the heart at inspection tables were found to be negative. Thirty dogs from Kansas City were negative when skin tested with histoplasmin, lot H-42, 1:10.

INSECTICIDES: The activation of a toxicology unit at Savannah permitted acceleration of investigative studies concerning the health hazard aspects and relative effectiveness against disease vectors of various insecticides, especially some of the newer ones offering promise of being effective against DDT-resistant flies. Attention was given to relative toxicity, modes of action, usage limitation, clinical manifestations, and usefulness in communicable disease control operations.

Dieldrin: This relatively new substance was subjected to extensive investigation, inasmuch as earlier tests indicated that it was the most promising insecticide for use in fly control against DDT-resistant strains. Although subsequently it was discovered that flies resistant to DDT quickly develop resistance to dieldrin, as well as other chlorinated hydrocarbons, toxicological studies

FIGURE 21

MAP OF KANSAS SHOWING PERCENT POSITIVE TO HISTOPLASMIN IN TESTS OF 11,451 GRADE AND HIGH SCHOOL STUDENTS RESIDING IN DIFFERENT SECTIONS OF THE STATE

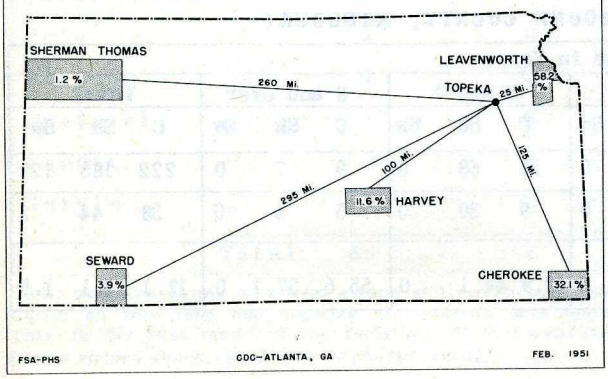


Table 20

NUMBER AND PERCENT POSITIVE TO HISTOPLASMIN IN SIX KANSAS COUNTIES BY AGE GROUP

County	Persons	Age in Years							Total
		5-6	7-8	9-10	11-12	13-14	15-16	17-18	
Thomas and Sherman	Number tested	313	299	265	255	244	167	94	1637
	Number positive	1	3	1	5	4	3	2	19
	Percent positive	0.3	1.0	0.4	2.0	1.6	1.8	2.1	1.2
Harvey	Number tested	97	319	308	293	247	184	86	1534
	Number positive	7	26	25	37	29	34	21	179
	Percent positive	7.2	8.2	8.1	12.6	11.7	18.5	24.4	11.6
Seward	Number tested	135	120	85	82	48	41	24	535
	Number positive	1	4	2	6	3	3	2	21
	Percent positive	0.7	3.3	2.4	7.3	6.3	7.3	8.3	3.9
Cherokee	Number tested	94	175	178	150	156	156	80	989
	Number positive	13	24	52	48	63	73	44	317
	Percent positive	13.8	13.7	29.2	32.0	40.4	46.8	55.0	32.1
Leavenworth	Number tested	1	151	422	357	341	305	128	1705
	Number positive	0	72	197	186	221	217	99	992
	Percent positive	0	47.7	46.7	52.1	65.0	71.1	77.3	58.2

Table 21

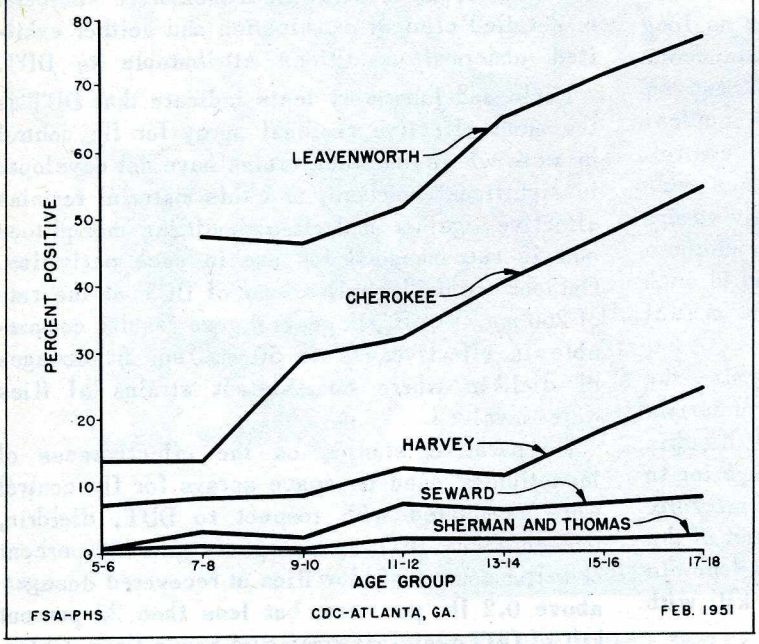
HISTOPLASMIN SENSITIVITY BY AGE OF CATTLE, SHEEP, AND SWINE IN BOONE COUNTY, MISSOURI

Number	Age in Years																	
	Under 2			2 and 3			4 and 5			6 and 7			8 and over			Total		
	C*	Sh	Sw	C	Sh	Sw	C	Sh	Sw	C	Sh	Sw	C	Sh	Sw	C	Sh	Sw
Tested	99	66	127	49	22	2	44	22	0	21	68	0	9	7	0	222	185	129
Positive	3	1	2	15	4	0	6	5	0	9	30	0	5	4	0	38	44	2
Percent Positive	3.0	1.5	1.5	30.6	18.1	0	13.6	22.7	0	42.9	44.1	0	55.6	57.1	0	17.1	23.1	1.5

*C, cattle; Sh, sheep; Sw, swine.

FIGURE 22

PERCENT POSITIVE TO HISTOPLASMIN IN 6 KANSAS COUNTIES BY AGE GROUP



and tests under field usage produced valuable information. It was indicated, for example, through tests on rats that dieldrin is about five times as toxic as DDT. Simulated field tests and laboratory studies, using guinea pigs, cats, dogs, and monkeys, yielded comparable results.

Since chronic exposure to dermal application is the more predominant type received by users of insecticides in field operations, particular inquiry was made in this general direction. Using standard volume comparable to 112 cc. for a 150-lb. man, individual doses were varied from 10 to 400 mg. of the active substance per kilogram of body weight. The results, using rats, mice, guinea pigs, dogs, monkeys, sheep, and cattle as test animals, show a considerable variation in the susceptibility of different species. Rabbits may be killed occasionally by a single application of 0.625 percent emulsion of dieldrin applied at the rate of 10 mg./kg., whereas rats have received as much as 234 doses of 1.25 percent emulsion for an accumulated dosage of 4,680 mg./kg. without apparent injury. All dogs and monkeys were brought to convulsion with repeated applications of 1.25 percent emulsion, the maximum number of doses tolerated being in the range 50 to 60 (1,000 to 1,200 mg./kg.). Emulsions containing 1.25 percent dieldrin are normally used in applying the material as residual spray for fly control at a rate of 50 mg./sq. ft.

Dieldrin was used experimentally for fly control in four of the five cities associated with the study of the influence of fly control on the transmission of poliomyelitis and in field tests in Pharr, Tex. Effective fly control was obtained in these tests but later field tests in Savannah, Ga., and Phoenix, Ariz., indicated that dieldrin is not effective against DDT-resistant flies, or more properly that flies resistant to DDT develop resistance to dieldrin in a short time.

In the Pharr, Tex., test (city-wide) spring treatments with dieldrin at a rate of 100 mg./sq. ft. provided satisfactory control of field strains of DDT-resistant flies for about 3 months. Fall treatments at lower rates (10,25, and 50 mg./sq. ft.) also gave satisfactory results. Laboratory tests on surfaces treated with dieldrin exposed to

Table 22

WILD ANIMALS TRAPPED AT LAWRENCE AND AUBURN, KANSAS AND LIVERS AND SPLEENS CULTURED FOR HISTOPLASMA CAPSULATUM

Species	Number	Number positive
Striped skunk*	7	1
Opossum	10	0
Gopher	2	0
House mouse	3	0
Field mouse	39	0
Mole	1	0
Lizard	1	0
Squirrel	1	0
Rabbit	3	0
Turtle	2	0
Total	69	1

*The positive skunk was from a farm at Lawrence, Kans. Cattle on this farm had negative histoplasmin skin tests. This is the first report of the isolation of *H. capsulatum* from a striped skunk *(Mephitis mephitis avia)*.

weathering indicated that dosages of 25 mg./sq. ft. or greater might remain effective against house flies for several months. In Savannah, field test deposits of 200 mg./sq. ft. remained effective against laboratory reared house flies for as long as 12 months. Thus, from an over-all standpoint it would appear that dosages in the 25 to 50 mg./sq. ft. range would be most feasible for outdoor residual spraying with dieldrin for fly control. However, as mentioned, field experience subsequent to these tests indicated that certain strains of flies develop resistance to dieldrin within a relatively short period, 2 to 3 months, and in such situations dieldrin is ineffective as a fly control residual.

In laboratory tests conducted to determine the relative residual effectiveness of various materials against *A. quadrimaculatus*, deposits of dieldrin at 100 to 200 mg./sq. ft. gave results superior to DDT through a 29-week test period. Ninety-six percent mortalities were obtained at the end of the period with 30 min. exposure to 100 mg. deposits of dieldrin as compared with 35 percent kill with DDT under comparable conditions.

Chlordan: Topical application of chlordan to experimental animals indicated that this material is considerably more toxic than DDT. A single application of 25 percent chlordan concentrate at the rate of 400 mg./kg. produced significant mortalities in rats, whereas a similar dosage of DDT showed no ill effects.

Chlordan has been found to be effective as a residual spray for the control of DDT-resistant flies, and was used rather widely during the 1950 spray season in certain spray areas. However, it is more volatile and therefore not as long lasting as DDT or dieldrin, particularly when applied as an outdoor residual spray. Because of its volatility and other qualities, chlordan is not recommended for complete inside residual spraying of residences. It is considered safe for porches, spot spraying in kitchens, the inside of privies and other outbuildings, and is effective in such situations.

DDT: Topical applications of 25 and 6.25 solutions and 2.5 percent emulsions of DDT, administered at dosages of 400, 100, and 40 mg./kg. respectively, indicate that DDT is strikingly less toxic than dieldrin and considerably less so than chlordan. Specimens of subcutaneous fat from two men who had undergone prolonged heavy exposures to DDT in connection with operational spray programs were analyzed for DDT content. One was found to contain 91 ppm and the other 291 ppm of DDT. Both men were subjected to detailed clinical examination and neither exhibited abnormal conditions attributable to DDT.

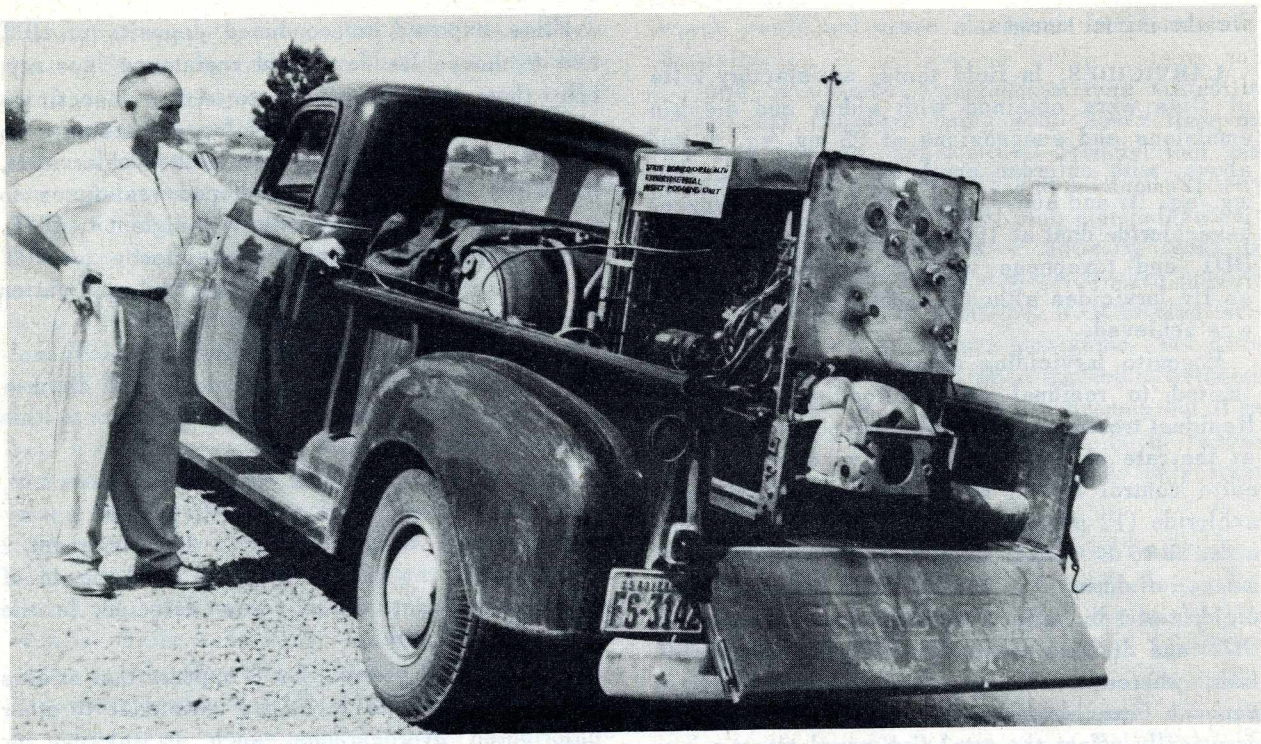
Field and laboratory tests indicate that DDT is the most effective residual spray for fly control in areas where resistant strains have not developed in significant numbers, and this material remains effective against malaria-transmitting mosquitoes and is recommended for use in such activities. Outdoor residual applications of DDT at the rate of 200 mg./sq. ft., in general gave results comparable in effectiveness to 50 mg./sq. ft. dosages of dieldrin where nonresistant strains of flies were involved.

Comparative studies on the effectiveness of insecticides used as space sprays for fly control were conducted with respect to DDT, dieldrin, and chlordan. DDT space sprays gave 80 percent or better control of blow flies at recovered dosages above 0.2 lb. per acre, but less than 20 percent kill of DDT-resistant strains of house flies. Chlordan was effective at recovered dosages above 0.06 lb. per acre and dieldrin at dosages above 0.012 lb. per acre. Dieldrin applied with conventional equipment as a mist or fog on a semi-operational basis gave effective reductions of fly populations. Smoke bombs containing 20 percent DDT and 5 percent chlordan were effective against flies when used indoors, but there was no residual effect.

Lindane: Results of tests on rats with topical applications of 25 and 6.25 percent solutions and 1.25 emulsions at rates of 400, 100, and 20 mg./kg. respectively indicate that lindane is less toxic to animals than is dieldrin. However, limited tests support information obtained from other laboratories to the effect that lindane is more toxic than dieldrin to certain domestic animals, particularly cattle.

Applications of lindane at the rate of 50 mg./sq. ft., as residual spray, gave satisfactory control of DDT-resistant flies for 4 to 8 weeks.

Related Studies: Investigative studies of sanitation factors in fly control augmented accumulated evidence that environmental sanitation is basic in all sound fly control programs, confirming the general conclusion that good sanitation is a prerequisite to permanent fly control. In the Pharr,



DDT, chlordan, and dieldrin used as space sprays give effective fly control when applied as mist or fog by conventional equipment such as the demonstrational fogging machine (Mississippi) shown above.

Tex., area, for example, a breakdown in equipment employed in the operation of sanitary landfills for garbage disposal resulted in a quick buildup of fly populations at the disposal site, whereas a resumption of landfill operations produced an immediate reduction in fly populations. Grill counts increased from less than 50 to more than 500 in less than 2 weeks during the interruption of landfill operations. Detailed investigations in small towns of the lower Rio Grande Valley indicated waste water is the most frequent fly attractant in that area, followed by garbage and animals pens. From the standpoint of fly production, however, garbage was by far the most important material.

In Savannah, Ga., and Pharr, Tex., areas, studies were made concerning the diurnal and nocturnal resting habits of adult flies. It was learned that both house flies and blow flies show a preference for the ground or other horizontal surfaces for resting during the daytime but usually rest in trees, bushes, grasses, or other vegetation at night.

Actual and simulated field studies were made to determine the degree of contamination to which residual spraying operators are exposed. Five percent DDT emulsion was used as the test material. Contamination was much greater in indoor spraying than in outdoor spraying, the average amount for the arms being 246 mg./sq. ft. for indoor as compared with only 34 mg./sq. ft. for outdoor spraying in simulated tests. The marked protection provided by clothing was demonstrated by the fact that the average contamination of exposed (unclothed) areas of workers in actual outdoor spraying was 23.6 mg./sq. ft. as compared with about 0.3 mg./sq. ft. for clothed areas.

Some 36 formulations for emulsifiable concentrates of chlordan were developed. Some contained conventional solvents and others only emulsion solubilizers. The formulation recommended for field use contained 8 gal. of chlordan, 2 gal. of emulsifier (Triton X-155 or X-100), and 40 gal. of xylene, which yields an emulsifiable concentrate containing about 25 percent chlordan.

Considerable attention was given to the problem of developing bio-assay techniques for use with compounds such as dieldrin, for which satisfactory methods of chemical analysis are not available. Using microloops to treat adult flies, techniques have been developed for making reasonably accurate determination of the amount of dieldrin in

certain animal tissues.

LARVICIDES: In field tests, satisfactory kills of flies were obtained with aldrin and dieldrin emulsions and suspensions at 25 mg./sq. ft. and above, with chlordan emulsions and dust at 100 mg./sq. ft. and above, and with 5 percent benzene hexachloride dust at 100 mg. gamma isomer/sq. ft. DDT and toxaphene were relatively ineffective as fly larvicides although some degree of control was achieved.

Mosquito larviciding studies during 1950 were limited to residual and preflooding treatments. Residual treatments of landlocked ponds with DDT at the rate of 3 lb. per acre gave effective mosquito control for 13 to 23 weeks; benzene hexachloride (12 percent gamma isomer) at 1 lb. per acre, 3 to 8 weeks; toxaphene at 1 lb., 4 to 6 weeks; dieldrin at 0.25 lb., 8 to 12 weeks; and dieldrin at 1 lb., effective 25 weeks after treatment. DDT and dieldrin treatments were destructive of fish, whereas as many as five applications of benzene hexachloride in a single season did not drastically affect the total fish populations.

Relatively long-lasting effectiveness also was obtained with DDT, dieldrin, toxaphene, and DDD when applied as preflood treatments at 3 lb. per acre. Toxaphene lasted for about 1 month, DDD and DDT for 3 to 4 months, and dieldrin remained effective 18 weeks after treatment.

INSECTICIDE RESISTANCE: Since the development of resistance to insecticides by vectors of disease may have very serious implications in communicable disease control operations, considerable investigative attention was given to this problem during the past year.

Tests with field strains of flies collected from the Savannah, Ga., and Pharr, Tex., areas showed that relatively high degrees of DDT resistance were maintained even in areas where routine applications of DDT had not been made for 2 years. When these resistant strains were reared in the laboratory for several generations in the absence of DDT they gradually lost their resistance, the rate of reversion being less rapid for the more resistant strains.

Laboratory studies on the relationship between the degree of surface coverage and the development of DDT-resistance by flies have shown that resistance developed more rapidly in colonies when 45 percent of the resting surface was treated than in colonies when only 5 percent of the surface was treated.

Flies exposed to combined deposits of DDT and methoxychlor developed resistance less rapidly than those exposed to either insecticide alone. Flies which had developed resistance to DDT were quite resistant to methoxychlor also, but flies which had developed resistance to methoxychlor were not similarly resistant to DDT. Flies which had developed resistance to DDT were not resistant to dieldrin (initial application of dieldrin).

Laboratory studies showed that house fly colonies exposed to sublethal doses of dieldrin developed a degree of resistance to this insecticide.

Some of the strains of flies in the Savannah, Ga., and Phoenix, Ariz., areas developed a very high degree of resistance to dieldrin about 2 months after the initial application. A strain of chlordan-resistant flies was detected in the Savannah, Ga., area.

From general observation it appears that strains of flies which have developed resistance to other chlorinated hydrocarbons, such as chlordan or DDT, develop dieldrin resistance much more quickly than strains not previously exposed to these materials. Chlordan-resistant strains appear also to have a high initial resistance to dieldrin.

There is little evidence to indicate that resistance to insecticides on the part of malaria-transmitting mosquitoes has developed to the point where it materially lessens the effectiveness of the common insecticides in control operations.

Preliminary laboratory studies with the oriental rat flea, *X. cheopis*, indicate that a degree of resistance to DDT may be developed in a few generations by exposure of populations to sublethal concentrations. However, this flea is highly susceptible to DDT and there is as yet no indication from general field observations that DDT resistance is developing under conditions which obtain in typhus control through DDT dusting.

RODENTICIDES: Major activities in this sphere were concerned with field and laboratory tests of the relatively new rodenticide, warfarin, which is an anticoagulant related to the common drug Dicumarol. It kills rats by causing hemorrhage, thus providing a new approach to rodent control. Whereas conventional rodenticides act on the "quick kill" principle, warfarin acts through small doses taken over a period of days. Animals can tolerate a massive dose many times the amount which would be fatal if taken in small repeated

doses. For example, rats tested withstood a single dose of 50 mg./kg., whereas when it was administered over a 5-day period most rats were killed by a total dose of 5 mg./kg. This quality makes the use of warfarin relatively safe for man and domestic animals, since there is little likelihood of poisoning from the accidental ingestion of a single dose. The danger of accidental deaths is further decreased by the fact that vitamin K is an effective antidote.

In field trials with Norway rats, generally good control has been obtained using yellow corn meal bait containing 0.005 percent warfarin. Somewhat less satisfactory results have been obtained with roof rats, particularly on farms; however roof rats were satisfactorily controlled with warfarin in corn meal at the rate 0.05 mg./gm. The only solid bait roof rats preferred over corn meal (in field tests) was corn meal containing 10 percent pecan crumbs. Water containing warfarin at the rate of 0.06 mg./ml. was effective also.

Warfarin produces a typical pathology which can be recognized with almost complete certainty in over 85 percent of rats poisoned. Secondary poisoning may occur if cats (and presumable other animals) consume warfarin-poisoned rats over a period of days.

Simulated field tests indicated that Norway rats given sublethal doses of ANTU develop an avoidance reaction to this rodenticide which persists for as long as 4 months. Warfarin, on the other hand, appears not to cause the development of an avoidance or bait refusal reaction.

ECTOPARASITE CONTROL: Tests were made with 16 samples of debris collected from rat runs which had been treated with DDT more than 2 years previously. Analyses showed that 14 of the 16 samples contained DDT and sufficient quantity remained in 11 to give 100 percent mortalities of the oriental rat flea.

In limited field tests against soil infestation of cat fleas, 5 or 10 percent DDT dust gave effective kills of adults but apparently was ineffective against the immature stages. Single applications of chlordan gave effective control.

DISINSECTIZATION OF AIRCRAFT: Investigations were continued under the sponsorship of the Division of Foreign Quarantine, in an effort to develop improved formulations for the disinsectization of intercontinental aircraft through use of space sprays. The objective was to develop a more effective and less expensive formulation which would not craze plexiglass nor leave oily deposits.

Some 64 different formulations were tested in Peet-Grady chambers using adult house flies as the test species. Experimental formula S-43 was found to be most suitable. This new formula is more toxic to insects than the previous standard formula G-382, giving a comparative mortality index of about 1.4 for adult *Musca domestica* when applied at a rate of 3 gm. per 1,000 cu. ft. It is also less expensive, does not craze plexiglass, and does not leave an oily deposit. When applied at standard treatment rates it is nontoxic to humans but it is somewhat irritating and therefore it is recommended that application be made only when passengers are not present.

RADIOACTIVE ISOTOPE LABORATORY: During the latter half of the fiscal year a new radioactive isotope laboratory was established at Savannah, Ga., consisting of: (1) a chemistry laboratory for synthesis of radioactive compounds, low level activity manipulations, and dry runs prior to incorporation of active material; (2) a hood for remote control handling of high level activity and for the storage of tracer shipments; (3) a biological specimen room for housing animals, insects, and other biological specimens containing radioactive material; (4) a counting room with electronic equipment for quantitative determination of radioactivity in specimens; and (5) office space for study, reading, and record keeping.

The laboratory will serve various investigations of the Communicable Disease Center in which radioactivity techniques are applicable.

EQUIPMENT DEVELOPMENT (Field, Laboratory, Scientific): A number of new pieces of equipment for use in the various aspects of communicable disease control and investigation were developed during the year either *de novo* or through improvements in old models.

In the realm of control, a gravity fed spray unit was developed for light and medium aircraft. It employs double throat venturi tubes with annular orifices to accomplish the spray solution break-up. Flight tests with PT-17 planes dispersing a 22 percent solution of DDT in methylated naphthalenes at rates of ¼ to ½ gal. per minute gave a particle size range of 10 to 50 microns.

Another item in the field of airplane spraying equipment was the incorporation of improved features into the CO_2 "packaged unit" for light aircraft which was developed for use in connec-

tion with epidemic and disaster aid. This unit has been approved by the CAA for installation by licensed airplane mechanics in Piper J-3 or PA-12 planes.

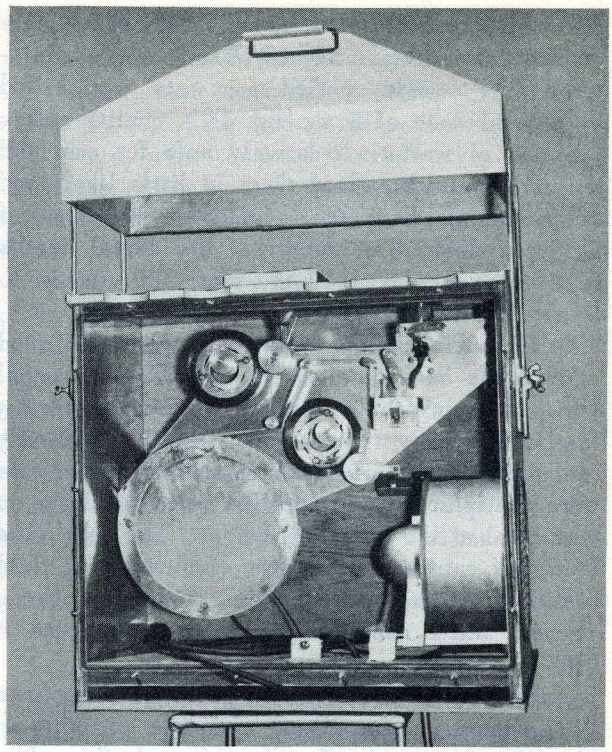
Items subjected to structural and performance tests during the year include: various types of hand spray cans suitable for dispersing emulsions or suspensions of water wettable powders; leak-proof hand shut-off valves; and xylene-resistant spray hose.

Demand for the development of new or improved laboratory and scientific equipment and apparatus was heavy during 1950.

A continuous recording sampler for atmospheric pollen and dust was developed and subjected to preliminary tests with favorable results. Although designed specifically for collection of pollen, it may be adapted for sampling of other air-borne allergens or pathogens.

A respiratory exposure chamber for use in studying the effects of air-borne toxicants upon experimental animals was designed and constructed. This device is particularly useful in determining the toxicities of gases, spray mists, and dusts of economic poisons.

Other equipment developed for use in toxicological investigations include (1) self-contained animal rearing cages with automatic watering device; (2) an instrument for measuring the degree of contamination to which operators are exposed in field residual spraying operations; and (3) equipment for exposing experimental animals to simulated field spraying conditions.



Field tests indicate that the apparatus shown above which was developed for measuring and recording atmospheric pollen and dust may be adapted for sampling other air-borne allergens or pathogens.

A reciprocal solution agitator with a capacity of sixteen 500 cc. separatory funnels was constructed for use in analytical chemistry.

LABORATORY ACTIVITIES

Laboratory facilities operated during 1950 include sections and/or units devoted to parasitology, general bacteriology, enteric bacteriology, virology and rickettsiology, serology, mycology, clinical pathology, tuberculosis, diphtheria, streptococcus, and nursing research. Responsibilities of Center laboratories include: (1) assistance to CDC components in field investigations; (2) providing laboratory facilities and services to other Divisions of the Bureau of State Services; (3) conducting methodology research; (4) providing training facilities and opportunities for personnel of State and local public health laboratories; (5) supplying reference diagnostic services to State, local, and other public health laboratories; (6) consultation services; and (7) evaluation of performance level of State and other laboratories.

The Plague Suppressive Laboratory, based in San Francisco, Calif., was integrated into the Center's combined laboratory program and desig-

nated the Western CDC Laboratory. Late in the fiscal year the relatively new clinical pathology laboratory was established in quarters adjacent to Grady Hospital, Atlanta, Ga., where it is being developed in cooperation with Grady Hospital and the Medical School of Emory University. The Venereal Disease Research Laboratories of the Venereal Disease Division of PHS were transferred from Staten Island, N. Y. to installations adjoining the main facilities of the Center Laboratories. Virus and Rickettsia Laboratories, based in Montgomery, Ala., were improved during the year through the acquisition of additional equipment and personnel.

During the past year laboratories of the Center handled more than 300,000 specimens (exclusive of research activities) submitted for diagnostic study. CDC operational programs provided some 200,000 of the 300,000 specimens, while 25,000 were submitted by State public health agencies, 21,000 by Veterans' Administration Hospitals, 7,500 by colleges and universities, 5,500 by practicing physicians, and varying numbers by other agencies. Table 23 indicates the source and type of specimens dealt with in this activity.

Table 23

STATES, TERRITORIES, AND FOREIGN COUNTRIES WHICH SUBMITTED REFERENCE DIAGNOSIS MATERIALS TO THE RESPECTIVE LABORATORIES

STATES	Parasitology	Virus	Gen'l Bact.	Serology	Enteric Bact.	Mycology	Tuberculosis
Ala.	X	X	X	X	X	X	X
Ariz.	X	X	X	X	X	X	X
Ark.	–	X	X	X	X	X	X
Calif.	X	X	X	X	X	X	–
Colo.	X	X	X	X	X	X	–
Conn.	X	X	X	X	X	X	X
Del.	–	X	X	X	X	–	–
D. C.	–	X	X	X	X	X	X
Fla.	X	X	X	X	X	X	X
Ga.	X	X	X	X	X	X	X
Idaho	X	–	X	X	X	X	X
Ill.	X	X	X	X	X	X	X
Ind.	X	X	X	X	X	X	X
Iowa	X	X	X	X	X	X	–
Kans.	X	X	X	X	X	X	X
Ky.	X	X	X	X	X	–	–
La.	X	X	X	X	X	X	X
Maine	X	X	X	X	X	–	–
Md.	X	X	X	X	X	X	–
Mass.	X	X	X	X	X	X	X
Mich.	X	X	X	X	X	X	X
Minn.	X	X	X	X	X	X	–
Miss.	X	X	X	X	X	X	–
Mo.	–	X	X	X	X	X	X
Mont.	X	–	X	X	–	X	–
Nebr.	–	X	X	X	X	–	–
Nev.	–	X	–	–	–	–	–
N. H.	–	X	X	X	X	–	–
N. J.	–	X	X	X	X	–	X
N. Mex.	X	–	X	X	X	X	X
N. Y.	X	X	X	X	X	X	–
N. C.	X	X	X	X	X	X	X
N. Dak.	X	X	X	X	X	X	–
Ohio	X	X	X	X	X	X	X
Okla.	X	X	–	X	X	X	X
Oreg.	X	–	X	X	X	X	X
Pa.	–	X	X	X	X	X	X
R. I.	X	X	X	X	X	–	–
S. C.	X	X	X	X	X	X	X
S. Dak.	X	X	X	X	X	X	–
Tenn.	X	X	X	X	X	X	X
Tex.	X	X	X	X	X	X	X
Utah	X	X	X	X	X	–	–
Vt.	–	–	X	X	–	–	–
Va.	X	X	X	X	X	X	X
Wash.	X	X	X	X	X	X	X
W. Va.	X	X	X	X	X	X	X
Wis.	X	X	X	X	X	X	X
Wyo.	X	X	–	–	–	–	–

(Continued on next page)

(Table 23, continued)

	Parasitology	Virus	Gen'l Bact.	Serology	Enteric Bact.	Mycology	Tuberculosis
TERRITORIES							
Alaska	X	X	X	–	X	X	X
Hawaii	–	–	X	X	X	–	–
P. I.	X	X	X	–	X	–	X
V. I.	X	–	–	–	–	–	–
FOREIGN COUNTRIES							
Bolivia	–	–	–	–	X	–	–
Brazil	–	–	X	–	X	–	–
Canada	–	–	X	X	X	X	–
Cuba	–	–	X	–	X	–	–
D.W.I.	–	X	–	–	–	–	–
Ethiopia	–	–	X	–	–	–	–
Germany	–	X	–	–	X	–	–
Honduras	–	X	–	–	–	–	–
Italy	–	–	–	–	X	–	–
Mexico	–	–	–	–	X	–	–
Norway	–	–	–	X	–	–	–
Peru	–	–	–	–	X	–	–
South Africa	–	–	–	X	–	–	–
Sweden	–	–	–	–	X	–	–

TRAINING: Table 24 summarizes the scope of regularly scheduled training courses in laboratory diagnosis, a major activity of Center Laboratories. In addition to courses listed in the table, field refresher courses were presented by laboratory staff members under the auspicies of the State health departments of Florida, Idaho, Montana, North Dakota, Oregon, Texas, and Washington. Over 700 persons attended one or more of the field refresher courses which dealt with improved diagnostic techniques in bacteriology-serology, parasitology, and virus-rickettsia diseases.

Collateral Activities: Extension Service shipments during the year included 20,000 specimens to 313 laboratories. Of this total some 60 percent went to State and local health departments on the permanent mailing list which includes the 48 States, District of Columbia, Alaska, Hawaii, Puerto Rico, and Canada.

Forty-one States and Territories (table 25) participated in the evaluation program for the laboratory diagnosis of amebiasis, which was completed during 1950. The program involved the mailing of 110 specimens to participating laboratories for examination and return of diagnoses for evaluation by a board of referees, including CDC consultants. The tuberculosis evaluation program was started with the mailing of about 25 percent of the scheduled specimens.

In the sphere of consultation services four members of the laboratory staff collaborated with consultants in reviews of 19 State and 1 local laboratories. This activity was carried on in cooperation with Regional PHS Offices.

METHODOLOGY RESEARCH AND RELATED STUDIES: Parasitology – (1) A cooperative program was developed with a local hospital which permitted direct comparison of laboratory techniques with clinical diagnosis of amebiasis which made it practical to compare a wide variety of procedures. (2) Balamuth's liquid medium with liver extract added was found satisfactory for diagnostic isolation and culture of amebae. (3) Polyvinyl alcohol fixation of feces proved to be an efficient aid to diagnosis of intestinal protozoa. (4) Addition of penicillin and streptomycin to culture media enabled workers to maintain *Dientamoeba fragilis*, small race *Endamoeba histolytica*, and *Endamoeba coli* over a long period of time. (5) Various modifications of Beemer's stain resulted in the development of a staining technique superior to any previously used for staining of parasitic protozoa. (6) A simple method was developed for furnishing scotch tape to physicians for the collection of pinworm eggs.

Virus and Rickettsia: (1) As yet, investigations of antiviral agents have been unfruitful. (2) Newcastle virus studies, reported in Howitt's paper, "Effect of Non-Specific Heat Labile Factor on the Neutralization Test for Newcastle Disease

Table 24

REGULARLY SCHEDULED LABORATORY DIAGNOSIS REFRESHER TRAINING COURSES CONDUCTED DURING FISCAL YEAR 1950

Title of Course	Length in weeks	Number Trainees
Laboratory Diagnosis of Parasitic Diseases	6	19
Laboratory Diagnosis of Parasitic Diseases Part I, Intestinal Parasites	3	22
Laboratory Diagnosis of Parasitic Diseases Part II, Blood Parasites	3	16
Laboratory Diagnosis of Parasitic Diseases Directors' Course	1	12
Laboratory Diagnosis of Mycotic Diseases	4	20
Laboratory Diagnosis of Mycotic Diseases Directors' Course	1	16
Laboratory Diagnosis of Tuberculosis	4	19
Laboratory Diagnosis of Tuberculosis Directors' Course	1	7
Laboratory Diagnosis of Bacterial Diseases Directors' Course	1	22
General Bacteriology	5	22
Advanced Enteric Bacteriology	2	16
*Phage Typing of *Salmonella typhosa* (by special request)	1	7
**Laboratory Diagnosis of Rabies	1	19
**Serologic Diagnosis of Rickettsial Diseases	1	11
Total	-	228

*Given three times

**Given two times

Thirty-two States and District of Columbia were represented by one or more trainees.

Virus in Eggs",* were concluded during the year. (3) The work on Coxsackie virus concerned with the recovery of the virus from material obtained from human patients** was completed and published. Work in the same field related to studies on typing methods, adaptation of the complement fixation test to typing, and comparison of complement fixation techniques with serum neutralization techniques was completed and a report is being prepared. (4) Results of experimental work on the effects of Coxsackie virus on monkeys show that mixed infections with Coxsackie virus may cause the recovery of one or both strains, and that mixed infections with poliomyelitis virus and Coxsackie virus do not interfere with the course of either. (5) A safe method for handling infected mosquitoes was developed. (6) Transmission studies attempting horse to horse transmission of Eastern equine encephalomyelitis with *Culex quinquefasciatus* were concluded with negative results. (7) Progress was made in investigations into the antigenic relationship of swine, equine, and human influenza; and in investigations into the preferable thiazine for general staining of nervous tissue.

Bacteriology

GENERAL: (1) Simplification and evaluation of Elek *in vitro* virulence test for *Corynebacterium diphtheriae*. (2) Studies on immunization of guinea pigs with endotoxic antigens of *C. diphtheriae* extended over a period of 4 months and involved more than 2 000 guinea pigs. (3) Studies of certain strains of *C. diphtheriae* showing low virulence revealed that many, especially the minimus type, while highly virulent for man, yield negative or

*Journal of Immunology 64(2): 73-84 (1950)

**Proceedings of Society of Experimental Biology and Medicine (1950)

Table 25

LABORATORIES PARTICIPATING IN THE DIAGNOSIS OF AMEBIASIS

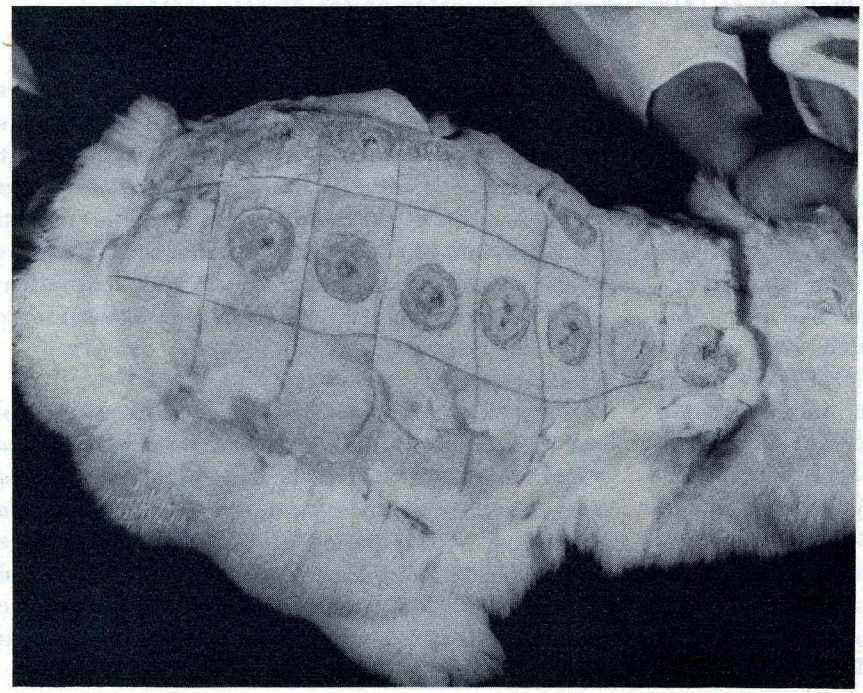
Arizona	Nebraska
Arkansas	Nevada
California	New Jersey
Connecticut	New York
Florida	North Carolina
Georgia	North Dakota
Idaho	Ohio
Illinois	Oregon
Indiana	South Carolina
Iowa	Tennessee
Kansas	Texas
Kentucky	Utah
Louisiana	Vermont
Maine	Virginia
Maryland	Washington
Massachusetts	West Virginia
Michigan	Wisconsin
Minnesota	Alaska
Mississippi	Canal Zone
Montana	Hawaii
Puerto Rico	

doubtful tests in animals as tested by standard methods. A new method of preparing the culture for virulence tests in animals yielded more accurate results.

ENTERIC: (1) Typing serums were prepared in considerable volume – *Salmonella*, 21,000 ml.; *Shigella*, 12,350 ml.; *Escherichia coli*, 16,500 ml.; and paracolons, 6,000 ml. (2) *Salmonella typhi* typing kits were distributed to selected laboratories. (3) The antigenic structure of the *Klebsiella* group was surveyed and experimental antiserums for capsular antigens prepared. (4) Commercially available antigens and antiserums for the enteric organisms were evaluated for accuracy and sensitivity.

STREPTOCOCCUS: (1) Representative strains of more than 50 types and species of streptococci were lyophilized to facilitate distribution. (2) Investigations were made to determine a simple method for developing and maintaining streptococcus cultures in condition satisfactory for use in serologic tests. (3) Definite progress has been made on a large-scale serum production program which was initiated after the New York State Health Department Laboratory indicated unwillingness to continue supplying serum in this field. (4) Streptococcus cultures for long term storage were prepared by three methods and plans were made for a comparative study of the three methods.

TUBERCULOSIS: Comparative studies disclosed that Herrald's medium and Lowenstein's medium give essentially similar results when used as substrate for streptomycin sensitivity testing of tubercle bacilli. (2) Virulent tubercle bacilli decolorize certain of four oxidation-reduction indicator dyes in a pattern different from that shown by nonvirulent strains. (3) Lowenstein's medium, which requires some skill and time to prepare, yields as



Test for virulence of *C. diphtheriae*. At 10 a. m. each square in the center horizontal row received, intradermally, 0.2 ml. of 48-hour broth culture to be tested, one culture to a square. At 3:00 p. m. the rabbit received 1000 units of diphtheria antitoxin intravenously, followed by injections of 0.2 mL of the broth cultures previously injected. This time each culture was injected into a square below the first injection. The picture shows the rabbit about 72 hours later. Positive tests for virulence are seen in all of the squares of the middle row except the first on the left.

Technician preparing Lowenstein's medium: Although strict observance of directions is required, Lowenstein's medium is one of the most efficient known for routine diagnostic purposes and can be prepared in small laboratories. It has the advantage that it can be prepared in large quantities and refrigerated for use as needed, since it can be stored at refrigerator temperatures for as long as 8 months without loss of effectiveness.

luxuriant growth of tubercle bacilli after storage at refrigerator temperatures for a period of 8 months as does freshly prepared media. (4) The Levya Nucleic Acid reaction, to measure desoxyribonucleic acid in serum, is positive in tuberculosis. It also indicates significant levels in other tissue-destroying diseases and apparently is not a specific reflection of the presence of tuberculosis organisms. (5) Lowenstein's, Petragnani's, Trudeau Society, and Dubos' media were compared to determine the most efficient substrate for *Mycobacterium tuberculosis* isolation from pathological material. Lowenstein's and Petragnani's were proven equally sensitive and both clearly superior to the other two. (6) Centrifugation of homogenized material does not result in concentration of all contained tubercle bacilli at the bottom of the tube. Considerable numbers of bacilli can be demonstrated in the supernate which is usually discarded.

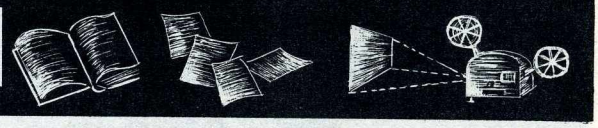
Mycology: (1) Histoplasmosis studies were carried on in cooperation with Midwestern CDC Services. (2) Pollen count and pollen determination studies were conducted in collaboration with epidemiological and technical development workers. (3) The physiological requirements of Dermatophytes were the subject of detailed investigations in the preparation of selective media for isolation and identification of these fungi.

Serology: (1) The evaluation of five techniques commonly used for the rickettsial complement fixation test was completed during the year. (2) Evaluation studies on the tube agglutination test for brucellosis were completed as a preliminary to further investigations in this field. (3) A liver extract catalase prepared for use in *Brucella* isolation was found to speed colony growth when added to the media.

Nursing Research: (1) Work continued on *in vitro* testing of ethyl alcohol and isopropyl alcohol in various concentrations in the presence and absence of serum against different strains of microorganisms for various time intervals. (2) Considerable progress was made in comparative testing of two *in vitro* methods (test tube and flask techniques) of testing disinfectants. (3) The effect of ethyl alcohol and isopropyl alcohol on sputum of patients with active tuberculosis was studied. (4) Tabulations of thermometer techniques as practiced in public health hospitals were made. (5) Attention was given to isolation and *in vitro* testing of streptococci and staphylococci from sputum.

WESTERN CDC LABORATORY: (1) In New Mexico the pocket gopher (*Thomomys fossor*) for the first time was proven to be a reservoir of plague. (2) It was demonstrated that 5 species of wild rodent fleas could transmit plague under laboratory conditions. (3) The coexistence of *Salmonella* and plague in flea collections inspired studies which showed that double infections diminish vector efficiency for plague in fleas. (4) Plague infected fleas showed a notable drop in vector efficiency at 85° F. as compared with efficiency at 74° and 47.5° F.

TRAINING ACTIVITIES



Center training activities are directed toward the over-all objective of helping the States increase the competence of their public health establishments by providing guidance and practical assistance in training staff personnel. In pursuit of this objective Center personnel in charge of training place emphasis upon improving training techniques and developing new ones.

During the past year States were assisted in various aspects of training (1) through the operation of field training centers, (2) through the assignment of experienced training officers to State health departments, and (3) through the loan of training officer teams to conduct short training courses in subjects and at places selected by State health officers.

Trainees enrolled in one or more field training courses during 1950 include 449 in regularly scheduled courses held at established training centers and 413 in decentralized courses conducted in different sections of the nation. In addition a large number were served through State training centers where CDC training officers were assigned, and through courses arranged to accomodate special groups.

FIELD TRAINING CENTERS: In addition to Atlanta, training centers were operated during 1950 in the following locations: Albany and Columbus, Ga.; Amherst, Mass.; Cincinnati, Ohio; Denver, Colo.; Pittsburgh, Pa.; Topeka, Kans.; and Troy, N. Y. Figure 23 shows the geographical distribution of training centers, by States. During the year arrangements were completed for the activation of a field training center in Bloomington, Ill., early in 1951.

SUPPORT OF STATE TRAINING CENTERS: Experienced training officers were assigned to Kentucky and Maryland during the past year and those previously assigned to New York, North Carolina, and South Carolina were continued in their respective assignments. Commitments were made to assign officers to California and Washington during 1951. Florida, Louisiana, Oklahoma, and Texas were assisted through the temporary loan of training-officer teams to conduct courses in insect and rodent control, milk and food sanitation, and housing hygiene.

ENVIRONMENTAL SANITATION: Training centers at Albany and Columbus, Ga.; Amherst, Mass.; Denver, Colo.; Topeka, Kans.; and Troy, N. Y., offered courses in the various areas of environmental sanitation; and the recently activated Pittsburg, Pa., center conducted at first course in enivronmental sanitation with inspectors from the Pittsburgh Health Department as trainees.

MILK AND FOOD SANITATION: Regularly scheduled training courses in food and milk sanitation were conducted through training centers at Columbus, Denver, Topeka, and Troy. In addition, decentralized training in this general field was conducted at the following locations:

Milk Sanitation – Columbus, Ohio; Madison, Wis.; Pocatello, Idaho; and St. Louis, Mo.
Food Sanitation – Chicago, Ill.
Milk and Food Sanitation – Sylvan Lake, S. Dak.

INSECT AND RODENT CONTROL: The following courses were conducted in Atlanta:

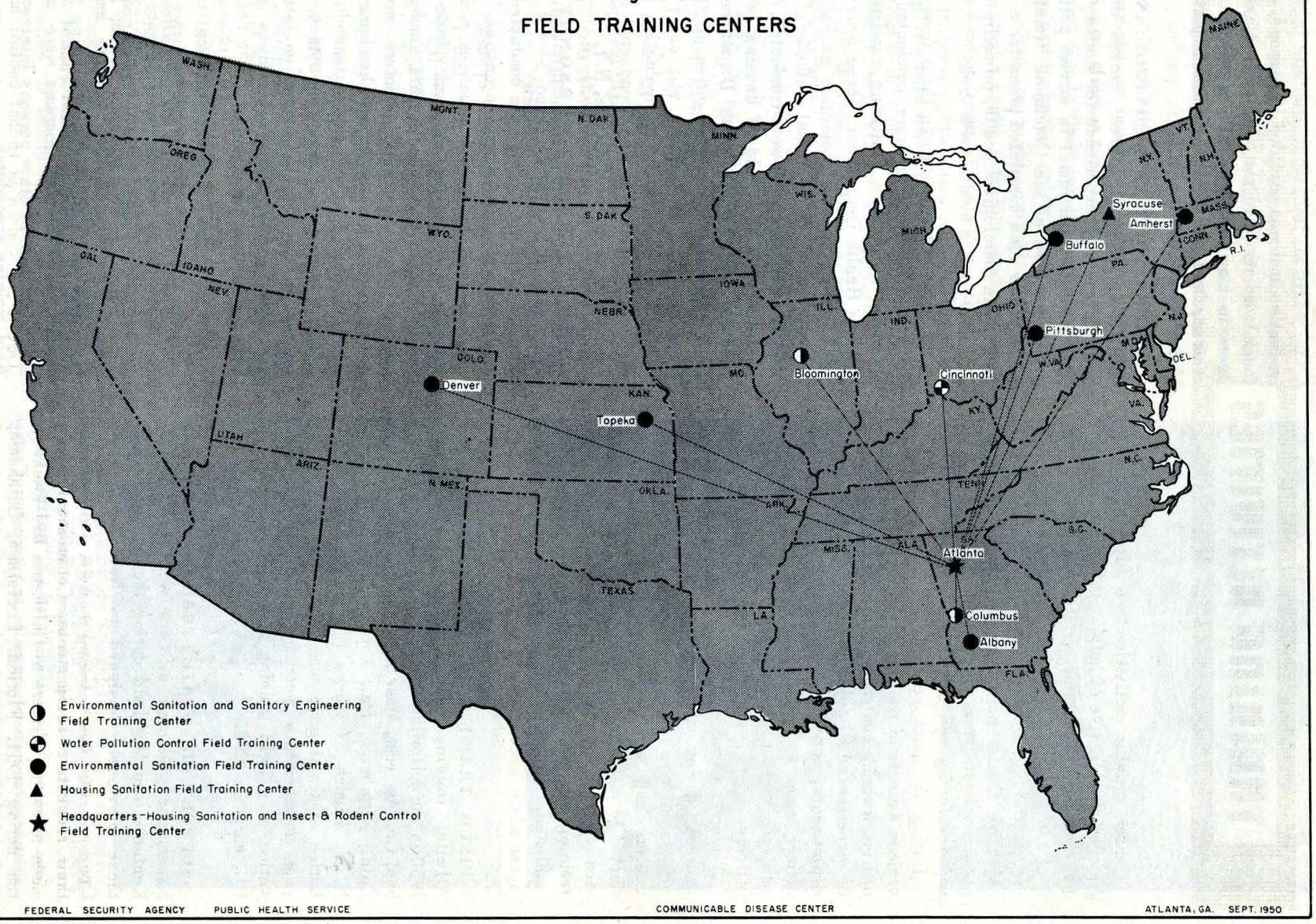
One 4-week course in rat-borne disease prevention and control
One 3-week course in insect control
Two 5-day courses in insect control
Two 5-day courses in fly control
Two special courses in insect and rodent control

Decentralized Courses

Four 5-day courses in insect and rodent control; two at New Orleans, La., and two at Columbus, Ga.
Two 5-day courses in insect and rodent control; one at Chapel Hill, N. C., and one at Tulane University.
One 3-day course in insect and rodent control at Louisville, Ky.
One 5-day course in fly control at Leesburg, Fla.
One 2-week course in rodent control at Kansas City, Mo.
One 2-day course in rodent control at Topeka, Kans.

Figure 23

FIELD TRAINING CENTERS



FEDERAL SECURITY AGENCY PUBLIC HEALTH SERVICE COMMUNICABLE DISEASE CENTER ATLANTA, GA. SEPT. 1950

Top: Training officer instructing trainee in restaurant sanitation. **Center:** Classroom discussion of housing hygiene in terms of environment and structural features. **Bottom:** Demonstration in rat control—preparation and placement of poison bait and proper use of traps.

In addition individual training in insect and rodent control was provided 15 persons, and assistance was rendered the California Health Department in connection with a 1-week fly control course, and the Texas Health Department in a 4-day fly control course.

STREAM POLLUTION CONTROL AND RADIOLOGICAL HEALTH: Three courses designed to provide practical experience for sanitary engineers and laboratory personnel in stream pollution control were held at the Cincinnati training center. This center also completed plans for a program of training in radiological health, primarily for Federal and State public health personnel.

HYGIENE OF HOUSING: Three 5-week courses in housing sanitation were conducted at Headquarters in Atlanta, utilizing facilities of the Atlanta Health Department Three 5-week courses in field survey and evaluation methods and two 5-week courses in appraisal methods of measuring quality of housing also were conducted. In addition, assistance in the field of housing hygiene was rendered the Texas Health Department, Kansas Health Department, and the cities of Augusta and Savannah, Ga.; Burlington, Vt.; and Providence, R. I. Three courses in the evaluation of methods of housing sanitation were conducted through the subtraining center at Syracuse, N.Y.

PUBLIC HEALTH PERSONNEL FROM FOREIGN COUNTRIES: Three 2-week courses in insect and rodent control were conducted for public health workers from foreign countries. In all, 119 trainees from 45 foreign countries were afforded training opportunities in some phase of public health work. Thirty-two of this number attended courses at field training centers and 87 were accommodated through Atlanta headquarters. Eight trainees from Venezuela attended fly control courses, with one of their countrymen, a previous student in the course, serving as interpreter. In the main, however, foreign trainees are familiar with the English language.

ORIENTATION: Eight orientation courses for recently employed CDC personnel were conducted during the fiscal year with an aggregate enrollment of 115. Two special orientation courses were arranged for 24 medical students employed as laboratory and field assistants during the summer months, and informal programs were arranged for 24 nurses and 13 other persons interested in CDC field training procedures.

TRAINING AID PRODUCTION: During the past year 79 major audio-visual productions, designed to support the diversified training efforts of CDC and other agencies interested in public health training, were released to users. Many others were carried to various stages of completion. Center productions are made in response to demonstrated need and are utilized in a broad field of professional and technical training not only by CDC and other PHS units but also by State and local health departments, medical schools, public health schools, various Federal agencies, private institutions engaged in public health activities, and for health training in foreign lands.

Motion picture, filmstrip, and slide series productions released during 1950 included:

Motion Pictures (16 mm)

1. Life Cycle of *Diphyllobothrium latum*. Sound, B&W, 16 minutes
2. Use of Aircraft for Insect Control – Part I, Mosquito Control.
   Sound, B&W, 13 minutes
3. The Fight Against the Communicable Diseases.
   Sound, color, 18 minutes
4. Striking Back Against Rabies.
   Sound, B&W, 12 minutes
5. Laboratory Diagnosis of Diphtheria – Part III, Tests for Virulence of *C. diphtheriae* in Animals.
   Sound, B&W, 13 minutes
6. The Laboratory Diagnosis of Tuberculosis – Part I, Preparation of a Culture Medium.
   Sound, B&W, 14 minutes
7. The Laboratory Diagnosis of Tuberculosis – Part II, Preparation of Sputum Specimens.
   Sound, B&W, 16 minutes
8. The Laboratory Diagnosis of Tuberculosis – Part IV, Typing of Tubercle Bacilli by Animal Inoculation.
   Sound, B&W, 14 minutes
9. Community Fly Control Series – Fly Control Through Basic Sanitation.
   Sound, color, 9 minutes
10. Occupational Nursing (A script preparation only – for the Division of Nursing Resources).
11. Preservation of Bacteria by Desiccation *in Vacuo*.
    Sound, B&W, 11 minutes
12. Rat-Proofing Procedures (for PHS Region V).
    Sound, B&W, 4 minutes
13. Intraoral and Pharyngeal Structures and Their Movements (V.A. – CDC Cooperative Project).
    Sound, color, 17 minutes
14. Laboratory Diagnosis of Diphtheria – Part IV, The *in Vitro* Test for Virulence of *C. diphtheriae*.
    Sound, B&W, 11 minutes
15. Community Fly Control Series – Spraying Procedures and Equipment – Part II, Space Spraying.
    Sound, color, 7 minutes
16. The Laboratory Diagnosis of Rabies.
    Sound, B&W, 6 minutes
17. Interviewing (First Film for FSA, SSA, OASI) (SSA, OASI – CDC Cooperative Project).
    Sound, B&W, 20 minutes
18. Claims Control (Second Film for FSA, SSA, OASI) (SSA, OASI – CDC Cooperative project).
    Sound, B&W, 32 minutes
19. Interviewing (Third Film for FSA, SSA, OASI) (SSA, OASI – CDC Cooperative Project).
    Sound, B&W, 18 minutes

Filmstrips (35 mm)

1. Identification of U. S. Species of *Anopheles* Larvae.
   Sound, B&W, 16 minutes
2. Fundamentals of Detergents.
   Sound, B&W, 9 minutes
3. Syphilis Horizons.
   Sound, B&W, 9 minutes
4. Use of Aircraft for Insect Control – Part I, Mosquito Control.
   Sound, B&W, 14 minutes
5. Home Safety and Health Departments.
   Sound, B&W, 15 minutes
6. Collection of Adult Flies.
   Silent, color, 37 frames
7. The Laboratory Diagnosis of Tuberculosis – Part I, Preparation of a Culture Medium.
   Sound, color, 5 minutes
8. The Laboratory Diagnosis of Tuberculosis – Part II, Preparation of Sputum Specimens.
   Sound, color, 6 minutes
9. The Laboratory Diagnosis of Tuberculosis – Part IV, Typing of Tubercle Bacilli by Animal

inoculation.
Sound, color, 7 minutes

10. Ten-Eighty, A Rat Poison for Professional Use.
Sound, B&W, 7 minutes

11. Laboratory Diagnosis of *Tinea capitis* in Children.
Sound, color, 9 minutes

12. Identification of U. S. Genera of Adult Ticks.
Sound, B&W, 14 minutes

13. How to Measure Deterioration in Dwellings.
Sound, B&W, 13 minutes

14. Fly Density Surveys by the Grill Method.
Silent, color, 28 frames

15. Field Training for Public Health Workers.
Sound, color, 10 minutes

16. Oral Hygiene – Toothbrush Technique.
Sound, color, 5 minutes

17. Constructing a Farm Pond.
Sound, B&W, 10 minutes

18. Municipal Sewage Treatment Plants – Part I, Primary Treatment Plants.
Sound, B&W, 7 minutes

19. Putting Vision into Education (for Georgia Department of Education).
Silent, color, 56 frames

20. Taking Care of Diabetes – Part I, What is Diabetes? (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 46 frames

21. Taking Care of Diabetes – Part II, Eating for Good Health (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 42 frames

22. Taking Care of Diabetes – Part III, Insulin and its use (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 69 frames

23. Taking Care of Diabetes – Part IV, Planning Good Meals (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 49 frames

24. Taking Care of Diabetes – Part V, The Effect of Insulin (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 36 frames

25. Taking Care of Diabetes – Part VI, Buying Good Food (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 48 frames

26. Taking Care of Diabetes – Part VII, Tests for Diabetes (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 37 frames

27. Taking Care of Diabetes – Part VIII, Cooking Good Meals (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 46 frames

28. Taking Care of Diabetes – Part IX, Keeping Out of Danger (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 33 frames

29. Taking Care of Diabetes – Part X, Care of Your Feet (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 39 frames

30. Taking Care of Diabetes – Part XI, Selecting Meals for All Occasions (Chronic Disease Division – CDC Cooperative Project).
Sound, color, 48 frames.

31. PVA Fixative Technique in the Diagnosis of Amoebiasis.
Sound, color, 7 minutes

32. The Diagnosis of Intestinal Protozoa by Means of Hematoxylin Stained Smears.
Sound, B&W, 8 minutes

33. Film Script to Filmstrip.
Silent, B&W, 20 frames

34. Municipal Sewage Treatment Plants – Part II, Chemical Precipitation Treatment Plant with Two-Stage Digestion.
Sound, B&W, 7 minutes

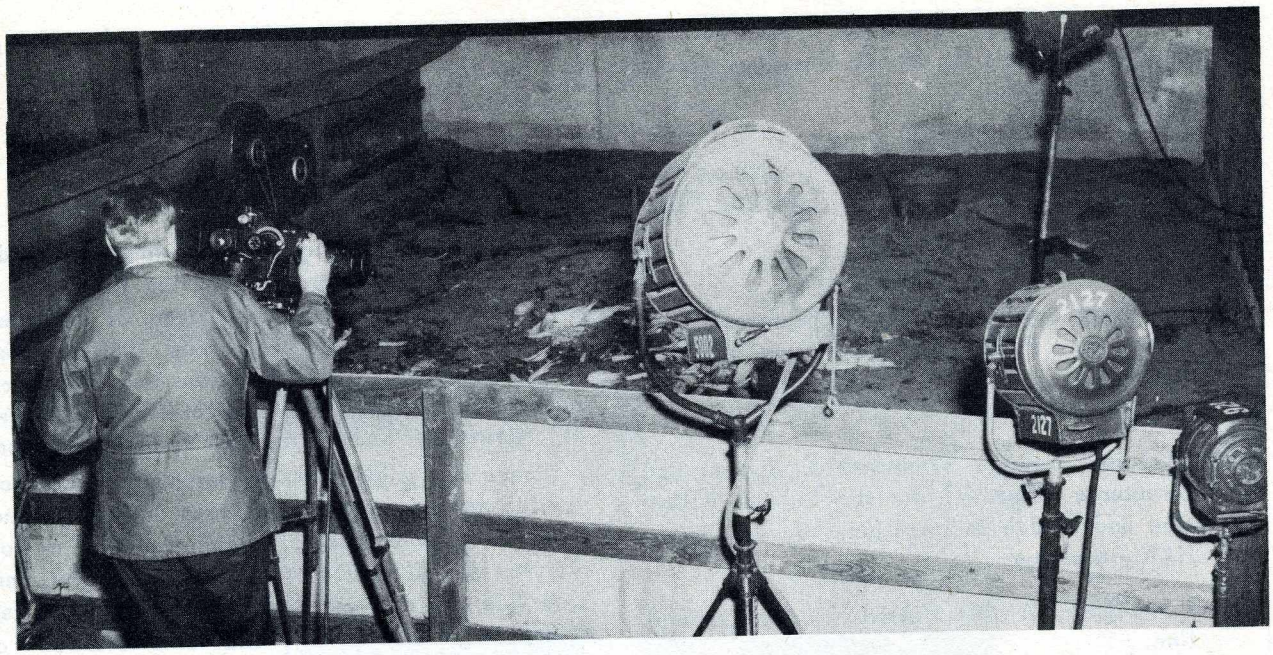
35. Municipal Sewage Treatment Plants – Part III, Trickling Filter Plants.
Sound, B&W, 9 minutes

36. Municipal Sewage Treatment Plants – Part IV, Activated Sludge and Vacuum Filtration Plant With Vacuum Filtration and Incineration.
Sound, B&W, 8 minutes

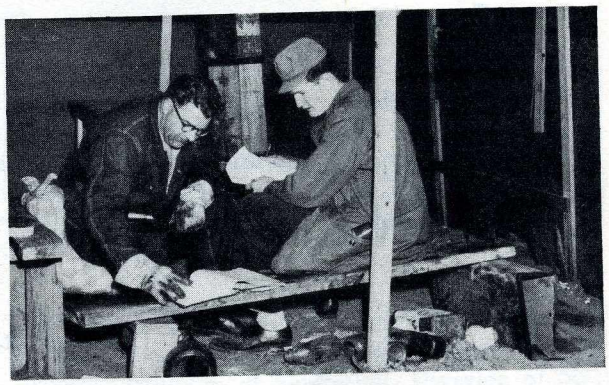
37. Laboratory Diagnosis of Diphtheria – The *in Vitro* Test for Virulence of *C. diphtheriae*.
Sound, color, 7 minutes

38. Diagnosis of Enterobiasis.
Silent, B&W, 40 frames

39. Visual Aids for Teaching Entomology.
Silent, color, 30 frames



The Center produces training aids, including motion picture, filmstrips, and slide series, in response to demonstrated needs. Above: Motion picture equipment on location during the shooting stage of a film for use in training courses on rural rat control. Right: Project supervisor and assistant correlating script and scene sequences during shooting of the same film.



40. Measurement of Serum Total Base – The Sunderman Conductivity Method.
Silent, B&W, 23 frames

41. The Grant-in-Aid Procedures (for PHS Region VI).
Silent, color, 46 frames

42. Insanitary Premises.
Silent, B&W, 100 frames

43. Histopathology of Human Fungus Infections – Part I, Superficial Infections.
Silent, color, 15 frames

44. Histopathology of Human Fungus Infections – Part II, Cutaneous Infections.
Silent, color, 16 frames.

45. Histopathology of Human Fungus Infections – Part III, Subcutaneous Infections.
Silent, color, 17 frames

Slide Series (2 by 2 inches)

1. Mosquitoes of the United States.
Color, 44 slides

2. Preventive Maintenance and Rust Control on CDC Vehicles and Equipment.
B&W, 13 slides

3. Storage and Handling of Food (for Division of Sanitation).
Color, 25 slides

4. Municipal Sewage Treatment – Equipment and Structures.
B&W, 259 slides

5. Municipal Sewage Treatment Equipment and Structures – Part I, for the Imhoff Tank Process.
B&W, 20 slides

6. Municipal Sewage Treatment Equipment and Structures – Part II, for the Primary Treatment Process.
B&W, 19 slides

7. Municipal Sewage Treatment Equipment and Structures – Part III, for the Chemical Precipitation Process.
B&W, 49 slides

8. Municipal Sewage Treatment Equipment and Structures – Part IV, for the Trickling Filter Process.
B&W, 104 slides

9. Municipal Sewage Treatment Equipment and Structures – Part V, for the Activated Sludge Process.
B&W, 41 slides

10. Municipal Sewage Treatment Equipment and Structures – Part VI, for the Vacuum Filtration and Sludge Incineration Process.
B&W, 16 slides

11. Ten-Eighty, A Rat Poison for Professional Use.
B&W, 73 slides

12. Q (Query) Fever.
Color, 75 slides

13. Measurement of Serum Total Base – The Sunderman Conductivity Method.
B&W, 23 slides

14. Quantitative Measurements in Radiological Health.
B&W, 9 slides

15. CDC Activities.
Color, 74 slides

Films, motion pictures, and filmstrips are made available to users through the film library on a short or indefinite loan basis. Figure 24 indicates the type of users served during 1950 and the relative number of loans from the two categories made to each. Table 26 shows total loans, number of showings, and aggregate audience served.

Utilization guides are prepared for each production and a copy provided each user. This has resulted in more effective employment of motion pictures and filmstrips in training operations, and also has enabled the Center to obtain data for determining the quality and usefulness of productions, since the guide includes an evaluation check list which users return to the film library. Utilization of productions is further promoted through the distribution of a film catalog and through listings in various professional and technical publications. A new condensed edition of the film catalog was published during 1950.

Table 26

LOANS, SHOWINGS AND AUDIENCES FOR FISCAL YEAR 1950

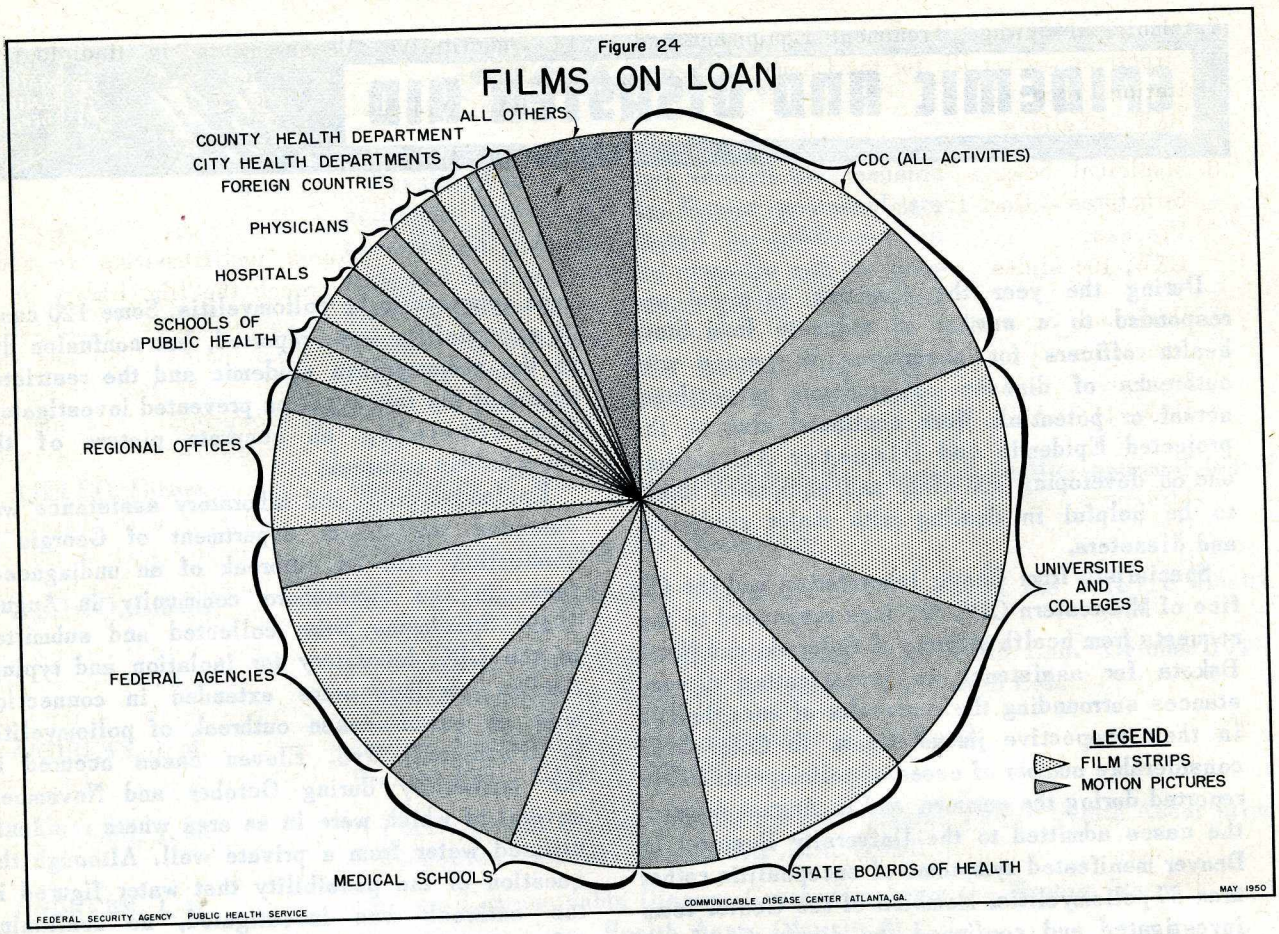
	Short Loans			Indefinite Loans			Totals		
	Loans	Showings	Audience	Loans	Showings	Audience	Loans	Showings	Audience
Motion Picture	1528	2292	80,220	134	914	31,990	1662	3206	112,210
Filmstrip	1464	2635	118,675	633	3386	152,370	2097	6021	271,045
Totals	2992	4927	198,895	767	4300	184,360	3759	9227	383,255

EXTANT INDEFINITE LOANS, AND ESTIMATED FISCAL YEAR 1950 SHOWINGS AND AUDIENCES FROM THESE LOANS

	Extant Loans	Showings	Audience	GRAND TOTALS Loans	Showings	Audience
Motion Picture	2775 X 10	27,750 X 35	971,250	4437	30,956	1,083,460
Filmstrip	3056 X 10	30,560 X 45	1,375,200	5153	36,581	1,646,245
Totals	5,831	58,310	2,346,450	9590	67,537	2,729,705

Totals with respect to short term loans are based on 1.5 showings per loan for motion pictures and 1.8 showings per loan for filmstrips, and audiences of 35 and 45 respectively per showing. Totals for indefinite loans are based on 10 showings per year (borrowers are required to return all films that are not shown at least 10 times per year), and an audience of 35 for motion pictures and 45 for filmstrips per showing.

Figure 24



Fiscal year 1950 was notable for the number of cooperative film projects completed and/or started. Work was performed in one or more phases on cooperative films with the following organizations: Academy of General Practice; Duke University; PHS Regions V, VI, and VIII; Bureau of Medical Services: Division of Hospital Facilities, Division of Nursing Resources, Division of Dental Resources; Bureau of State Services: Division of Chronic Disease, Division of Engineering Resources, Division of Sanitation, Division of State Grants (Calif. Health Department), Division of Venereal Disease; Midwestern CDC Services; National Institutes of Health, Scientific Reports Branch; Social Security Administration; Tennessee Valley Authority; and Department of Army.

EPIDEMIC AND DISASTER AID

During the year the Center received and responded to a number of requests from State health officers for assistance in coping with outbreaks of disease of epidemic proportions, actual or potential. Work continued also on the projected Epidemic and Disaster Aid manual and on developing materials and equipment likely to be helpful in dealing with major epidemics and disasters.

Specialists from Center laboratories and the Office of Midwestern CDC Services responded to the requests from health officers of Colorado and North Dakota for assistance in investigating circumstances surrounding the outbreaks of encephalitis in their respective jurisdictions. In Colorado a considerable number of cases of poliomyelitis were reported during the summer, and in August some of the cases admitted to the University Hospital in Denver manifested symptoms of encephalitis rather than of poliomyelitis. Members of the Center team investigated and confirmed the diagnosis of encephalitis; and by the end of the summer 85 cases had been reported in the eastern plains area of Colorado. In cooperation with State health authorities and others, follow-up studies were conducted. Results of these studies were recorded in confidential summary reports filed in May 1950.

Assistance of CDC was requested in investigating a similar situation in the area around Valley City, N. Dak., in August 1949, and a team from Midwestern CDC Services responded. Here, as in Colorado, a fairly severe epidemic of poliomyelitis occured and local physicians suspected that some of the cases were encephalitis. The diagnosis of clinical encephalitis was confirmed in some cases in the Valley City area although all cases examined in the Bismarck, N. Dak., area appeared to be poliomyelitis. Some 120 cases of encephalitis were reported, but confusion due to the poliomyelitis epidemic and the restricted nature of the investigation prevented investigators from obtaining an accurate picture of the encephalitis outbreak.

Epidemiological and laboratory assistance was extended the health department of Georgia in connection with an outbreak of an undiagnosed fever in the Swainsboro community in August 1949. Specimens were collected and submitted to the CDC laboratory for isolation and typing. Similar services were extended in connection with an out-of-season outbreak of poliomyelitis in Tarrington, Wyo. Eleven cases occured in the community during October and November, several of which were in an area where residents utilized water from a private well. Although the question of the possibility that water figured in the outbreak was investigated, no confirming information was obtained.

In response to request of the health officer of North Carolina, assistance was rendered in investigating an outbreak of influenza in a rural community in the mountains of North Carolina (Hayesville) which affected 35 percent of the population. The existence and severity of the attack rate was confirmed, and several strains of influena A prime virus were isolated from throat swabs and washings. The diagnosis was further confirmed by demonstration of influenza antibody rises in acute and convalescent blood serums.

Appropriate assistance was extended health authorities in dealing with rabies epizootics in Denver, Colo., Charleston, W. Va., and northern Louisiana.

Appendix

Results of investigations, studies, and research activities carried on by Center personnel are recorded in papers prepared for publication in technical and professional journals and for presentation before public health groups and various scientific association.

During fiscal year 1950 the following papers were cleared for publication or presentation:

AJELLO, Libero : The Nature of the So-called Macroconidia Observed on Microsporum-Infected Hairs
*Publication: Investigative Dematology

AJELLO, Libero : The Need for Mycological Diagnostic Services in the Public Health Laboratory
Presentation: Conf. State and Provincial Pub. Health Lab. (October 1949)
*Publication: Bulletin State and Provincial Pub. Health Lab.

ANDREWS, J. M. : Current Status of Malaria Eradication in the South
Presentation: A.P.H.A. (1950)

ANDREWS, J. M. : A Public Health Biology Section for the American Public Health Association
Presentation: Southern Branch A.P.H.A. (1950)

ANDREWS, J. M. : How the Communicable Disease Center Can Serve the Western States
Presentation: Colo. Health Assn. (May 1950)

ANDREWS, J. M. : Sanitarian Relationships in an Expanding Public Health Program
Presentation: Colo. Health Assn. (May 1950)
Publication: Proceedings of Assn.

ANDREWS, J. M. : The Eradication of Malaria in the United States
*Publication: J. Economic Entomology

ANDREWS, J. M. : Advancing Frontiers in Insect Vector Control
Publication: Am. J. Pub. Health 40(4): 409–416 (1950)

ANDREWS, J. M.
Gilberston, W. E. : Final Phases of Malaria Eradication in the United States
Publication: J. Nat. Malaria Soc. 9(1): 5–9 (1950)

BAUM, M. D. : Colorado's Meat Inspection Program
Publication: J. Am. Vet. M. A. 116(876): 176–181 (1950)

BELL, E. J.
Parker, R. R.
Stoenner, H. G. : Experimental Q Fever in Cattle
Publication: Am. J. Pub. Health 39(4): 478–484 (1949)

BELLAMY, R. E. : An Unusual Winter Population of *Anopheles quadrimaculatus* Say
Publication: J. Nat. Malaria Soc. 9(1): 80–83 (1950)

BELLAMY, R. E.
Repass, R. P. : Notes on the Ova of *Anopheles georgianus* King
Publication: J. Nat. Malaria Soc. 9(1): 84–88 (1950)

BRADLEY, G. H.
Lyman, F. E.
: Discussion of Five Years' Use of DDT Residuals Against *Anopheles quadrimaculatus*
Publication: J. Nat. Malaria Soc. 9(2): 113–118 (1950)

BRADLEY, G. H.
Saylor, L. W.
: Malaria Control Through the Use of New Insecticides as Residual Sprays Against Adult Mosquitoes
Publication: Proc. and Papers 17th Ann. Conf. Calif. Mosquito Association 51–53 (1949)

BRADLEY, G. H.
: Book Review: Medical Entomology, 2nd Edition, by Robert Matheson
Publication: Am. J. Trop. Med. 30(4): 595–596 (1950)

BRADLEY, G. H.
: Present Status of the Malaria Eradication Program
Presentation: N. J. Mosq. Extermination Assn. (March 1950)
Publication: Proceedings of Assn. pp 156–162 (1950)

BROOKE, M. M.
: Amabiasis Panel (Dr. Brooke's part)
Publication: Am. J. Trop. Med. 30(2): 863–875 (1950)

BROOKMAN, Bernard
: The Ecology of *Culex* Mosquitoes
Presentation: Calif. Mosquito Control Assn. (1950)
Publication: Proceedings of Meeting

BROOKMAN, Bernard
Reeves, W. C.
: A New Name for a Californian Mosquito (Diptera, Culicidae)
*Publication: Pan-Pacific Entomologist

BRUNER, D. W.
Edwards, P. R.
Kinkaid, A. S.
: The Serological Classification of the Ballerup Group of Paracolon Bacteria
Publication: J. Infect. Dis. 85: 290–294 (1949)

CARROLL, L. D.
: Book Review: Communicable Disease Nursing, 2nd Edition, by Theresa I. Lynch
*Publication: Am. J. Pub. Health

CHAMBERLAIN, R. W.
Sikes, R. K.
: Laboratory Rearing Methods of Three Common Species of Bird Mites
*Publication: J. Parasitology

CHAMBERLAIN, R. W.
: A Safe Way of Handling Mosquitoes for Virus Transmission Experiments
*Publication: J. Parasitology

CLAPP, R. F.
: The Activities of the Public Health Service in Food Handling Training
Presentation: Conf. Sanitarians (August 1949)

COFFEY, J. H.
Maier, P. P.
: Fly Control Techniques
Publication: Am. J. Pub. Health 40(5): 561–566 (1950)

CRAWFORD, J. H.
: Field Training for Sanitarians and Sanitary Engineers
Presentation: Congress of Inter-American Sanitary Engrs. (1950)

DAMON, S. R.
Scruggs, J. H.
: Studies on Brucellosis in Indiana. IV Recovery of *Brucella melitensis* from the Hog
Publication: Pub. Health Rep. 65(11): 374 (1950)

DOUTHIRT, C. H.
Link, V. B.
: Plague - I. Epidemiology
*Publication: J. Am. Med. Assn.

DURHAM, W. F.
Bloom, W. L.
Lewis, George T.
Mandel, E. E.
: Rapid Measurement of Carbohydrate in Blood — Preliminary Report
Publication: Public Health Rep. 65(20): 670–674 (1950)

ECKE, DEAN H.
Johnson, Clifford W.
: Sylvatic Plague in Park County, Colo.
Presentation: North American Wildlife Conference, San Francisco (1950)
Publication: Conference Proceedings

EDWARDS, P. R.
West, M. G.
: A New *Salmonella* Type: *Salmonella duval*
Publication: Pub. Health Rep. 65(26): 839 (1950)

EDWARDS, P. R.
: Unusual Antigenic Variations in an Enteric Bacterium
*Publication: Proc. Soc. Experimental Biol. and Med. (1950)

EDWARDS, P. R.
: Unusual Types of Enteric Bacteria
Publication: J. Infect. Dis. 87: 184–188 (Sept.-Oct. 1950)

EDWARDS, P. R.
Hermann, G. J.
: Two New *Salmonella* Types, *S. corvallis* and *S. colorado*
Publication: J. Bact. 58(I): 111–112 (1950)

EDWARDS, P. R.
Hermann, G. J.
: A New *Salmonella* Type, *Salmonella allandale*
Publication: Pub. Health Rep. 65(16): 547 (1950)

EDWARDS, P. R.
Barnes, L. A.
Babcock, M. C.
: The Natural Occurence of Phase 2 *Salmonella paratyphi A*
Publication: J. Bact. 59(1): 135–136 (1950)

EMMONS, C. W.
Morlan, H. B.
Hill, E. L.
: Histoplasmosis in Rats and Skunks in Georgia
Publication: Pub. Health Rep. 64: 1423–1430 (1950)

EWING, W. H.
: *Shigella* Grouping Antiserums
Publication: J. Lab. and Clin. Med. 36(3): 471-472 (1950)

EWING, W. H.
Hucks, M. C.
: Two Intermediate Members of Enterobacteriaceae
Publication: J. Bacteriology 60(3): 367–368 (1950)

FAY, R. W.
: The Toxicological Aspect of the Selection or Induction of DDT Resistance
Presentation: Ent. Soc. (December 1949)

FELLTON, H. L.
Barnes, R. C.
Wilson, C. A.
: New Distribution Records of the Mosquitoes of New England
Publication: Mosquito News 10(2): 84–91 (1950)

FREEBORN, S. B.
: Anophelines of the Nearctic Region
Publication: Malariology (Edited by Boyd), 379–398 (1950)

FROHNE, W. C.
Weathersbee, A. A.
Williams, G. M.
Hart, J. W.
: Observations on the Persistence of *Plasmodium* Infections in *Anopheles* Mosquitoes in an Area of Low Observed Human Malaria Parasitemia in South Carolina
Presentation: Nat. Malaria Soc. (1949)

GAINES, T. B.
Sumerford, W. T.
Hayes, W. J., Jr.
: The Nontoxicity of Urine from Rats Poisoned with 1080
Publication: Pests and Their Control (June 1950)

GALTON, M. M.
Hardy, A. V.
Mitchell, R. B.
: The Public Health Laboratory Diagnosis of Enteric Infections
Publication: Am. J. Trop. Med. 30(1): 77–90 (1950)

GILBERTSON, W. E.
: Sharpening the Focus of Sanitation Measures
Publication: Lancet (Issued by Dakota-Minnesota Medical Association)

GOLDMAN, Morris
: Iron Alum-Picric Acid-Hematoxylin, a Progressive Sequence Stain for Tissues
*Publication: Stain Technology

GOLDMAN, Morris
: An Iron Alum-Picric Acid-Hematoxylin Stain for Parasites in Tissues
Publication: J. Parasitology 35(6): 36 (1949)

GOLDMAN, Morris
Johnson, S. A.
: A Deep-Freeze Preservation of Stool Specimens Containing Intestinal Parasites
Publication: J. Parasitology 36(1): (1950)

GOODWIN, M. H., Jr.
: Observations on the Recession of Malaria in an Area of Southwestern Georgia
*Publication: J. Nat. Malaria Soc. or J. Trop. Med.

GOODWIN, M. H., Jr.
: Observation on Saurian Malaria in Southwestern Georgia
Presentation: Nat. Malaria Soc. (November 1949)

GOODWIN, M. H., Jr.
Bellamy, R. E.
: Factors Influencing Variations in Populations of *Anopheles quadrimaculatus* Say
Presentation: Nat. Malaria Soc. (November 1949)

GORDON, M. A.
: Rapid Permanent Staining and Mounting of Skin Scrapings and Hair
*Publication: J. Investigative Dermatology

HALL, L. B.
: Malaria Control Program for Iran
Publication: (Resume by Miriam Ziony) Pub. Health Rep. 65(11): 351–367 (1950)

HAYES, W. J., Jr.
Gaines, T. B.
: Control of Norway Rats with the Residual Rodenticide Warfarin
*Publication: J. Trop. Med. or Wildlife Management

HENDRICKS, E. L.
Goodwin ,M. H., Jr.
: Observations on Factors Influencing Water Levels in Ponds in Limestone Sinks in Southwestern Georgia, with Particular Reference to Breeding Places of *Anopheles quadrimaculatus* Say
*Publication: U. S. Geological Survey

HESS, A. D.
: Some Recent Developments in the Control of Animal Reservoirs and Vectors of Disease
Publication: Tenn. Pub. Health Workers Assn. (1950)

HOWITT, B. F.
: Isolation and Differentiation of Coxsackie Group of Viruses
Publication: Federation Proc. 9(3): 574–580 (1950)

HOWITT, B. F.
: A Nonspecific Heat-Labile Factor in the Serum Neutralization test for Newcastle Disease Virus
Publication: J. Immunology 64(2): 73–84 (1950)

HOWITT, B. F.
: Recovery of the Coxsackie Group of Viruses from Human Sources
Publication Proc. Soc. Exp. Biol. & Med. 73: 443–448 (1950)

HOWITT, B. F. : Isolation and Differentiation of the Coxsackie Group of Viruses
Presentation: American Soc. Immunology (April 1950)

HOWITT, B. F.
Benefield, U. R. : Use of Complement Fixation in the Differentiation of Strains of Coxsackie Virus
Publication: Proc. Soc. Exp. Biol. & Med. 73: 90–92 (1950)

JEFFERY, G. M. : Incidence of *Enterobius vermicularis* in Puerto Rican Children, with Comparison of Diagnostic Methods
Publication: J. Parasitology 36(5): 485–488 (1950)

JOHNSON, P. T.
Thurman, E. B. : The Occurrence of *Aedes* (*Ochlerotatus*) *pullatus* (*Coquillet*), 1904 in California
*Publication: Pan-Pacific Entomology

KING, Elizabeth O.
Frobisher, Martin, Jr.
Parsons, Elizabeth I. : Further Studies on the *In Vitro* Test for Virulence of *Corynebacterium diphtheriae*
Publication: Am. J. Pub. Health 40(6): 704–707 (1950)

KISSLING, R. E.
Rubin, Harry : Pathology of Eastern Equine Encephalomyelitis
*Publication: Am. J. Vet. Research

LINK, Vernon B. : Psittacosis
Presentation: Conf. on Diseases of Nature Communicable to Man, Berkley, Calif. (1949)

LINK, Vernon B. : A History of Plague in the United States of America
*Publication: Public Health Bulletin

LINK, Vernon B. : Plague in North America
Presentation: Annual Meeting U. S. Mexican Border Public Health Assn. (April 1950)

LINK, Vernon B. : Plague Epizootic in Cottontail Rabbits
Publication: Pub. Health Rep. 65(21): 696 (1950)

LINK, Vernon B. : Plague in the United States
Presentation: Western Br. A.P.H.A. (May 1950)
Publication: Proceedings of Assn.

LITTIG, Kent S. : Wood Decay in the House
Publication: Orkin Technical Dept. Bulletin 50 (1950)

MALDONADO, J. F.
Acosta-Matienzo, J.
Velez-Herrera, Freddy : Biological Studies on the Miracidium of *Schistosoma mansoni*. Part III-The Role of Light and Temperature in Hatching
*Publication: Puerto Rico J. Pub. Health & Trop. Med.

MANDEL, E. E.
Owings, R. H. : Quick Blood Sugar Method Suitable for Routine Use and Screening
Publication: Federation Proc. 9(1): 198 (1950)

MANDEL, E. E.
Lehman, E. B. : Simple Test for the Approximate Estimation of Blood Creatinine and Glucose in One Procedure
Publication: J. Lab. & Clin. Med. 34: 720–724 (1949)

MANDEL, E. E.
Paris, D. A. : Evaluation of the Flocculation Test with Hayem's Solution
Publication: J. Lab. & Clin. Med. 34: 653 (1949)

MANDEL, E. E.
Lehman, E. B.
Paris, D. A.
: Simple Blood Tests Available to the General Practitioner
Publication: Clin. Symposia 2(3): 91–99 (1950)

MATHIS, W. V.
Quarterman, K. D.
: Field Investigations on the Use of Heavy Dosages of Several Chlorinated Hydrocarbons as Mosquito Larvicides
Presentation: Nat. Malaria Soc. (November 1949)

MATHIS, W. V.
Ferguson, F. F.
Upholt, W. M.
Quarterman, K. D.
: The Relative Effectiveness of DDT and DDD as Anopheline Mosquito Larvicides Under Field Conditions
Publication: J. Nat. Malaria Soc. 9(1): 95–98 (1950)

MENGES, R. W.
Furcolow, M. L.
Rue, J. S.
: Experimental Histoplasmosis in Dogs; Nonfatal Case
Publication: Pub. Health Rep. 65(19): 628–631 (1950)

MENGES, R. W.
: Meat Inspection–Past, Present, and Future
*Publication: Modern Sanitation

MILES, V. I.
: Insect Ectoparasites and Disease
Publication: Proc. North Central States Br. A.A.E.E.

MILLER, S. E.
: New Concepts in Laboratory Diagnostic Medicine
Presentation: Western Br. A.P.H.A. (June 1949)
Publication: Proceedings of Meeting

MORLAN, H. B.
Hill, E. L.
Schubert, J. H.
: Serological Survey for Murine Typhus Infection in Southwestern Georgia Animals
Publications: Pub. Health Rep. 65(2): 57–63 (1950)

McNEEL, T. E.
: Interest in Fly Control in Southwestern States
Presentation: Southern Br. A.P.H.A.
Publication: Proceedings of Meeting (1950)

McNEEL, T. E.
: The Newer Insecticides and Rodenticides and Their Use
Presentation: Food and Drug Assn. Meeting, Texas
Publication: Bulletin of Food and Drug Assn. U. S. Vol. XIV, No. 4 (1950)

NELSON, F. W.
: Dental Service at CDC
*Publication: Div. Dental Resources Newsletter

NICHOLSON, H. P.
Vetter, M. H.
: A Lethal Trap for Capturing Small Mammals with Their Ectoparasites
Publication: J. Parasitol. 36(3): 235–237 (1950)

NICHOLSON, H. P.
Mickel, C. E.
: The Simuliidae of Minnesota with Reference to the Taxonomy and Biologies
*Publication: Technical Bull. of Univ. Minnesota

PAL, Rajindar
McCauley, R. H., Jr.
: The Relationship Between the Physical Forms of DDT and Biological Effectiveness on Water Surfaces
Presentation: Nat. Malaria Soc. (1949)

PAFFENBARGER, R. S., Jr.
: Tick Paralysis: Implicating *Amblyomma maculatum*
*Publication: New Orleans Med. and Surgical J.

'ARKER, R. R.
Bell, E. J.
Stoenner, H. G.
: Q Fever— A Brief Survey of the Problem
Publication: J. Am. Vet. M. A. 114(863): 55–60 (1949)

'ARSONS, E. I.
Frobisher, Martin, Jr.
: Studies of the Somatic Antigens of *C. Diphtheriae*
Publication: Am. J. Hyg. 52(2): 247–250 (1950)

PARSONS, E. I.
Frobisher, Martin, Jr.
: Studies of Type-Specific Immunization with Somatic Antigens of *C. Diphtheriae*
Publication: Am. J. Hyg. 52(2): 239–246 (1950)

PRATT, H. D.
Lane, J. E.
: Rediscovery of *Tarsopsylla coloradensis* (Baker) in Colorado (Siphonaptera Dolichopsyllidae)
Publication: Proc. Ent. Soc. 52(6): 305–307 (1950)

PRATT, H. D.
: Notes on *Anopheles earlei* and Other Species of the *Anophe les maculipennis* complex
Presentation: Nat. Malaria Soc. (November 1949)
*Publication: J. Nat. Malaria Soc.

PRICE, E. R.
: Encephalitis as a Public Health Problem
Publication: Am. J. Vet. M.A. 116(876): 182–186 (1950)

PRINCE, F. M.
Stark, H. E.
: Three New Fleas of the Genus *Dactylopsylla* Jordan 1949 (*Siphonaptera*)
*Publication: Pan-Pacific Entomologist

QUARTERMAN, K. D.
Hess, A. D.
: Current Investigations on Mosquito Control
Presentation: Florida Anti-Mosquito Assn. (1950)
Publication: Proceedings of Assn.

QUARTERMAN, K. D.
: Field Studies on the Control of DDT-Resistant House Flies
Presentation: Am. Soc. Trop. Med.
*Publication: Am. J. Trop. Med.

QUARTERMAN, K. D.
Jensen, J. A.
: The Outdoor Residual Effectiveness of Several Insecticides
Presentation: A.A.E.E. (December 1949)

QUARTERMAN, K. D.
Parkhurst, J. P.
Dunn, W. J.
: The Use of DDT in Control Programs Against the Stable Fly or Dog Fly in Northwest Fla.
Presentation: Fla. Anti-Mosquito Assn. (April 1949)
*Publication: J. Economic Ent.

RECTOR, Nelson H.
: Laws and Statutes with Reference to Insect Control
Presentation: Va. Mosq. Control Assn. (Feb. 1950)

ROBINSON, J. H.
Cummings, M. M.
Patnode, R. A.
: Comparison of Two Solid Media For Testing Sensitivity of Streptomycin
Publication: Am. Rev. Tuberculosis 62(5): 484–490 (1950)

ROWE, J. A.
: Entomological Aspects of Public Health Problems
Presentation: North Central States Br. A.A.E.E. (1950)
Publication: Proceedings

SCHOOF, H. F.
: Community Fly Control
Presentation: North Central States Br. A.A.E.E.
Publication: Proceedings (1950)

SCHOOF, H. F. : Insects and Poliomyelitis
Presentation: North Central States Br. A.A.E.E.
Publication: Proceedings (1950)

SCHUBERT, J. H. : A Study of Certain Factors Affecting the Agglutination Test for Brucellosis
Publication: Pub. Health Rep. 65(28): 883–890 (1950)

SCUDDER, H. I.
Tarzwell, C. M. : The Effects of DDT Mosquito Larviciding on Wildlife...Routine Larviciding by Airplane.
Publication: Pub. Health Rep. 65(3): 71–87 (1950)

SERFLING, R. E. : Quantitative Estimations of Plankton from Small Samples of Sedgewick-Rafter-Cell Mounts of Concentrate Samples
Publication: Tr. Am. Microscopical Soc. 68(3): 185–199 (1949)

SIMMONS, S. W. : Some Current Developments in the Use of Economic Poisons
Presentation: Southern Br. A.P.H.A., Birmingham, (1950)

SIMMONS, S. W. : Resume of Recent Developments on Insecticides and Rodenticides at U. S. Public Health Service Laboratories, Savannah, Ga.
Presentation: Nat. Agric. Chem. Assn. (September 1949)

SIMMONS, S. W. : The Resistance of Flies to DDT
Presentation: A.A.E.E. (December 1949)
Publication: Proceedings

SIMMONS, S. W.
Upholt, W. M. : Resume of Disease Control by Insecticides
Presentation: Am. Soc. Trop. Med. (November 1949)
*Publication: Am. J. Trop. Med.

SOOTER, C. A. : Insects and Encephalitis
Presentation: North Central States Br. A.A.E.E.
Publication: Proceedings (1959)

STEELE, J. H. : The Role of Veterinary Public Health in Control of Communicable Diseases of Man
Publication: J. Am. Vet. M.A. 116(875): 83–85 (1950)

STEELE, J. H. : Human Health Hazards from Animal Diseases
Presentation: Conf. Veterinarians, Univ. Wisconsin (1950)

STEELE, J. H. : World Scope of Veterinary Medicine
Presentation: Conf. Veterinarians, Univ. Wisconsin (1950)

STEELE, J. H. : Tropical Veterinary Public Health
Presentation: A.V.M.A. (August 1950)

TARZWELL, C. M. : Effects of DDT Mosquito Larviciding on Wildlife. V. Effects on Fish of Routine Manual and Airplane Application of DDT and other Mosquito Larvicides
Publication: Pub. Health Rep. 65(8): 231–235 (1950)

TETZLAFF, Frank : Insect Vector Control Activities of U. S. Public Health Service
Presentation: A.P.H.A. (October 1949)
*Publication: J. Inter-American A. Engr.

THOMPSON, G. A. : Anopheline Threshold of Malaria Transmission Noted in Jamaica
Publication: Pub. Health Rep. 65(21): 692–695 (1950)

THURMAN, Deed C., Jr.
Mortenson, Earl W. : Studies of the Biology of *Aedes* Mosquitoes in Irrigated Pastures in California During 1949

Presentation: California Mosquito Control Assn. (1950)
Publication: Proceedings of Assn.

THURMAN, E. B.
Johnson, P. T.
: The Taxonomic Characters of the Larvae of the Genus *Culiseta* Felt, 1904 in California (Diptera, Culicidae)
*Publication: Pan-Pacific Entomologist

THURMAN, E. B.
Peters, R. F.
: The Ecology of *Aedes* Mosquitoes in California
Presentation: California Mosquito Control Assn.
Publication: Proceedings of Assn.

TIERKEL, E. S.
Graves, L. M.
Tuggle, H. G.
Wadley, S. L.
: Effective Control of an Outbreak of Rabies in Memphis and Shelby County, Tennessee
Presentation: A.P.H.A. (October 1949)
*Publication: Am. J. Pub. Health

TIFFANY, E. J.
: Opportunities for Staff Training During Laboratory Program Reviews
Presentation: A.P.H.A. (October 1949)
*Publication: Bulletin of Conf. of Lab. Directors

TISDALE, E. S.
Crawford, J. H.
: Field Training of Sanitary Engineers and Sanitarians
Presentation: State Sanitary Engineers Conf., Washington, (May 1950)

TISDALE, E. S.
: Supplementary Training of Sanitary Engineers for Public Health Career
Presentation: Am. Soc. Engineering Education, Seattle
Publication: Bulletin of Am. Soc. Engr. Ed. Vol. 116, No. 1 (1950)

TISHIP, Victor
Rector, N. H.
: Cost Accounting of Malaria Control
Publication: Malariology (Edited by Boyd) Vol. II, Chapter 58, 1277–1281 (1949)

WATT, James
: Fly Control and the Acute Diarrheal Diseases
Publication: Bull. of Pan-American San. Bureau, 249–258 (March 1949)

WATT, James
Walton, Mary
: Relative Familial Attack Rates as a Measure of the Pathogenicity of an Organism
Publication: Am. J. Hyg. 50: 263–269 (1949)

WATT, James
DeCapito, Thelma
Hermann, G. J.
Edwards, P. R.
: Two New *Salmonella* Types: *Salmonella donna* and *Salmonella pharr* with a Reference to New Types found in Hidalgo County, Texas
Publication: Pub. Health Rep. 65(7): 214–216 (1950)

WEST, Mary G.
: Differentiation of Paracolon Bacteria
*Publication: Am. J. Pub. Health

*Submitted to indicated publication; confirmation data (reprint) unreceived January 1951

☆ U. S. GOVERNMENT PRINTING OFFICE : O—1951