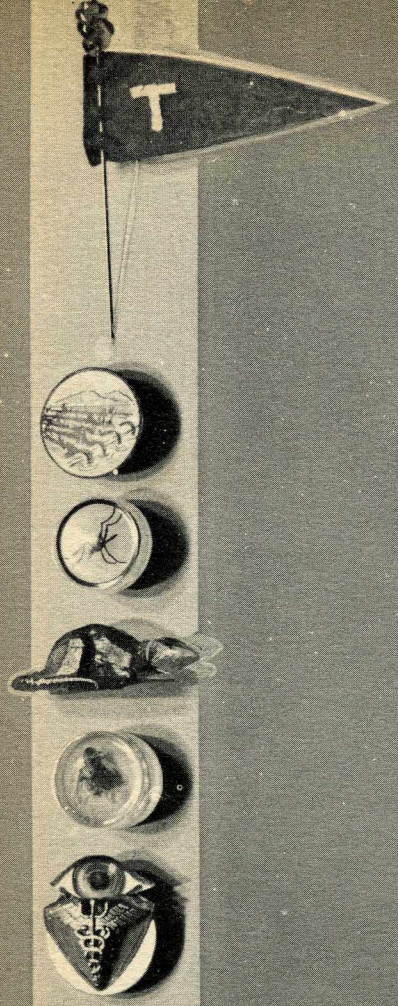

FEDERAL SECURITY AGENCY ■ PUBLIC HEALTH SERVICE

CDC ACTIVITIES 1950-1951

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

CDC ACTIVITIES 1950-1951

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FOREWORD

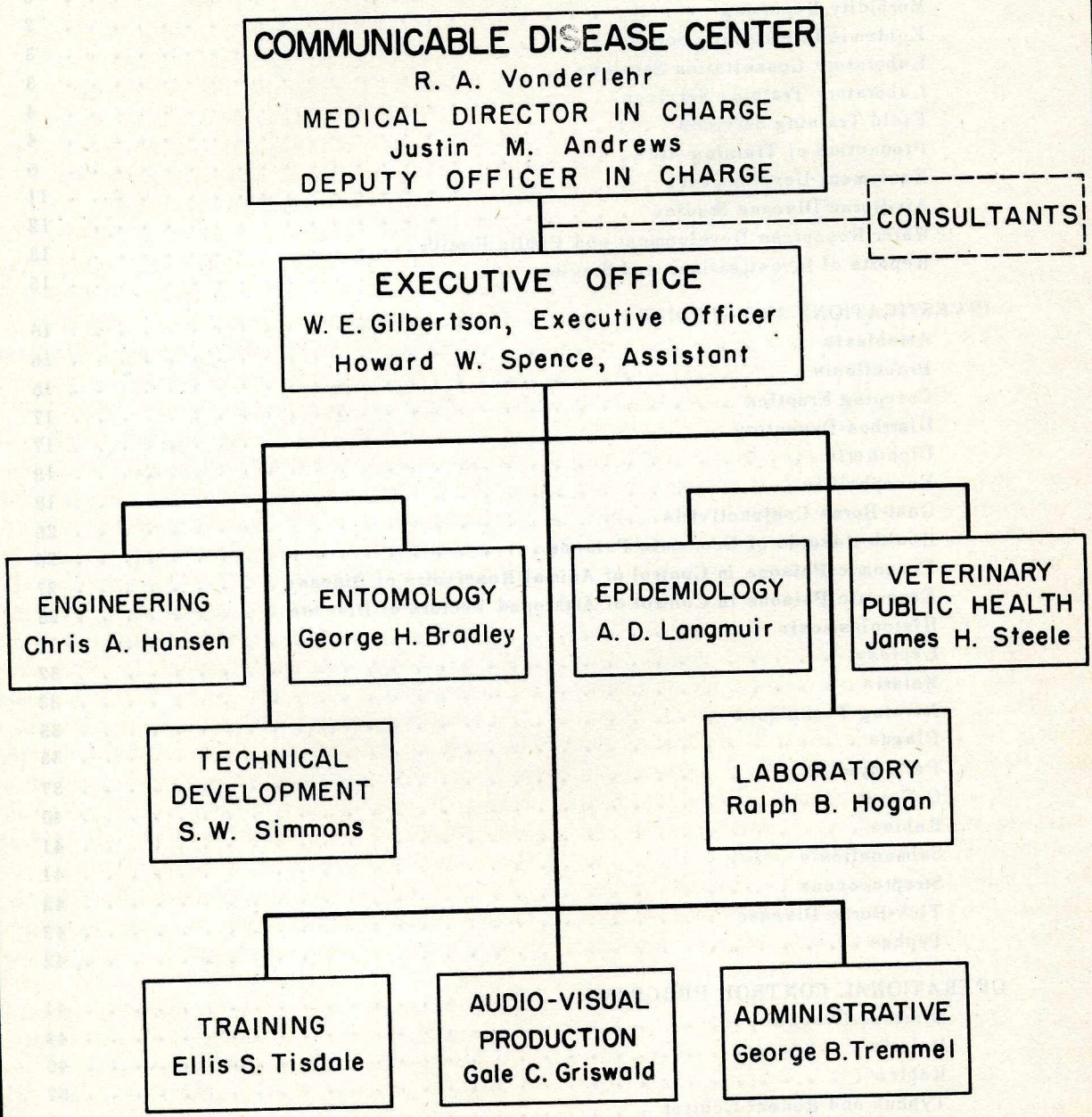
Activities summarized in this report represent undertakings and accomplishments by the combined staff of the Communicable Disease Center in the interdependent pursuit of an integrated program encompassing the several aspects of communicable disease control and prevention. Many of the projects were carried on in cooperation with other agencies. In some the Center was principal sponsor and in others the Center's contribution was relatively minor. It is probable that in some instances allocation of credit has overemphasized the role of the Center and depreciated that of coparticipants, and vice versa.

As a presentation expedient, activities recorded have been grouped under four major headings: (1) General Activities; (2) Investigations and Studies; (3) Operational Control Programs; and (4) Epidemic and Disaster Aid. This is not a precise grouping, nor is the list of items under the respective headings intended as a complete catalog of activities pursued during the report period. Rather, the purpose is to indicate in general terms something of the interrelationships, comprehensiveness, relative nature, and application of various activities carried on in different areas of public health work.

CONTENTS

FIGURE I

HEADQUARTERS ORGANIZATION



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

INTRODUCTION

The Communicable Disease Center is a component of the U. S. Public Health Service charged with the responsibility of assisting States, when requested, in the diagnosis, prevention, and control of communicable diseases. Organizationally it is a Division of the Bureau of State Services with headquarters and major facilities in Atlanta, Ga. Specialized installations are located in various parts of the United States including: Savannah, Ga.; Montgomery, Ala.; Kansas City, Kans.; San Francisco, Calif.; Thomasville, Ga.; Pharr, Tex.; Wenatchee, Wash.; Phoenix, Ariz.; Newton, Ga.; Manning, S. C.; Charleston, W. Va.; and other places. Field training centers, operated by the Communicable Disease Center in cooperation with States and/or educational institutions, are located in Amherst, Mass.; Bloomington, Ill.; Buffalo, N. Y.; Columbus, Ga.; Denver, Colo.; Pittsburgh, Pa.; Syracuse, N. Y. (hygiene of housing); and Topeka, Kans. Diarrhea and dysentery control demonstration projects, sponsored by the Center, were operated during 1951 in selected cities of Arizona, Kentucky, New Mexico, and Texas. In addition, as circumstances required and resources permitted, Center specialists were loaned to State health departments to reinforce their programs in relation to communicable disease control problems. Also the Center cooperated with the National Institutes of Health and other Divisions of the Public Health Service, educational institutions, foundations, and other agencies, Federal and non-Federal, in studies and investigations pertaining to various problems of public health.

As indicated in figure 1, the Center headquarters organizational structure is aligned somewhat with professional disciplines. However, in practice emphasis is on teamwork and neither professional nor administrative lines are sacrosanct. The Center maintains specialists and their satellite technicians in various fields of medicine, veterinary medicine, nursing, engineering, biology, and field training which are organized into integrated teams under a single organizational unit. These teams are utilized in: (1) making field investigations concerning the transmission and prevention of communicable diseases; (2) converting scientific observations and accumulated data into practices which can be applied in the diagnosis, control, and prevention of diseases of particular concern to the Center; (3) testing these practices in the laboratory and in the field under conditions of increasing diversity until their usefulness is established; (4) promoting the utilization of these practices by State and local health departments through demonstrations, training courses to indoctrinate State and local personnel in their application, and by loaning trained personnel to States to supervise the inauguration of State programs; (5) providing epidemic and disaster aid, when requested; and (6) enforcing the medical aspects of interstate quarantine regulations.

Center activities, whether they are operational control programs designed to bolster the capacity of States to deal with particular problems or investigative studies to develop new information, are geared to the concept that the over-all mission of the Center is to help the States increase their competencies in public health matters, particularly in communicable disease control. Thus, in the earlier years of its history, the Center expended a major portion of its resources, manpower, and technological capacity assisting States in combating malaria and murine typhus by supporting, with trained personnel and funds, operational control programs directed against these two diseases. Through an integrated program of field training and applied research, and the development of improved methods and techniques, a relatively high degree of competence has been attained in these areas and the need for Center participation in control operations has diminished. Accordingly, there has been a reorientation of Center activities toward more emphasis on applied research, laboratory and field, and less on actual control operations. During the past year, for example, epidemiological, laboratory, and training activities consumed a proportionally larger share of the Center's total effort. This trend is in keeping with the principle that the preferred function of the Center is to help the States develop and expand their competencies to deal with communicable disease problems to the point where they can proceed on their own, relying upon the Center for general consultation services, specialized

guidance, and support in coping with unusual outbreaks and major disasters. Adherence to this principle in the future is contingent upon such variable factors as the elusiveness of disease and the outcome of continued search for new control weapons, methods, and techniques.

During the past year the staff of the Center approximated 1,400, including 230 commissioned officers.* Insofar as applicable laws, regulations, and procedures permit, the complex, diverse, and detailed procedures associated with the management of such a staff are coordinated by an administrative staff under a single director. This concept not only relieves professional personnel of considerable time-consuming detail, but it also enables the administrative officer to improve management by modifying and reorienting procedures in keeping with changes in activities, and in accordance with higher echelon policy directives. This year, for example, reorganization of Center operational control program activities entailed the discontinuance of malaria control assistance in six States and the consequent redeployment of personnel and equipment. This was accomplished with a minimum of confusion and considerable economic gain by reason of the integration of administrative and management services at headquarters. Likewise this administrative approach facilitates the incorporation of uniform practices, economies in procurement, property inventory, and the integration of new laws and regulations such as the 1951 Civil Service changes.

In the implementation of a broad program of assistance to the States, and in pursuing applied research, in the laboratory and in the field, the Center maintains liaison with FSA Regional Offices (usually through the Center representative stationed at the Regional Office) and collaborates with other components of the Public Health Service in studies and investigations of common interest. There is a continuous interchange of information between operational and investigational personnel and frequently the former inspires the latter, namely, problems encountered in operational programs are made the subject of investigations. Likewise, findings resulting from investigations are tested in operational programs. Thus, the concept of teams of specialists is employed in a dual manner, by bringing the combined skills of different specialists to bear on particular problems and also by combining the findings of operational and investigational personnel.

*Regular corps, 80; reserve, 150.

GENERAL ACTIVITIES

Although Center projects and activities are interdependent and directed toward the common objective of helping States to do a better job of communicable disease prevention and control, some deal with general and others with specific disease control problems. The former encompass morbidity reporting, epidemic intelligence services, laboratory consultation services, laboratory training services, field training services, production of training aids, equipment development, air-borne disease studies, and water resources development and public health studies.

MORBIDITY REPORTING

Reasonably accurate and current knowledge of when, where, and under what conditions cases are occurring is prerequisite to the intelligent planning and execution of communicable disease control programs. Hence, all efforts to improve morbidity reporting are of immediate and continuing interest to Center personnel.

During 1951, the Center participated in the cooperative morbidity study initiated by the Conference of State and Territorial Officers (1949). This Conference recommended: (1) that the Public Health Service and the American Public Health Association study the diseases reportable at that time in the various States and Territories, and make recommendations concerning additions and deletions; and (2) that the Public Health Service survey morbidity requirements for all notifiable diseases

and recommend advisable changes. Center personnel served on the committee designated to make the survey on behalf of the Public Health Service, and in April 1950 the Center cooperated with the Association of State Epidemiologists in sponsoring a conference to explore the problems of morbidity reporting. This conference was held in Atlanta, Ga., and primarily was concerned with an examination of the proposed changes in communicable disease reporting recommended in a preliminary report* of the Public Health Service committee. Out of the Atlanta conference emerged recommendations which were formulated into a formal report for submission to the American Public Health Association and the Conference of State and Territorial Health Officers. Both agencies approved the report of the Atlanta conference** and effective January 1, 1952, States and Territories activated the new reporting system.

It is believed that the new formula constitutes a step toward more useful reports on the incidence of communicable diseases throughout the country and that more timely data concerning the occurrence of epidemic outbreaks will thereby be provided. It is recognized that the adopted revisions are only a beginning and do not represent a completed task, particularly with respect to usability of morbidity reports at State and local levels. Further study is needed in this area, and the Center's facilities are available for that purpose.

EPIDEMIC INTELLIGENCE SERVICE

Confronted with an increasing volume of requests for assistance in investigations pertaining to epidemics, and recognizing the need for an adequate corps of trained epidemiologists available for any contingency, including biological warfare defense, the Center initiated steps to bring into being an epidemic intelligence service. Some 21 medical officers, carefully selected for the purpose, were assembled in Atlanta for an 8-weeks period of orientation and intensive training in epidemiology, biostatistics, and public health procedures as applied to communicable disease detection and control. The training, conducted by outstanding specialists, was designed to equip the newly recruited medical officers to serve as epidemic intelligence officers in the field.

*CDC Bulletin X(2): 4-12 (1951)

**CDC Bulletin X(12): 50-53 (1951); Pub. Health Rep. 67(1): 21-25 (1952)

Upon completion of the formalized training the officers were assigned to public health agencies, Federal and State, selected on the basis of facilities for providing them supervised field training in the application of epidemiologic skills and techniques to communicable disease detection and control.

Duties of the officers in the field are: (1) to assist State and local epidemiologists in the investigation of all types of epidemics and outbreaks as opportunity arises; (2) to investigate individual cases of significant communicable diseases, especially those of importance in interstate quarantine; (3) to act, when designated, as agents of the Public Health Service in the enforcement of interstate quarantine regulations; (4) to participate in the development and promotion of sound programs of communicable disease control; (5) to serve in a liaison capacity between official health agencies and the nonofficial laboratories of the Sectional Research program of the National Microbiological Institute; (6) to serve as auditors or junior consultants to biological warfare defense committees of States and strategic centers within their areas of assignment; and (7) to be on call, upon request, for epidemic aid anywhere in the country.

The object of this program is to provide a nucleus of professional personnel trained in the methods and techniques of field epidemiology who can be employed immediately in event of enemy action involving biological warfare and who, at the same time, are available to alleviate the shortage of this type of personnel that many times handicaps peacetime programs. From time to time the officers will be recalled from field assignments for further training, evaluation of accomplishments, and intragroup exchange of experiences.

LABORATORY CONSULTATION SERVICES

Guidance and assistance in the development of a high level of competence in public health laboratory performance is offered by the Center through a system of program reviews of State laboratories, and special surveys of local public health laboratory installations. Usually these services are provided in collaboration with FSA Regional Offices and upon the request of the State health departments involved. The objective is not so much to foster standardization as it is to make available

to the State laboratories the combined competencies and experience of Center laboratory specialists, thereby contributing to the increased proficiency of laboratorians at the State level, particularly in the area of communicable diseases.

During 1951, program reviews were accomplished of State laboratories in 26 States, and surveys were conducted of the Louisville-Jefferson County (Ky.) Laboratory; the Kiowa Indian Hospital Laboratory, Lawton, Okla.; 7 laboratories in Cincinnati and Dayton, Ohio; the Kentucky State Department of Health Laboratory, and the New York City Bureau of Laboratories. A program review also was accomplished of Center laboratories at Chamblee, Ga., and Montgomery, Ala. The latter program review was by consultants from outside the Center.

Through an arrangement with the Environmental Health Center, Cincinnati, Ohio, the sanitation laboratory phase of program reviews accomplished during 1951 was conducted by specialists from that agency. This innovation proved helpful in the effort to integrate Center program reviews with the activities of other units of State health departments, and it is being extended.

Center laboratories also render consultation-type services, such as reference diagnosis, aid in investigations of epidemics, and assistance in dealing with unusual laboratory problems. These activities are reported in other sections of this summary.

LABORATORY TRAINING SERVICES

The effectiveness of public health laboratories, particularly in communicable disease control, depends in large measure on the competence of laboratory personnel. In many instances, satisfactory performance requires specialized training and periodic refresher-type training. The Center strives to assist States develop, maintain, and increase the general effectiveness of their laboratory personnel by offering regularly scheduled training courses in laboratory diagnostic methods and techniques. The courses are conducted by the combined staff of Center laboratories and are patterned to meet the needs of persons employed in State and local health department laboratories.

The type and scope of courses offered during 1951 and the distribution of trainees enrolled are shown in table 1. One or more students from all States except Colorado, Nevada, New Hampshire, Oklahoma, Oregon, Rhode Island, and Vermont attended Center-sponsored courses during the year. In enrollment, preference is given to persons employed in State and local health department laboratories, but, as table 1 indicates, enrollees from Federal agencies, hospitals, and universities are accepted.

In addition to scheduled courses (table 1), refresher-type courses were conducted in Kansas, Missouri, and Ohio; and special lectures were presented in Alabama, Georgia, Louisiana, Texas, and Virginia.

Supplementing organized training courses, Center laboratories operate an extension service which is widely used. During 1951, 1,736 requests for material were received and processed. Items distributed included reference diagnostic charts, manuals, reprints of reference materials, and letters of instruction. Recipients represented 48 States, the Territories, Australia, Brazil, Canada, Cuba, England, Greece, Japan, Madras, Mexico, Peru, and the Philippines.

FIELD TRAINING SERVICES

Throughout its existence, the Center has cooperated with States in the development of effective field training for all types of public health workers, particularly in such areas as environmental sanitation, food sanitation, housing sanitation, and the control of insects and animals which transmit or harbor disease. During 1951, in collaboration with State and local health departments, educational institutions, and other agencies, the Center supported a comprehensive field training program encompassing the major public health disciplines.

Regularly scheduled courses were offered at Atlanta and at established regional training centers. Through these courses, training opportunities patterned to fit the needs of trainees and based on the principle of "learning by doing," were made available to some 700 public health workers – sanitary engineers, sanitarians, record analysts, health educators, public health physicians, and other disciplines. Another 800 were enrolled in a series of courses conducted on a decentralized basis, namely, at locations selected to suit the convenience of trainees involved and on the basis of available facilities. Trainees represented all sections of the United States and 36 foreign countries. In general, regularly scheduled courses were more comprehensive and basic in content while decentralized courses were of the

refresher type and extended over a shorter period of time. As in previous years, field training activities were directed toward the objective of improving existing training methods and techniques and developing new ones where required.

This broad program of assisting States to develop and maintain a corps of trained public health workers through field training was implemented through: (1) the operation of regional training centers, usually in cooperation with State health departments and/or schools of public health; (2) the assignment of training specialists to State health departments to promote and help operate State training programs; (3) the loan of training officer teams from Atlanta to regional and State training centers to conduct specialized training courses; and (4) by making pertinent training aids, motion pictures, filmstrips, slides, and printed materials available to States for training purposes.

REGIONAL TRAINING CENTERS: In addition to Atlanta, field training centers were operated at Amherst, Mass.; Columbus, Ga.; Bloomington, Ill.; Buffalo, N. Y.; Denver, Colo.; Pittsburgh, Pa.; and Topeka, Kans. Courses offered through these centers are indicated in table 2.

COOPERATION WITH STATE TRAINING CENTERS: Training officers assigned to New York, North Carolina, and South Carolina were continued in their respective assignments during 1951. A training officer assigned to Maryland completed his tour of duty there and was reassigned to South Carolina to assist the activation of a State training center at Charleston. New assignments of training officers were made to California and to Oklahoma. All of these training officers worked with State training personnel in developing new training programs, in expanding existing programs, and in analyzing the field training needs in their respective areas. As required, these and other States were provided further assistance through the loan of teams of specialists to conduct courses in such subjects as rodent control, milk sanitation, housing sanitation, and fly control.

INSECT AND RODENT CONTROL: Table 3 indicates the character, scope, and geographical distribution of field training activities in insect and/or rodent control carried on during 1951. Many of these courses, it will be observed, were conducted in Atlanta, and teams from Atlanta participated in some of those conducted at other centers.

HYGIENE OF HOUSING: Regularly scheduled courses, varying in length from 4 weeks to 1 day (seminar), were conducted at Atlanta, Ga., and Syracuse, N. Y. Three 4-week courses were conducted at Atlanta and one at Syracuse. Including the 1-day orientation courses, 14 scheduled courses were held during the year: 4 at Atlanta and 10 at Syracuse. In addition, decentralized courses were held at Charleston, S. C. (1 day); Denver, Colo. (4 days); Lancaster, S. C. (1 day); and Oakland, Calif. (3 weeks). In all, 224 trainees received training in hygiene of housing.

TRAINEES FROM FOREIGN COUNTRIES AND TERRITORIES: Training opportunities in some phases of public health work were offered to 100 persons from 36 countries other than the United States. Many of the 100 foreign trainees attended a 2-week course in insect and rodent control organized to fit their needs. Twenty-two of the 100 attended courses at regional training centers and 78 were trained at Atlanta. Table 4 shows the countries represented and the number of trainees enrolled from each.

TRAINING FOR PERSONNEL ASSIGNED TO ECA MISSIONS: The Center assumed responsibility, during 1951, for arranging appropriate field training experiences for Public Health Service officers detailed for work with the Economic Cooperation Administration in various parts of the world, particularly in Southeast Asia. Trainees, including medical officers, engineers, parasitologists, malariologists, and health educators, came to the Center after 6 weeks at the Harvard School of Public Health. Utilizing facilities of Atlanta training headquarters and the Columbus, Ga., regional training center, field training was provided in rural sanitation methods and procedures, control of malaria and other insect-borne diseases, venereal disease, leprosy, and maternal child welfare. Thirty-eight officers participated in this program. In addition, through FSA Region VI, local health department experience was made available in selected communities in Georgia, Florida, and Mississippi. Special field training programs were arranged for a group of six medical officers who reported in advance of the scheduled course.

PRODUCTION OF TRAINING AIDS

The production and distribution of audio-visual and other types of training aids is a major Center

Table 2

COURSES OFFERED THROUGH REGIONAL TRAINING CENTERS DURING 1950-1951

Location	Title	Length	Times Given	Number Trainees
REGULARLY SCHEDULED COURSES				
Amherst, Mass.	Environmental Sanitation	12 wks.	2	32
Amherst, Mass.	Environmental Sanitation	8 wks.	2	31
Amherst, Mass.	Organization and Presentation of Food Handler Training Programs	4 days	1	12
Amherst, Mass.	Milk-Laboratory Procedures	4 days	1	12
Amherst, Mass.	Sewage Pollution Operators' Course	2 days	1	41
Amherst, Mass.	Water Bacteriology	2 days	1	16
Bloomington, Ill.	Environmental Sanitation	12 wks.	2	22
Bloomington, Ill.	Milk Sanitation	4 wks.	2	10
Buffalo, N. Y.	Environmental Sanitation	12 wks.	3	54
Columbus, Ga.	Environmental Sanitation	12 wks.	1	16
Columbus, Ga.	Sanitary Engineering	12 wks.	2	27
Columbus, Ga.	Milk Sanitation	4 days	2	9
Denver, Colo.	Environmental Sanitation	12 wks.	3	26
Denver, Colo.	Plumbing	4 days	1	44
Denver, Colo.	Milk and Food Sanitation	2 wks.	1	17
Denver, Colo.	Laboratory Workshop	4 days	1	22
Pittsburgh, Pa.	Environmental Sanitation	12 wks.	2	22
Topeka, Kans.	Environmental Sanitation	12 wks.	1	18
Topeka, Kans.	Milk Sanitation	2 wks.	1	58
Topeka, Kans.	Eating and Drinking Establishment Sanitation	2 wks.	1	26
			Total	515
DECENTRALIZED TRAINING*				
Bismarck, N. Dak.	Milk Sanitation	2 wks.	1	18
Boise, Idaho	Milk Seminar	3 days	1	17
Green Bay, Wis.	Standard Milk Ordinance and Code	2 days	1	33
Seattle, Wash.	Fly and Milk Sanitation	4 days	1	70
Spearfish, S. Dak.	Milk and Food Sanitation	4 days	1	43
Spokane, Wash.	Fly and Milk Sanitation	4 days	1	30
Sylvan Lake, S. Dak.	Milk Sanitation	4 days	1	75
			Total	286

*Courses arranged and conducted in cooperation with Regional Office and State health departments concerned.

activity. During the past year, 66 important productions, as indicated in table 5, were completed and released to users. Of this number there were 21 motion picture productions, 22 filmstrips, and 23 slide series. Work was carried forward to various stages of completion on 48 motion pictures, 29 filmstrips, and 34 slide series. Through a film catalog and other suitable media pertinent information concerning available Center productions was disseminated to eligible users.

Audio-visual productions are developed and processed to the finished stage in a fully equipped studio staffed with experienced specialists. Production schedules are worked out by educationalists, training officers, consultants, and others familiar with the need for training aids and who know the type of subject matter that lends itself to audio-visual treatment, where the need is great-

Table 3

INSECT AND/OR RODENT CONTROL TRAINING OFFERED DURING 1950-1951

Location	Length	Times Given	Number Trainees
REGULARLY SCHEDULED COURSES			
Atlanta, Ga.	5 wks.	1	6
Atlanta, Ga.	4 wks.	2	23
Atlanta, Ga.	3 wks.	2	12
Atlanta, Ga.	2 wks.	5	62
Atlanta, Ga.	4 days	2	26
Atlanta, Ga.	2 days	1	7
Bloomington, Ill.	2 days	1	25
DECENTRALIZED TRAINING*			
Boston, Mass.	4 days	1	34
Bremerton, Wash.**	4 days	1	17
Chapel Hill, N. C.	4 days	1	18
Fort Jackson, S. C.	4 days	1	75
Grants Pass, Oreg.**	4 days	1	10
Kansas City, Mo.	2 wks.	1	28
Montgomery, Ala.	1 day	1	25
New York, N.Y.	4 days	1	26
New Orleans, La.	4 days	2	21
Pasco, Wash.**	4 days	1	10
Portland, Oreg.**	4 days	2	42
Seattle, Wash.**	4 days	1	30
Spokane, Wash.**	4 days	1	23
Washington, D.C.	4 days	1	24
Yakima, Wash.**	2 days	1	10
		Total	393

*Conducted in cooperation with Regional Offices and State health departments.
**Fly and Mosquito Control - conducted by headquarters team.

Table 4

TRAINEES FROM FOREIGN COUNTRIES AND TERRITORIES

Country	Number	Country	Number
Afghanistan	1	Hawaii	9
Alaska	1	India	5
Argentina	2	Indonesia	1
Austria	3	Iran	1
Belgian Congo	1	Israel	2
Bermuda	1	Italy	1
Brazil	7	Japan	8
Canada	3	Lebanon	1
Ceylon	1	Liberia	1
Chile	5	Mexico	5
China	3	Nigeria	1
Colombia	2	Pakistan	1
Ecuador	3	Peru	1
El Salvador	3	Philippines	10
England	1	Puerto Rico	1
Finland	1	Switzerland	2
Germany	3	Thailand	1
Greece	6	Venezuela	2
	Totals 36		100

est, and which areas can be served best by facilities and resources available to the Center. There is the fullest interchange of information and ideas among the several professional disciplines on the Center staff, and priority is given to the production of training aids essential to the proper execution of programs for which the Center is primarily responsible. Considerable effort also is devoted to the production of films and filmstrips requested by other components of the Public Health Service and by various Federal agencies; and in some instances projects are undertaken in cooperation with medical schools and similar institutions engaged in particular areas of public health. During 1951, for example, productions were undertaken at the instance of, and in cooperation with, the National Institutes of Health, National Office of Vital Statistics, Army Medical Illustration Service, Social Security Administration, Army Chemical Corps, Department of State, and others. In addition, audio-visual specialists from the Center cooperated in the planning of audio-visual training aid production programs for the Division of International Health, worked with the Economic Cooperation Administration in evaluating the needs in public health training in ECA-aided nations, and participated as consultants in health activities under the Point Four Program.

Center productions, based on demonstrated needs in the training of public health personnel, are for use in connection with health training programs and are not for general distribution. Films are edited and reviewed by specialists prior to release to users and are subjected to continuous evaluation both as to technical accuracy and effectiveness as training aids. Prints of all productions are on file in a film library maintained by the Center and are available on a loan basis. During the year the film library handled 8,493 applications for loan of films – 4,433 filmstrips and 3,343 motion pictures. This represents a 75 percent increase over loans during the preceding year.

Table 5

MAJOR AUDIO-VISUAL PRODUCTIONS RELEASED DURING 1950-1951

21 MOTION PICTURES (16 mm)			
Title	**Color**	**Black and White**	**Running Time (Min.)**
Laboratory Diagnosis of Diphtheria			
Part I - Microscopic Study and Isolation of *C. diphtheriae*		x	13
Part II - Determination of Types of *C. diphtheriae*		x	12
Community Fly Control Series			
Part I - Residual Spraying	x		9
Sanitary Milk Production on the Farm		x	14
Epidemiology of Influenza		x	12
Laboratory Diagnosis of Influenza		x	13
Rural Rat Control		x	16
Municipal Sewage Treatment Processes		x	15
High Temperature Short Time Pasteurization			
Part II - Inspection and Testing		x	19
Basic Principles of Analytical Balance		x	19
Techniques of BCG Vaccination	x		40
Rodent Control Series*			
The Rat Problem		x	25
Habits and Characteristics of Rats			
Part I - The Norway Rat		x	28
Part II - The Roof Rat		x	14
Practical Rat Control			
Part I - Sanitation Techniques in Rat Control		x	21
Part II - Ratproofing		x	18
Part III - Rat Killing		x	37
Rat Ectoparasite Control		x	12
Visual Report of Social Security in Brazil**	x		14
Chick Embryo Techniques		x	15
Infectious Hazards of Bacteriological Techniques***	x		12

22 FILMSTRIPS (35 mm)			
Title	**Color**	**Black and White**	**Frames**
The Electrokymograph†		x	49
Sampling and Testing Drinking Water	x		74
Q Fever	x		90

*Army-CDC Cooperative project.
**For Social Security Administration - not distributed by CDC.
***For Biological Department of Army Chemical Corps, Camp Detrick, Md. - not distributed by CDC.
†For National Heart Institute of NIH - not distributed by CDC.

Table 5 (Continued)

Title	Color	Black and White	Frames
Isolation and Identification of *Salmonella* and *Shigella* Cultures			
Part I - Isolation and Preliminary Identification of Cultures	x		85
Part II - Simplified Serologic Identification of *Shigella* Cultures	x		29
Part III - Simplified Serologic Identification of *Salmonella* Cultures	x		32
An Introduction to Bacteriology			
Part I - Basic Biology	x		56
Part II - Identifying Pathogens	x		64
Laboratory Diagnosis of Diphtheria			
Part II - Determination of Types of *C. diphtheriae*	x		53
High Temperature Short Time Pasteurization			
Part I - Equipment and Controls	x		95
Basic Principles of Analytical Balance		x	99
Histopathology of Human Fungus Infections			
Part IV - Systemic Infections	x		60
Food Handling			
Part I - Basic Principles of Refrigeration		x	71
Part II - Refrigerated Food Storage		x	70
A Mycological Slide Culture Technique	x		36
Medical Certification of Causes of Death††		x	59
How to Make a Filmstrip (Spanish Version)		x	50
Infectious Hazards of Bacteriological Techniques***			
Part I - The Inoculating Needle	x		101
Part III - The Hypodermic Syringe	x		101
Part IV - The Pipette	x		75
Part VII - The Lyophilizer	x		88
An Introduction to Indo-China	x		54

23 SLIDE SERIES (2 in. x 2 in.)

Title	Color	Black and White	Number of Slides
Insects of Importance to Public Health in the United States	x		35
Municipal Sewage Treatment Processes - Primary Sewage Treatment at Gainesville, Fla., and Opelika, Ala.	x		40
Municipal Sewage Treatment Processes - Secondary Sewage Treatment at Gainesville, Fla.	x		40
Sanitary Landfill		x	31
Sanitary Landfill Operations		x	31

††For BSS, National Office of Vital Statistics - distributed by NVOS.
***(see preceeding page)

not be obtained through the modification of commercial products.

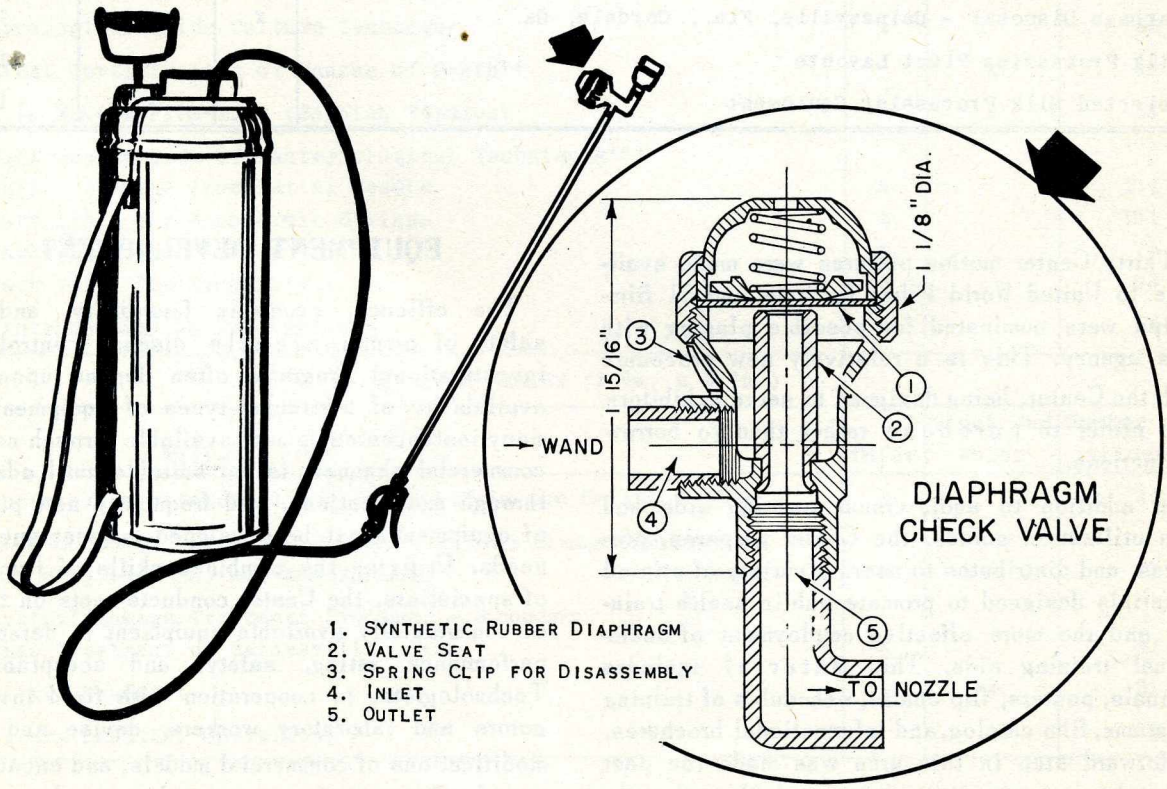
In the area of field control programs, particular attention was given to the problem of developing an improved type leakproof shut-off valve. On the basis of a series of tests, valve manufacturers were furnished recommendations for a redesigned valve that will make hand sprayers more suitable in dispersing the more toxic insecticides. Center technologists also developed a valve which automatically cuts the flow at a predetermined minimum pressure when placed in the liquid line of sprayers.

During the past year considerable effort was directed toward the development of improved air sampling devices and equipment. A previously constructed automatic pollen recorder was redesigned and tested, with encouraging results. The new unit is more compact, simpler in construction and operation, and may be adapted for use in airplanes. Models were supplied to the various laboratories and field stations engaged in an intensified program of air-borne disease studies. Evaluations were made of equipment for sampling air-borne bacteria and fungi, and various accessory devices were developed for improving their use. Devices studied included: (1) open settling plates, (2) sieve samplers, (3) bubbler samplers, (4) several modifications of Shipe sampler, and (5) a combination tangential jet-molecular filter sampler.

In support of scientific investigations and studies, a device for collecting air samples for parathion analyses was designed and fabricated. Field tests in connection with toxicology investigations gave satisfactory results. Other items tested included: (1) a knock-down type cage for holding and observing experimental animals exposed to test vapors in Peet-Grady chambers; (2) an automatic basal metabolism rocker for use in studying metabolic rates of small animals; (3) a precision atomizing dispenser for application of small amounts of pollen or dust; and (4) chambers for quantitative respiratory exposure of animals to gases, dusts, and aerosols.

AIR-BORNE DISEASE STUDIES

In December 1950, a committee on air-borne disease studies was established within the Center to coordinate an expanded program of activities in this area, with emphasis on the evaluation of



This type of check valve, developed by CDC technicians, improves the efficiency of hand sprayers. When inserted in the liquid line at the tip of the spray wand, the rubber diaphragm (1) automatically cuts off the flow at a predetermined pressure.

sampling techniques and devices adaptable to biological warfare defense. This committee, consisting of representatives from various scientific disciplines, convened December 21 and recommended that the Center utilize available air sampling devices to establish sampling stations at Chamblee, Ga., Montgomery, Ala., New Orleans, La., and Savannah, Ga., where facilities and staffs already existed. Periodically the committee reviewed the results of field operations, explored ways of improving sampling devices and techniques, and exchanged information with other groups engaged in similar studies.

First reports from sampling stations disclosed many discrepancies and the inadequacy of instruments and techniques. Accordingly, efforts were directed toward standardization of instruments, laboratory procedures, type of media used, air flow rate through the device, report of colony counts per volume of air, and the development of a simple mechanism for measuring the air flow. However, routine sampling of extramural air was carried on and progress was made toward the establishment of a base line for comparison of various sampling techniques and for detection of artificial dissemination of bacteria. It was found possible to detect peaks in bacterial counts resulting from the airplane dispersal of bacterial clouds in the vicinity of the test station. Studies were made of the normal content of air in different environments, employing differential media. And perhaps of more immediate value, comparative studies were made of the different sampling devices (bubbler, sieve, open plate, impinger, and others) which yielded needed basic information and also data useful to technologists in improving tested devices and in developing new ones.

Continuation of these studies on an expanding scale and in the closest cooperation with other groups is anticipated, not only because of its importance in terms of defense against biological warfare but also in relation to the peacetime airborne disease phase of public health.

WATER RESOURCES DEVELOPMENT AND PUBLIC HEALTH

Mosquitoes propagate in quantity only where water is available under conditions favorable for their production. Usually any increase in the impoundment and dispersal of water, an adjunct of most water resources development projects, augments the area favorable for the production of mosquitoes. Thus, water development projects, whether for recreational purposes, irrigation, flood control, or for production of hydroelectric power, have a public health feature and are of concern to the Center.

In the past, one of the activities of public health workers in the malarious southeastern States has been water impoundment studies and consultation with project sponsors, directed toward the prevention of conditions conducive to the breeding of malarial mosquitoes (*Anopheles quadrimaculatus*). These activities resulted in the evolving of cooperative agreements whereby mosquito prevention features were built into impoundment projects, public and private. With the decline of malaria incidence in the endemic areas, the volume of this type of work on the part of health agencies diminished, but did not cease. Moreover, with the recognition of pest mosquitoes as a health hazard, many States redefined laws and regulations pertaining to mosquito control to encompass war against nonmalarious mosquitoes. Hence, independent of malaria control, water impoundments and their maintenance are a concern of public health workers, and the Center continues to cooperate with State and local health departments in surveys and renders consultation services designed to insure that antimosquito measures are incorporated in water development projects, large and small, in all sections of the country.

In recent years the Center has conducted mosquito surveys and worked with sponsors and agencies associated with water resources development programs in major river basins, some of which are in areas where encephalitis is endemic and where mosquitoes which transmit it to man, particularly *Culex tarsalis*, are prevalent. During the past year, for example, work proceeded on comprehensive surveys of insect problems in the Missouri River Basin, Arkansas-White-Red River Basin, the Weber River (Utah) Basin, and to some degree in the Columbia River Basin. In each instance the objective is to define the existing problem with respect to insects of public health importance, to assess the probable effect of projected water development programs, and to outline in some detail the action necessary to minimize the aggravation of health hazards through increased production of disease-transmitting and pest insects.

MISSOURI RIVER BASIN: Irrigation for agricultural purposes is practiced on a considerable

scale in parts of the vast basin area and a comprehensive water resources development program currently under way will bring millions of additional acres into production. The construction program, a joint undertaking of Corps of Engineers and U. S. Reclamation Service, entails dams and reservoirs for flood control and power production as well as irrigation systems, which makes the area a profitable one for investigative studies to determine the specific causes and the degree of mosquito production associated with multipurpose water utilization projects. Although it has been recognized for many years that mosquito populations generally increase appreciably in areas where irrigation is established, there are little data available which pinpoint the features of irrigation responsible for mosquito production. Field investigations initiated 2 years ago with the objective of accumulating these types of data were expanded during 1951.

In order to acquire comprehensive data, study plots were selected in representative sections of the basin and intensive studies conducted on each. Through cooperation of the constructing agencies (pursuant to agreements with Corps of Engineers and Reclamation Service), field investigators obtained free access to the area, and maps and other data including plans and specifications of proposed installations. This on-the-scene type of cooperation smoothed the way for the selection of study plots, which was on the basis of topography, type of soil, size of irrigated area in relation to adjacent dryland, predominant vegetation, character of irrigation installation, and similar factors. Study areas encompass old irrigation systems, modern irrigation projects, and areas not under irrigation but included in proposed projects. Through the combined studies it should be possible to accumulate authentic data useful in delineating the answers to some of the questions as to precisely why irrigation increases mosquito production. It is believed, too, that out of the studies will come information providing a solid basis for prescribing with more certainty the exact type of preventive features that need to be built into irrigation projects to forestall mosquito production.

Data* collected to date indicate that the following situations or conditions are common in many irrigated areas, and are significantly important as sources of mosquito breeding:

1. Inadequate drainage systems for the removal of waste water from irrigated lands, particularly roadside ditches.
2. Application of water to land which has not been properly prepared for irrigation.
3. Seepage resulting from irrigation at higher elevations.
4. Inadequate maintenance of irrigation distribution and drainage systems.

Studies of a representative plot, covering 22 weekly inspections, indicated that roadside ditches were responsible for 64 percent of total mosquito breeding area and drainage ditches were responsible for 33 percent. Waste water from irrigated fields was responsible for the larger percentage of breeding associated with roadside ditches. Most of the breeding in drainage ditches was found in a section of the system where the flow was sluggish due to improper grade and to vegetative growth. The study plot involved was fairly flat and uniform. All irrigable land was well leveled during the initial preparation of the farm for irrigation. The top soil (sandy loam and silt loam) averaged about 4 feet in depth and had a well drained substratum of gravel.

As might be expected, findings in the several studies varied in relation to topography of area, type of soil, and condition of irrigation system. Studies on demonstration farms, for example, revealed relatively few breeding places, with most of those noted being associated with accumulations of waste water in roadside ditches.

Over-all findings indicate: (1) that careful attention to the inclusion of preventive features in irrigation projects offers a practical method of holding mosquito production to a minumum; (2) that avoidance of waste water, through proper construction and control of volume of water applied, is essential; (3) that adequate maintenance is necessary regardless of efficacy of construction; (4) that surveys of insects of public health importance are an integral part of the planning of irrigation projects; and (5) that the incorporation of survey findings into construction insures the holding of health hazards to a minimum.

ARKANSAS-WHITE-RED RIVER BASIN (AWRRB): Center participation in field studies and surveys of insects of public health importance in this project area is through the Inter-Agency Committee, established by presidential directive, which coordinates the work of Federal, State, and

*Details are recorded in 1951 Report of Survey Section of Midwestern CDC Services.

other agencies in formulating a comprehensive plan for the development of the soil, water, and mineral resources of the combined basins. The Committee consists of representatives of the Department of the Army, Department of Interior, Department of Agriculture, Department of Commerce, Federal Power Commission, Federal Security Agency, and the governors of the eight States concerned – Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas.

The Center, through the Federal Security Agency representative on the Committee, inaugurated surveys and studies to obtain data pertaining to the public health problems in the area in terms of insect-borne disease, the prevalence of implicated insects, the probable influence of projected developmental projects on the disease and insect incidence, and to provide a basis for recommending appropriate insect preventive and/or control features for inclusion in construction plans. Facilities for these activities were established to carry on the work in cooperation with the officer in charge of the Basin Office in Little Rock, Ark. Preliminary studies to obtain base line data have been initiated and the work is proceeding satisfactorily.

WEBER BASIN (UTAH): The U. S. Reclamation Service plans a developmental project to provide additional water for irrigation and to improve drainage facilities in the portion of the Weber Basin west of the Wasatch Front, and has requested the Center to investigate the mosquito problems and estimate the probable effects of the development on mosquito production. Preliminary surveys by personnel working out of Salt Lake City, Utah, and Denver, Colo., indicate the existence of an acute mosquito situation in the basin, and that major breeding sources are associated with improper disposal of irrigation waste water. A summary of findings and recommendations is scheduled for issuance during the ensuing fiscal year.

COLUMBIA RIVER BASIN: Studies in this area, which did not reach the field stage during 1951, are scheduled to follow the general pattern of the AWRRB project. An Inter-Agency Committee has been named and Center personnel assigned thereto will conduct appropriate surveys.

WATER IMPOUNDMENT ACTIVITIES: Throughout its existence the Center has conducted surveys on proposed and established impoundments, usually in cooperation with and at the request of State health departments, and furnished guidance in the inclusion of mosquito preventive features. During 1951, survey reports were entered on 9 projects involving 13 proposed artificial lakes in 12 States – Arkansas, Colorado, Georgia, Idaho, Kansas, Kentucky, Nebraska, New York, Oregon, Pennsylvania, Tennessee, and Washington.

The Surgeon General's announcement urging that more attention be given to the health hazards associated with nuisance mosquitoes stimulated interest in the revision of State and local health laws and regulations governing water impoundments and mosquito control in general. This broadening of the mosquito control horizon precipitated requests for a digest of existing mosquito control legislative acts and guidance in the preparation of amendments to bring control authority in line with the concept that nuisance mosquitoes as well as malarial mosquitoes constitute a public health problem. The Center responded to this request and a number of States were assisted in overhauling their mosquito control statutes. The Center has scheduled the issuance of one or more monographs for distribution to agencies for their guidance in modernization and application of laws and regulations pertaining to impoundments and mosquito control procedures. One monograph will deal with postimpoundment clearing and a second with biological stabilization of uncleared areas.

REPORTS OF INVESTIGATIONS AND STUDIES

The preparation of papers, for publication in technical and scientific journals and presentation at meetings of scientific groups, is a continuing activity of members of the Center staff. During 1951, independently or in collaboration with other investigators, Center scientists prepared 177 papers* dealing with various types of investigations and studies in the general area of public health.

*Listed in the Bibliography of Scientific Publications, Bureau of State Services, for calendar years 1950 and 1951.

INVESTIGATIONS AND STUDIES

A working knowledge of the causative agent, how it is transmitted, conditions under which the infection flourishes, and related facts is essential to the development of effective measures for the prevention and control of disease, particularly of communicable diseases. Since this type of information is lacking with respect to most diseases with which the Center deals, a continuous program of investigations and studies is necessary to the accomplishment of its objectives. The scope, intensity, and character of undertakings depend upon the status of knowledge of the disease or problem involved. In most instances both field and laboratory work is required, and in some instances research of a basic nature is called for.

Listed below in alphabetical order, without reference to relative importance or extensiveness of work entailed, are some of the activities pursued during 1951. Only summaries of work pertaining to particular diseases or associated problems are presented. More detailed reports are contained in papers prepared for publication which are included in the Bibliography of Scientific Publications referred to previously.

AMEBIASIS

The National Evaluation Program for laboratory diagnosis of amebiasis, conducted by Center laboratories, completed during the year, revealed a wide variation of proficiency among State public health laboratories. This development led to special consultations where reported increased incidence of amebiasis appeared to be due to laboratory error, and resulted in the establishment of intrastate parasitological programs.

Within the laboratories, utilizing material collected in special investigations made at the requests of States, work has continued on evaluation studies of culture media, concentration techniques, polyvinyl alcohol collection methods, and procedures for the appraisal of serologic tests.

Other activities during 1951 included: (1) the assignment of a parasitologist as a member of the Army Medical Epidemiological Board to investigate amebiasis in Korea; (2) a survey to determine the incidence of amebiasis among World War II veterans in the southeastern States, upon request of Veterans Administration; (3) epidemic aid in the investigation of a very high incidence of amebiasis in the population of an institution of a Midwestern State; and (4) cooperating with the American Society of Tropical Medicine in an attempt to appraise laboratory methods used in the diagnosis of amebiasis. A parasitologist from the Center served as chairman of a subcommittee exploring this problem, the ultimate objective of which is to establish procedures and criteria on which valid diagnosis can be based.

BRUCELLOSIS

The annual incidence of human brucellosis in the United States is not known with any degree of accuracy. Available data are fragmentary and reflect attacks of the disease which may be primary, relapses, or chronic. In a paper* published during the year, the incidence for 1949 was reckoned at 10,709. This figure was arrived at by calculations based on data from Illinois, Iowa, Minnesota, and Wisconsin.

Field studies in Indiana and elsewhere indicate that human brucellosis occurs principally in: (1) groups infected from food of animal origin; (2) groups employed in animal handling industries; (3) groups associated with animals on farms. Thus, the relationships between humans and animals are a determining factor in the incidence of brucellosis in the human population. Rather comprehensive studies suggest that these relationships are complex, and exact measurement in all aspects is not easy with present methods.

During the past year, a new scheme for reporting brucellosis in animals, which should contribute to more reliable data, was activated in Indiana. In Illinois, analysis of data is being made to determine the repetitive reporting of single cases in humans in successive years. In other studies, data on brucellosis are being compiled and processed to determine the seasonal and geographic factors which may be involved in the distri-

*Proc. Third Inter-American Brucellosis Congress.

bution of reported human cases, and in the distribution of reactors in animal herds tested by the Bureau of Animal Industry, Department of Agriculture.

Blood specimens, collected during a *Salmonella* survey of poultry in Florida, were tested for *Brucella* agglutinins. In tests of 145 serums with both *Brucella* and *Tularense* antigens, 1 positive reactor was recorded.

In Center laboratories evaluation of the various types of agglutination tests was begun, comparing antigens designed by various authorities in this country with the standard antigens submitted by WHO members.

CREEPING ERUPTION

This disease, which results from transmission to humans of the dog hookworm (*Ancylostoma braziliense*), is considered a public health problem from Maryland through Texas, particularly in parts of Florida. Control of the causative agent through the application of soil larvicides is believed to be an appropriate approach, and studies to determine the effectiveness of various larvicidal materials are under way. Through the cooperation of the Florida Bureau of Laboratories and greyhound kennel operators, the larvicidal efficacy of sodium borate (Borascu) was investigated during 1951. The material was applied on each of four separate runs, and soil samples were collected prior to treatment and again 26 days and 60 days after treatment. Comparative studies on the possible use of other materials are under way, as are investigations of the possibility of an *in vitro* study of the sensitivity of hookworm larvae to various agents.

Members of the Center laboratory staff supported the Florida investigations through special lectures, demonstrations, and diagnostic services.

DIARRHEA-DYSENTERY

Essential to the control of these diseases is knowledge of the etiological agent so that the transmission route may be determined. Among 200 enteric bacterial pathogens, certain of them almost always cause disease through a particular transmission route such as foodstuffs, water, animal products, fly contamination, or negligence in human-to-human contact. When specific identification, or sometimes generic subgroup, of a pathogen from an enteric disease can be determined exactly the time for epidemiological back-tracking to primary source can be shortened greatly and control thereby improved.

LABORATORY ACTIVITIES: Because cases of enteric disease are so numerous, aids to identification must be widely distributed so as to provide broad coverage and to make available authoritative laboratory procedures on a comparable scale. The most efficient diagnostic tool currently in use is serologic testing and identification of isolated bacteria.

Center laboratories, in an attempt to meet the requirements of wide distribution of aids to identification and authoritative procedures, prepared antiserums for typing enteric bacteria for distribution to State health department laboratories and to the Armed Forces. Complete *Salmonella* and *Shigella* grouping and typing kits were assembled and distributed, including 15,534 ml. of serums in kits and 3,698 corresponding cultures. Polyvalent Arizona paracolon typing serum also was distributed to State laboratories to aid them in determining how often these bacteria are found in humans. In addition, aid was given commercial laboratories in the preparation of *Salmonella* and *Shigella* grouping antiserums, and acceptable products were on the market by the end of 1951.

Typing and diagnostic serums and antigens for use in agglutination test were submitted by several State laboratories for evaluation by Center laboratories, and 5,933 enteric bacteriology specimens were examined for confirmation and identification.

After serologic and biochemical identification of either *Salmonella typhi* or *Salmonella paratyphi B* recovered from humans, a more elaborate laboratory test is available which permits very exact identification of cultures. This process involves testing organisms with various types of bacteriophage to indicate the precise subdivision. Dissemination of disease from a particular typhoid carrier may be traced by 'phage typing of typhoid cultures in new cases, or a new source of disease in a community may thus be detected.

In its function as Regional and National Enteric Bacteriophage Typing Center, 332 cultures of *S. typhi* and 87 cultures of *S. paratyphi B* were typed by the enteric bacteriology laboratory during 1951. This laboratory also was designated as the International Shigella Center.

FIELD ACTIVITIES: An investigative study* in Hidalgo County, Tex., showed that, in an area of high dysentery morbidity, effective fly control materially reduced the prevalence rates of *Shigella* infection, but exerted no significant influence on *Salmonella* infections. In order to determine the usefulness of this method of dysentery control in an area of low to moderate morbidity rates, a comparable study was initiated in selected communities in the vicinity of Thomasville, Ga. Fly control measures which were employed included use of chemical sprays supplemented by sanitary measures. Control of flies achieved, as evaluated by the median grill index, and its influence upon *Shigella* prevalence rates, as evaluated through rectal swab cultures, are shown in figure 2 for the Hidalgo County, Tex., study; for the Thomasville, Ga., study, in figure 3. It will be observed that in each instance (intentional in Hidalgo County and due to insecticide resistance in Thomasville) the loss of effective fly control resulted in a rise of the *Shigella* infection rates to the precontrol level. In the Hidalgo County study, fly control was practiced in Group "A" cities for some 15 months, after which control was discontinued in Group "A" and inaugurated in Group "B" cities. As shown in figure 2, the decline in *Shigella* rates that accompanied control in Group "A" cities vanished soon after fly control operations ceased; and *Shigella* rates started to decline in Group "B" cities soon after fly control measures were inaugurated in those cities. Virtually the same pattern (figure 3) resulted from the Thomasville operations, except in this instance fly control was lost through fly resistance to dieldrin and a rise in *Shigella* rates followed.

While this study confirmed the thesis that effective fly control yields a considerable degree of control of dysentery due to *Shigella* organisms, it also demonstrated the unreliability of chemical measures as a long-range fly control approach, and pointed out the necessity for incorporating into the control program more fundamental measures such as sanitation.

DIPHTHERIA

It is generally agreed that morphological recognition of *Corynebacterium diphtheriae* by diagnostic laboratories is a grossly inadequate basis for epidemiological studies and the development of control measures. Biochemical studies offer little additional enlightenment. Significant findings must be based upon the virulence of isolates, manifested by the production of exotoxin. Virulence can be determined by injection of animals, but the process is expensive in terms of materials and time consumed. Some workers have sought to circumvent the cost factor by using the same animals repeatedly. Center laboratories have found this a risky procedure, since test rabbits may develop antibodies, thus causing false negative results.

In an attempt to meet the need for a simpler and less expensive procedure, workers in Center laboratories have modified the Elek *in vitro* test to yield a measure of virulence practicable in any public health laboratory. Using this modified procedure, it has been found feasible to replace rabbit serum (which is not available in all State laboratories) with human serum and obtain satisfactory results.

ENCEPHALITIS

Investigations, directed toward the broad objective of developing effective means for controlling arthropod-borne virus encephalitis infections, were conducted in Weld County, Colo., and in Kern County, Calif. The Weld County investigations were in the nature of the application of knowledge gained through earlier, less concentrated studies in the Missouri River Basin areas. They were accomplished by intensive study of a restricted area where human and equine encephalitides have been endemic for many years. Activities in Kern County were in cooperation with the Hooper Foundation for Medical Research of the University of California and represent the sixth year the Center has participated in the exploring of the epidemiology of encephalitides found in this area.

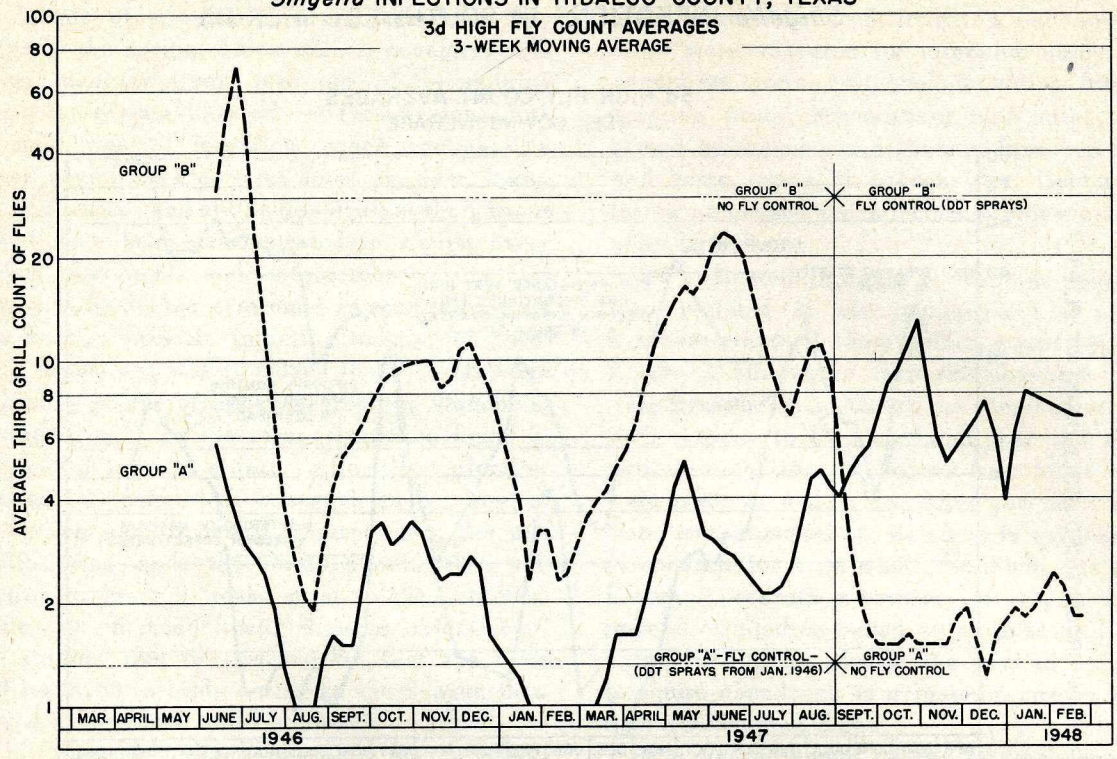
WELD COUNTY, COLO.: On the basis of accumulated information, and with concurrence of other scientific groups interested in the problem, the 1951 studies were geared to the postulation that mosquitoes are the principal vectors that transmit encephalitis virus to humans and equines. Accordingly, the discovery of how vectorial mosquitoes acquire the virus and from what source was accepted as a reasonable departure point.

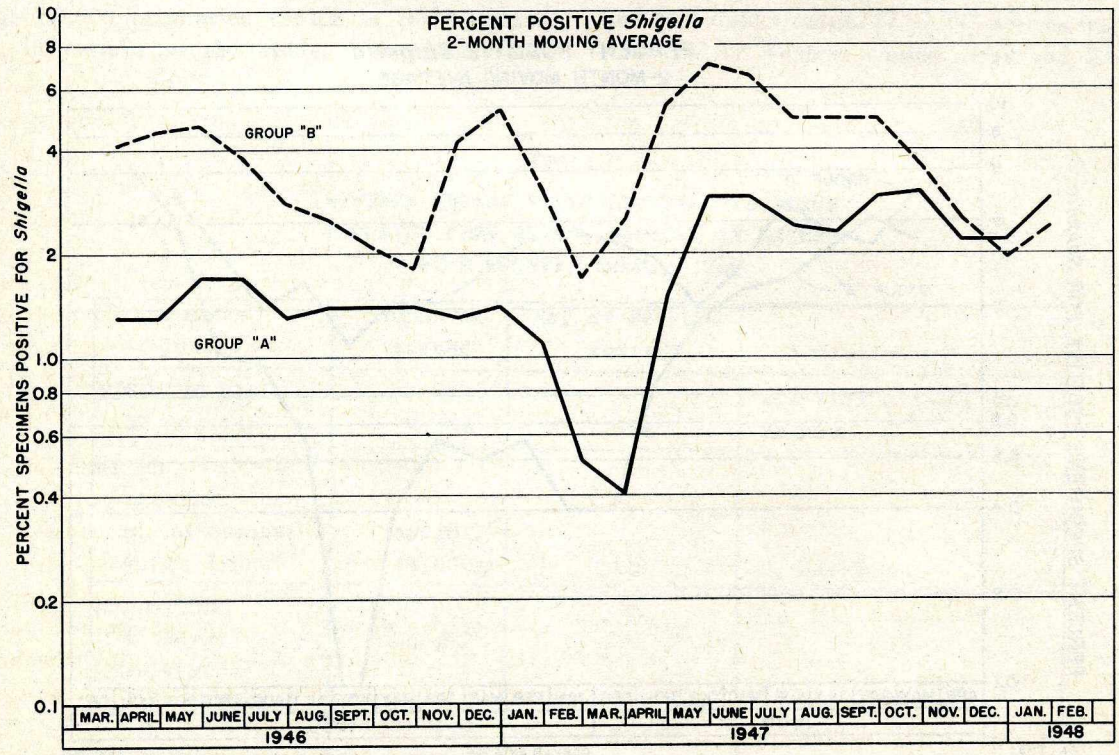
Many forms of animal life have been found infected with various viruses at different times; but the favored thesis regarding encephalitis is

*Pub. Health Rep. 63: 1319–1334 (1948)

FIGURE 2

EFFECTS OF FLY CONTROL UPON
Shigella INFECTIONS IN HIDALGO COUNTY, TEXAS





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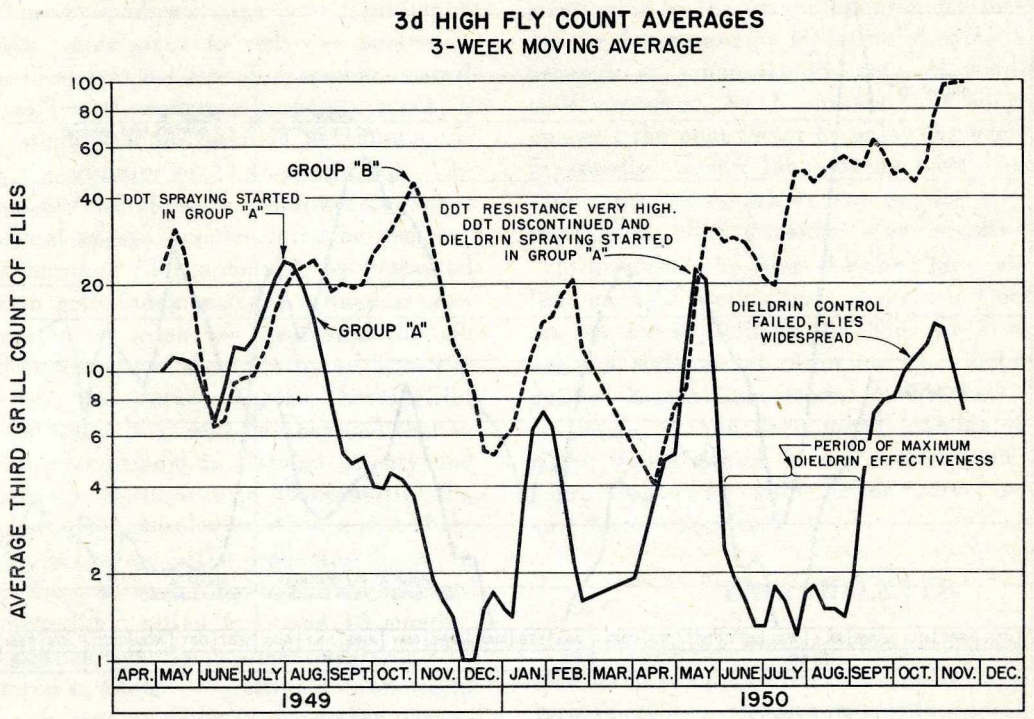
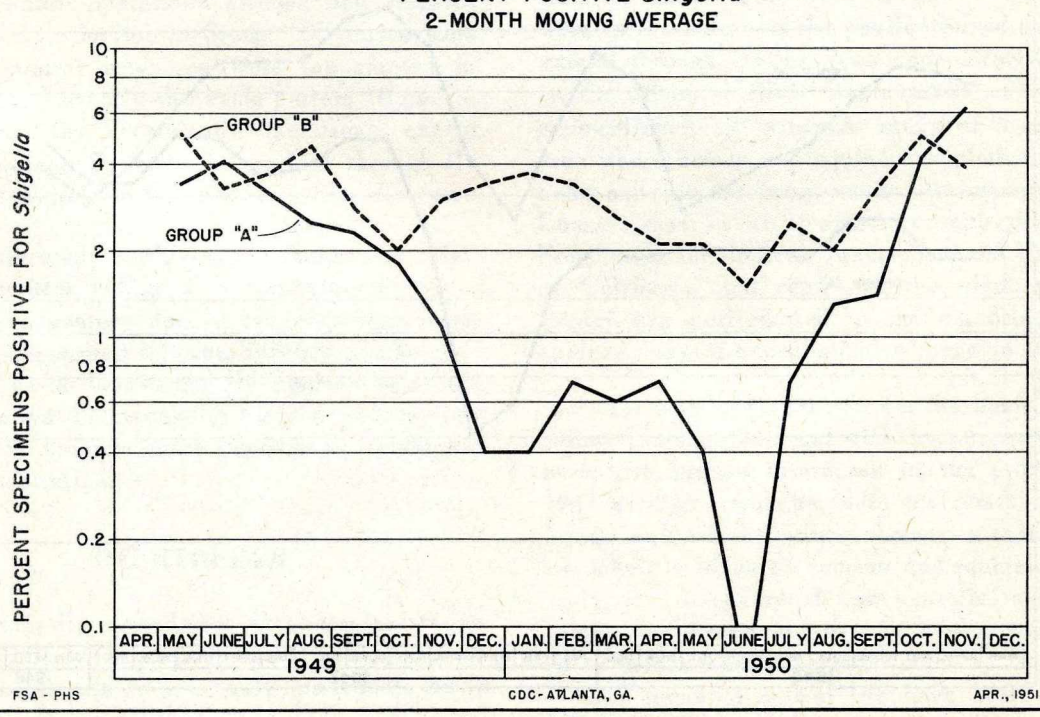
APRIL, 1950

FIGURE 3

EFFECTS OF FLY CONTROL UPON
Shigella INFECTIONS IN SOUTHWEST GEORGIA





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that some warm-blooded vertebrate with the virus circulating in its blood is the reservoir from which new broods of mosquitoes are infected as they emerge in the spring. The problem, accepting this thesis, resolves itself into one of determining which of the warm-blooded vertebrates constitute the main line of infection, since encephalitis viruses have been recovered from pig, deer, horse, bird, and human; and antibodies against the various viruses have been demonstrated in almost every species of warm-blooded vertebrates.

Interpreting evidence in hand as pointing toward birds as the probable infecting animal, on theoretical grounds it was reasoned that if birds were the primary source of infection from the standpoint of mosquitoes, then the virus should be found in the blood of birds at a date earlier than infection appeared in mosquitoes. Inasmuch as a period of time is required to permit transmission, the assumption was made that birds should show the infection at least 2 weeks prior to the detection of infection in mosquitoes. A major objective of 1951 studies was to demonstrate that the virus could be found in birds earlier in the season than infected mosquitoes could be found.

Weld County contains about 3,600 square miles, a third of which is under irrigation. Some 55,000 of the 60,000 population reside in the irrigated area. In setting up the study, five plots, each representing a type of habitat (dryland, irrigated upland, irrigated river bottomland, marsh irrigated area, border between irrigated and nonirrigated area) were selected for intensive study. Various specimens were collected including blood from nestling birds; mosquitoes, bird mites, and assorted arthropods; and tissues from human cases and horse cases of encephalitis. Center laboratories processed the specimens using established procedures.

As indicated in table 6, Western equine virus was isolated in six instances: bird nestlings, 3 times; mites, 1 time; and mosquitoes, 2 times. Figure 4 shows the time relationships of infections, as shown by isolations recorded in table 6, with respect to birds, mosquitoes, and mites. It will be noted that isolations from blood of birds were made at a date preceding the date of isolations from mosquitoes, which is in agreement with the postulation upon which the study was planned. Figure 5 presents a summary of data on mosquito population studies based on an average light trap catch, indicating clearly the marked increase in mosquito abundance in irrigated areas as compared with nonirrigated areas.

In a human serum survey for the presence of neutralizing antibodies against Western equine and St. Louis viruses, 21 of 283 serums were found positive for Western equine virus and 20 of 268

Table 6

WESTERN EQUINE ENCEPHALOMYELITIS VIRUS ISOLATED FROM ANIMAL SOURCES IN NATURE WELD COUNTY, COLO., 1950

Animals Tested	Total No. Tested	No. of Batches Tested	Isolation of Virus	
NESTLING BIRDS			Red-wing Blackbirds	2
20 Species	1,578	654	Magpie	1
MITES				
Chiefly				
D. americanus	Approx.			
D. gallinae	40,000	119	*D. americanus*	1
MOSQUITOES				
A. dorsalis	4,492			
A. vexans	1,928			
C. tarsalis	1,141			
Others	324	238	*A. dorsalis*	2
OTHER ARTHROPODS	Approx.			
9 species	2,000	64		0

FIGURE 4

WESTERN E. E. VIRUS
TIME RELATIONSHIPS OF INFECTIONS
WELD COUNTY, COLORADO
1950

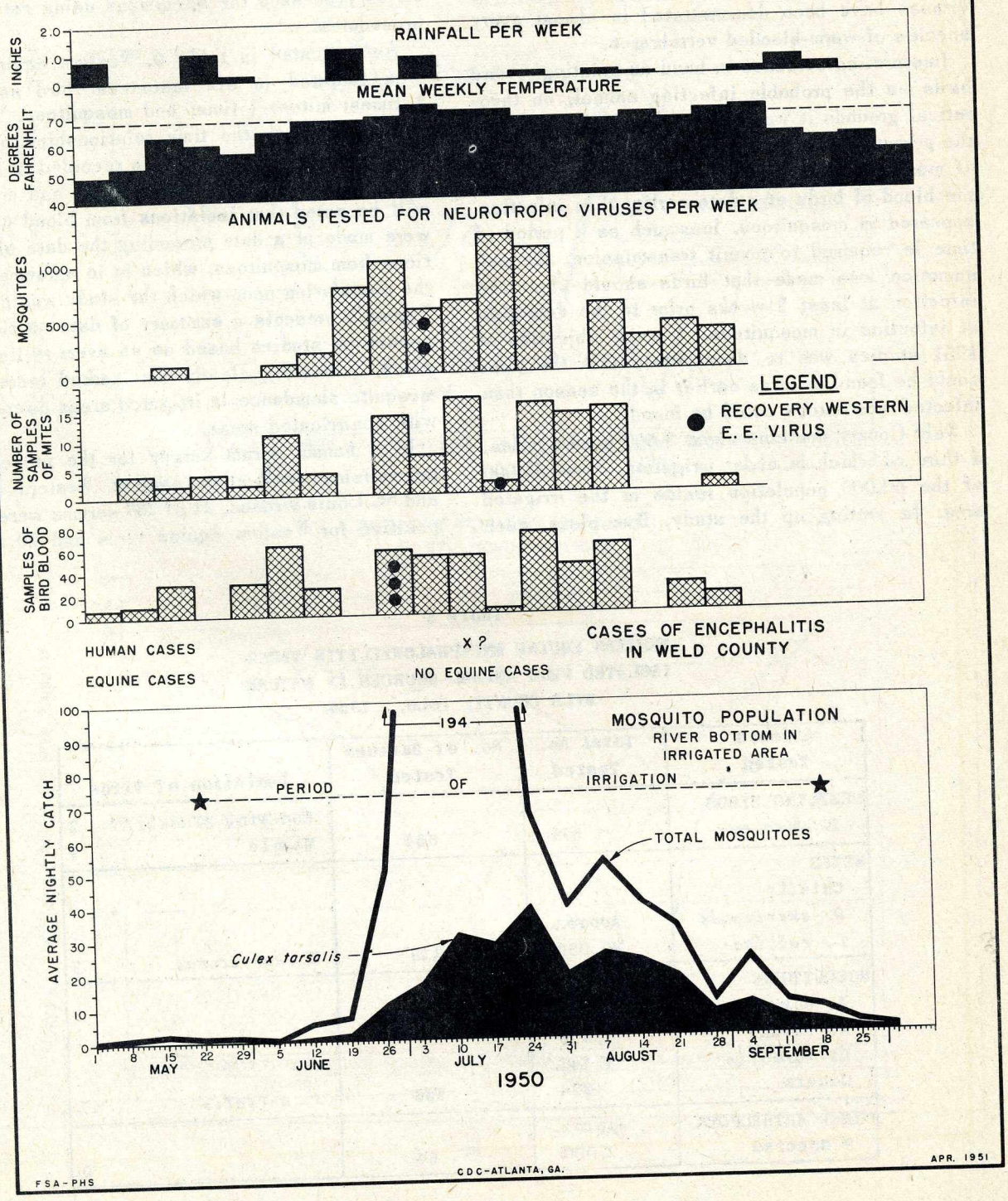

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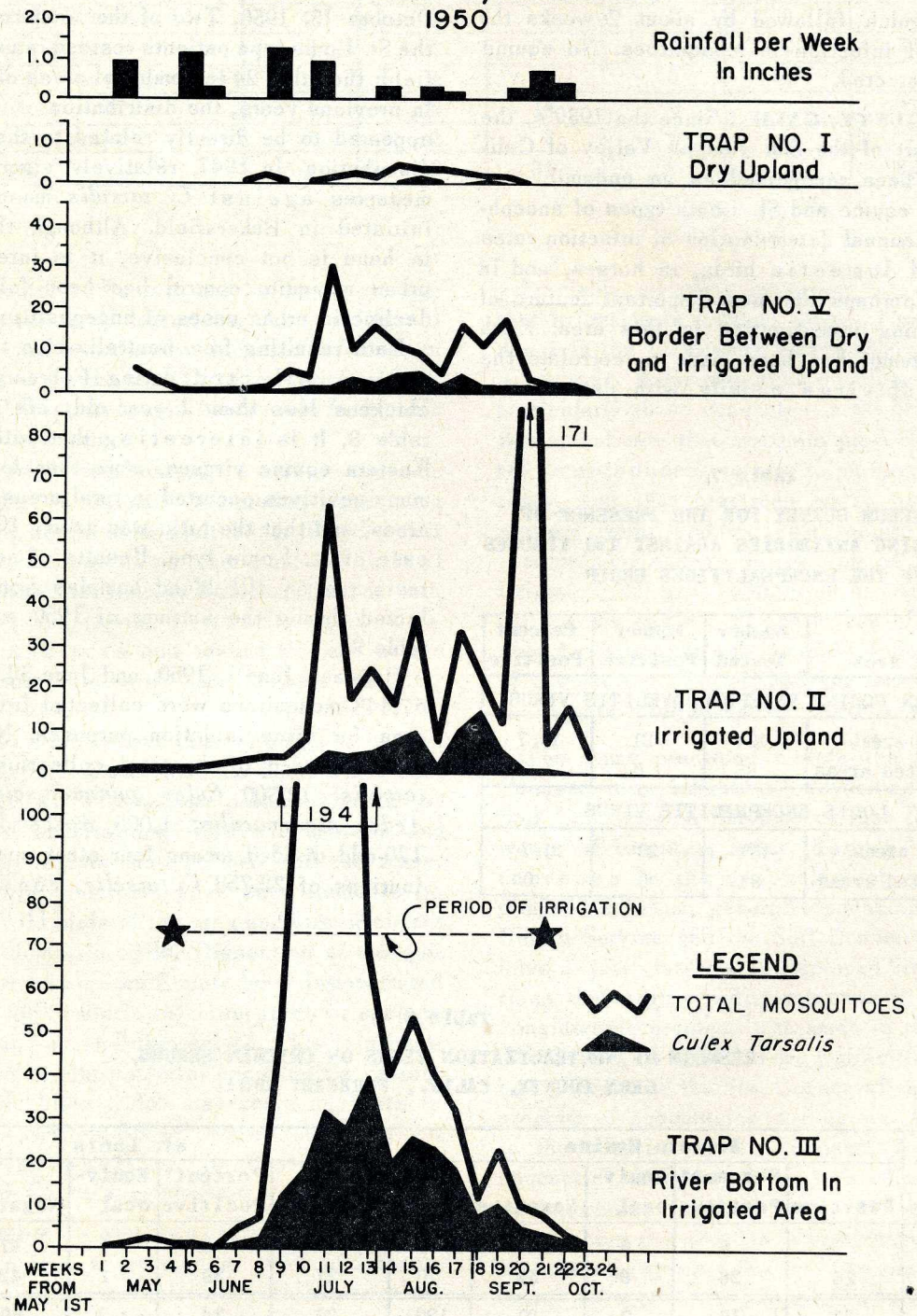
FIGURE 5

MOSQUITO POPULATION STUDIES
AVERAGE LIGHT TRAP CATCH PER NIGHT BY WEEKS
WELD COUNTY, COLORADO
1950



FSA-PHS CDC-ATLANTA, GA. MAY 1951

were positive for St. Louis virus. As shown in table 7, in each instance all positives came from residents of irrigated areas. In a similar equine serum survey the results were different in that a considerable number of positives were found in both irrigated and nonirrigated areas.

During the studies one possible human case was detected, which followed by about 2 weeks the detection of infection in mosquitoes. No equine case was detected.

KERN COUNTY, CALIF.: Since the 1930's, the southern part of the San Joaquin Valley of California has been recognized as an endemic area for Western equine and St. Louis types of encephalitis. The annual determination of infection rates in wild and domestic birds, in horses, and in humans is perhaps the most important feature of the continuing investigation in this area. Each year an attempt has been made to correlate the magnitude of virus activity with determinable changes such as climatic conditions, extent and success of mosquito control, and alterations in agricultural practices which might affect the vector population.

Twenty-eight cases of encephalitis in man (7 Western equine, July 4-Sept. 17; 21 St. Louis, July 21-Oct. 15) were recorded between July 4 and October 15, 1950. Two of the Western and two of the St. Louis type patients resided in urban Bakersfield; the other 24 in semirural areas of the county. In previous years, the distribution of human cases appeared to be directly related to the population distribution. In 1947, relatively vigorous control measures against *C. tarsalis* mosquitoes were initiated in Bakersfield. Although the evidence in hand is not conclusive, it is interesting that urban mosquito control has been followed by a decline in urban cases of encephalitis.

Data resulting from neutralization tests on 120 serums, collected during February 1951 from chickens less than 1 year old, are presented in table 8. It is interesting that, with respect to Western equine viruses, more than four times as many positives occurred in rural areas as in urban areas, and that the ratio was nearly 10 to 1 in the case of St. Louis type. Results of neutralization tests run on 101 blood samples from birds collected during the summer of 1950 are shown in table 9.

Between June 1, 1950, and June 30, 1951, some 67,448 mosquitoes were collected from the study area for virus isolation purposes. Nine species were included in the total collection: 43,000 *C. tarsalis;* 12,500 *Culex quinquefasciatus;* 11,000 *Aedes nigromaculis;* 1,000 *Aedes dorsalis;* and 120-odd divided among four other species. Examinations of 22,758 *C. tarsalis*, considered the

Table 7

HUMAN SERUM SURVEY FOR THE PRESENCE OF NEUTRALIZING ANTIBODIES AGAINST TWO VIRUSES OF THE ENCEPHALITIDES GROUP

Type of Area	Number Tested	Number Positive	Percent Positive
WESTERN EQUINE ENCEPHALOMYELITIS VIRUS			
Irrigated areas	197	21	10.7
Nonirrigated areas	86	0	0
ST. LOUIS ENCEPHALITIS VIRUS			
Irrigated areas	187	20	10.7
Nonirrigated areas	81	0	0

Table 8

RESULTS OF NEUTRALIZATION TESTS ON CHICKEN SERUMS, KERN COUNTY, CALIF., FEBRUARY 1951

Locality	Western Equine					St. Louis				
	Positive	Percent* Positive	Equivocal	Negative	Total	Positive	Percent* Positive	Equivocal	Negative	Total
Urban	3	6	0	47	50	2	4	1	47	50
Rural	18	26	0	52	70	27	39	1	42	70
Total	21	18	0	99	120	29	24	2	89	120

*Calculations of percent positive exclude equivocals from totals.

Table 9

RESULTS OF NEUTRALIZATION TESTS ON WILD BIRD SERUMS, KERN COUNTY, CALIF., SUMMER, 1950

Bird Species	Western Equine			St. Louis		
	Positive	Equivocal	Negative	Positive	Equivocal	Negative
English Sparrow	0	3	30	9	0	24
Brewer Blackbird	0	0	3	0	0	3
House Finch	3	7	34	1	5	38
Black-headed Grosbeak	0	0	1	0	0	1
Bullock's Oriole	1	2	14	0	0	17
Valley Quail	0	0	3	0	0	3
Total	4	12	85	10	5	86

principal vector of Western and St. Louis encephalitis, resulted in 81 isolations. Only 7 of the 81 isolations were immediately identified – 6 Western equine and 1 St. Louis. Three isolations (2 St. Louis and 1 Western equine) were made from pools of *C. quinquefasciatus*.

During January and February, a survey was made to accumulate additional information concerning the wintering habits of mosquitoes. It revealed that *C. quinquefasciatus* was the most abundant species during the January-February period, both as to adults and larvae. *C. tarsalis* adults were present in shelters and toward the end of the survey became relatively more abundant than *C. quinquefasciatus*.

Since 1946, studies have been in progress in Kern County to determine the mosquito vectors and host range of avian *Plasmodium* parasites, with the objective of ascertaining whether malaria and encephalitis vectors may be one and the same. Avian malaria infections have been found to be common in wild birds of the area and rare or absent in common domestic birds. Dissection of mosquitoes collected from Kern County have demonstrated remarkably high malaria infection rates in species suspected as encephalitis vectors. This is accepted as evidence that potential encephalitis vectors feed on wild birds which may serve as hosts to encephalitis viruses. Six percent of 750 *C. tarsalis* dissected were positive for *Plasmodium*. One specimen of *Culex stigmatosoma* was positive.

IRRIGATION – ENCEPHALITIS STUDIES: An extensive review, undertaken in 1951, of information concerning the mosquito-encephalitis relationship yielded a considerable body of data supporting the thesis that mosquito breeding increases appreciably wherever irrigation is practiced, and that irrigation is a prime cause of mosquito abundance in the 17 Western States where encephalitis is endemic. Water resources development studies,* particularly those conducted in the Missouri River Basin, indicate that mosquito production in irrigated areas is directly related to surface water collections, and that practices which accentuate the surface water collection feature of irrigation include: (1) inadequate leveling of land prior to irrigation; (2) over-application of irrigation water; (3) ponding and run-off due to use of soils unsuitable for irrigation; (4) improper drainage and lack of maintenance of drainage systems; and (5) inadequate provisions for surface water run-off.

The same practices violate the principles of "conservation irrigation" advocated by the U.S. Soil Conservation Service, in that they result in waste of irrigation water, damage to soil, and increase in the per unit cost of agricultural production. Thus, generally speaking, the Public Health Service and the Soil Conservation Service have a joint interest in improved irrigation practices that augurs well for teamwork. During 1951, considerable progress was made in this direction. The Center, on behalf of the Public Health Service, has joined with the Soil Conservation Service in a program of encouraging and guiding irrigationists in the adoption of the "conservation irrigation" concept. This approach not only offers the Center an opportunity to attack the spread of encephalitis by reducing the abundance of mosquitoes, including nuisance species, but it offers the Soil Conservation Service an opportunity to attain its goal

*Page 13 of this report.

of better use of water and soil, and gives to irrigationists the guidance of the combined skills and resources of the two Federal agencies.

A major contribution to the joint "conservation irrigation" program by the Center was the preparation and release of a brochure delineating the mosquito-producing features of irrigation as now practiced and how they can be eliminated through "conservation irrigation," with a resultant reduction in mosquito abundance.

GNAT-BORNE CONJUNCTIVITIS

Investigations in this area during 1951 dealt with: (1) the general biology of the eye-gnat (*Hippelates pusio*); and (2) methods of measuring the prevalence of adult gnats.

The biology studies were in laboratory colonies. When confined in quart jars, adult gnats produced eggs about 6 days after emergence. Transferred to ~~open~~ containers and supplied with human excrement the eggs hatched within 2 to 3 days. The mean larval period has been determined as about 11 days and the puparium around 12 days, which suggests an average cycle of around ~~35~~ 30 days. Observations of the laboratory colony indicated a rather low rate of hatching. In one series less than 15 percent of 1,100 eggs hatched.

Studies to measure the prevalence of adult gnats, conducted in the field from the middle of March to end of November 1950, included operation of traps in nine communities encompassed by dysentery investigative programs. Bait was made of ground pork liver mixed with an equal amount of water and about 1/16 of total weight of urea. The bait was mixed weekly and not used until the fifth week after mixing. There was a great variation in the size of catch from trap to trap throughout the trapping period. In a different approach, each trapper was told to observe the number of gnats seen in the vicinity of each trap station, preferably gnats gathering around each of five or more different children. The weekly average of gnats observed around trap stations by trappers did not appear grossly inconsistent with weekly mean of gnats caught per trap.

HEALTH HAZARDS OF ECONOMIC POISONS

Laboratory and field investigative studies of the health hazards associated with the use of, or habitational contact with public health insecticides, agricultural chemicals, and certain other related materials were carried on at Center installations near Savannah, Ga., Wenatchee, Wash., and other places. Hazards which were considered include: (1) those incurred through vocational use of, or incidental exposures to, compounds employed in public health programs and/or in agriculture; and (2) those incurred through ingestion or incidental contact with this group of toxicants in the home or in normal activities outside of industry.

DIELDRIN: Toxicity and related tests on dieldrin were pursued in 1951 not only because of the potential value of this material as an insecticide, but also because it is a representative chlorinated hydrocarbon and data accumulated from studies on it may be applied to similar compounds. Previous studies, for example, showed that crystalline dieldrin was absorbed almost as readily as dieldrin in solution, and that solid diluents such as occur in 25 percent water-wettable powder interfere only slightly with absorption of the compound. This suggests that when equal volumes are considered, the hazard from dieldrin is proportional to the concentration of the formulation. It appears, too, that any significant contamination by dieldrin or by concentrates containing 6 percent or more of the compound may be dangerous.

Dieldrin toxicity studies, wherein the material was applied repeatedly to the skin of various species of animals, indicated there are individual and species differences in the susceptibility. In general, of the animals tested with dermal applications, rabbits and mice were the most susceptible, followed by rats, guinea pigs, and dogs and monkeys.

The LD_{50} for male rats (single application) was 90 mg./kg. and 60 to 72 mg./kg. for female rats. Rats repeatedly exposed to low dosage rates developed small but definite tolerance to dieldrin.

Preliminary starvation, which almost completely eliminated the fat stores of experimental rats, failed to influence their mortality as compared with unstarved controls, when both groups were subsequently poisoned with dieldrin. This suggests that in acute dieldrin poisoning storage of the compound in fat plays little or no part in intoxication.

Starvation decreased the liver weights of otherwise normal rats. On the other hand, rats poisoned by dieldrin either failed to show this loss in liver weight or showed a slight gain in spite of the same

degree of starvation. The greater weight of liver in the poisoned animals probably was due in part to their failure to mobilize lipids. The ratio of the various lipid fractions in poisoned animals was essentially the same as that in controls. Liver glycogen was less affected by dieldrin poisoning than was liver lipid. Various lipotropic agents produced no change in lipid storage in rats poisoned by dieldrin.

Seventy percent hepatectomy reduced the LD_{50} of dieldrin in male rats from 90 to 50 mg./kg. In view of the radical surgery involved, this indicates that the liver plays an insignificant part in the toxicity of dieldrin. Animals submitted to 70 percent hepatectomy and then poisoned by a single dose of dieldrin at the rate of 50 mg./kg. showed more rapid regrowth of the liver than did controls that received no dieldrin, indicating that dieldrin does not interfere with the replacement of damaged liver tissue.

DDT: When applied to white rats dermally, DDT was found to be somewhat less toxic than dieldrin. Rats exposed to DDT exhibited gross signs of poisoning over a period of weeks or months without manifest effect on their survival. In fact, the animals frequently recovered and showed no signs of poisoning while receiving repeated doses of DDT. This was in marked contrast to the pattern noted with dieldrin where animals receiving repeated doses usually appeared normal or died after initial signs of poisoning. Rats poisoned by DDT lost weight but, in contrast to dieldrin, DDT exerted little effect on the liver weight.

Since DDT is used extensively, both in disease control and in the control of insects which attack agricultural products, studies were made in quest of information as to the extent to which this insecticide is stored in the bodies of persons exposed to it in varying degree. Analyses were made of human fat obtained by biopsy sampling of some 40 persons, chiefly individuals in the Savannah, Ga., and Wenatchee, Wash., areas. Among this group, values for DDT ranged from 0 to 38 parts per million. Values ranging from 91 to 291 p.p.m. were found in three separate examinations of samples from two persons with extensive occupational exposure to DDT. No injury traceable to DDT was found even in persons with the highest DDT values.

CHLORDAN: A series of tests on the toxicity of chlordan vapors from residual spray deposits indicated that vapors arising from the residue of applications of 200 mg./sq. ft. in a poorly ventilated modified Peet-Grady chamber did not effect the health, growth, or reproduction of rats. The test was repeated three times and data from the replications compared favorably. Three generations were produced from the original females over a period of 9 months. Rats subjected to 2 or 3 dermal applications of 25 percent solution of chlordan at the rate of 400 mg./kg. died within 7 days after the initial dose. The mean weight loss during the period was 14 percent of the original weight.

ALDRIN: Dermal applications to mice, rats, and rabbits of a floor wax containing aldrin gave results suggesting that this compound should not be used in this type of formulation. Mice which were allowed to live on a wooden floor finished with the wax absorbed enough aldrin for the contamination to be detected in their tissues.

LINDANE: On an acute basis, lindane showed approximately the same toxicity to rabbits as did dieldrin; on a chronic basis, lindane was less toxic than dieldrin.

PARATHION: A screening of methods of cholinesterase determination in the laboratory revealed one that was deemed worthy of further study.

SODIUM MONOFLUOROACETATE (1080): The use of hydroxylamine hydrochloride appeared to indicate it may have some value as an antidote in 1080 poisoning. Some dogs poisoned with 1080 were saved from death.

ECONOMIC POISONS IN CONTROL OF ANIMAL RESERVOIRS OF DISEASE

Activities in this general area during 1951 concerned further studies on warfarin, a relatively new rodenticide, and tests of DDT as a rodenticide.

WARFARIN: Baiting studies using both Norway rats and roof rats showed that repeated feeding with warfarin-treated bait (yellow corn meal is satisfactory bait material) did not cause bait refusal. Roof rats required a concentration of 0.25 mg./gm. for satisfactory control under field conditions, whereas 0.10 mg./gm. was found effective against Norway rats, and mice. Observations indicated that with roof rats an increased bait avoidance attends an increase in the concentration of warfarin in the bait material. However, this avoidance is not considered of sufficient intensity to be of significance in the type of con-

trol operations usually carried on under normal field conditions.

A laboratory method for the rapid evaluation of warfarin, and similar rodenticides, was developed. It also was determined that warfarin produces a typical pathology recognizable with complete certainty in over 85 percent of rats killed by this rodenticide.

DDT: Laboratory and field experiments showed that DDT is not a satisfactory rodenticide even when used in ultrahigh concentrations. There was evidence, however, that DDT might be reasonably effective for the control of mice.

RELATED STUDIES: Final analysis of rat-proofing tests, involving 35 different construction materials, emphasized the fact that rats require a gnawing edge in order to make penetration of the harder materials, and that when edges are protected, the materials listed in the accompanying tabulation are those which offer protection against normal rat gnawing.

Material	Thickness
C-4 Marine board	1/8 in. or more
C-5 Marine board	3/16 in. or more
Century APAC Marine board	3/16 in. or more
Transite asbestos wood	1/4 in. or more
Asbestos lumber	1/4 in. or more
Aluminum alloy(brinnell hardness, No. above 73)	.040 in. or more
Sheet iron (preferably galvanized)	.049 in. or more

ECONOMIC POISONS IN CONTROL OF ARTHROPOD VECTORS OF DISEASE

The increasing problem of insecticide resistance on the part of house flies gave added urgency to laboratory and field investigations designed to develop formulations effective against DDT-resistant strains. Considerable data were accumulated during the year but a satisfactory solution to the resistance problem is yet to be evolved.

Much attention was devoted to studies calculated to develop data concerning the various factors entering into the insecticide resistance phenomenon, and to bringing all available information on the subject into common focus. This approach became advisable when the development of resistant strains of flies necessitated the overhaul of many organized fly control programs where chief reliance was upon chemical sprays. The concensus is that whereas increased emphasis on environmental sanitation points the way toward sounder fly control, there is need for basic research to determine some of the "whys" and "wherefores" of resistance.

Laboratory and field studies carried on at Savannah revealed that: (1) Some DDT-resistant strains of flies which were held in the laboratory free of DDT for several generations tended to lose their resistance, whereas other strains showed no evidence of reversion. Field strains of house flies in six towns in Texas showed no loss of DDT resistance 2 years after regular treatments were discontinued. (This may have been due, at least in part, to the persistence of residual deposits of DDT and the general use of DDT formulations for agricultural purposes in adjacent areas.) (2) A dieldrin-resistant strain of house flies was developed from the normal insectary strain through the use of residual deposits in holding cages. The dieldrin-resistant strain developed more rapidly than did the DDT-resistant strains. Reciprocal crosses of dieldrin-resistant strains with normal strains produced flies of intermediate resistance. (3) In some areas, where dieldrin had not been used previously, a high degree of resistance developed within 2 months after the initial application. In other areas, dieldrin has been effective over a span of more than 2 years, with resistance not appearing until the third year.

OUTDOOR RESIDUAL SPRAYS: Standard panel weathering tests were made with several types of DDT formulations, including water-wettable powder, emulsifiable concentrates containing rosin, and melted DDT. Under outdoor conditions, DDT-rosin deposits were the most lasting. Of some 46 formulations evaluated (adult house flies and standard wall cages were used), only those containing DDT or dieldrin exhibited any appreciable residual qualities. Dieldrin at 50 mg./sq. ft. gave approximately the same results as DDT at 200 mg./sq. ft. The addition of rosin aided the DDT formulation somewhat but had no detectable effect on the

dieldrin formulation. Oily-based formulations of dieldrin were markedly inferior to xylene-based formulations.

In field tests to evaluate its use in combined mosquito and fly control programs, dieldrin gave marked mosquito control for 10 weeks, and effective fly control for 5 to 7 weeks when applied as a residual to the outside of dwellings at 50 mg./sq. ft. The rapid development of resistant strains prevented full evaluation of this method for fly control purposes.

OUTDOOR SPACE SPRAYS: In tests to determine the effectiveness of various outdoor space spray formulations, it was noted that blow flies were susceptible to most of the insecticides used, while house flies were resistant to most of them. Of the tested materials, the most promising against both species of flies were: (1) a 5 to 1 combination of DDT and DMC; (2) benzene hexachloride (12 to 26 percent gamma isomer); (3) lindane; and (4) pyrethrin with piperonyl butoxide.

FLY LARVICIDES: Tests at dairies and rural premises showed that dieldrin, chlordan, and lindane gave satisfactory results as larvicides at dairies practicing good to fair sanitation, but all were ineffective in the presence of poor sanitation. And, as in residual applications, flies developed a high degree of resistance to dieldrin within 2 months or less after the initial application.

In fly control operations at Phoenix, Ariz., where resistant strains have been encountered, a water-wettable suspension of benzene hexachloride was found to be effective as a larvicide.

MOSQUITO LARVICIDES: Of all materials tested, dieldrin at the rate of 1 lb./acre was the only larvicide showing any promise of effectiveness against larvae of *Mansonia perturbans*. Dieldrin emulsion, used as residual larvicide at 1 lb./acre gave effective control of mosquito breeding for 1 year. However, at this rate of application dieldrin is very destructive of fish and other aquatic life.

After two seasons of routine treatment of fish ponds with water emulsion of technical BHC (12 percent gamma isomer) at the rate of 1 lb./acre, there was no apparent reduction in the fish population attributable to the insecticide. Five applications were made each season at approximately 5-week intervals, each application giving control for 5 to 8 weeks.

RELATED ACTIVITIES AND STUDIES: Associated with the use of economic poisons in the control of vectors of diseases are many related problems, such as the chemistry of insecticides, resting habits of flies, fly dispersal habits, fly breeding media and attractants, and bio-assay techniques. These problems have received attention at different Center installations, some in detail and others as time and resources permitted.

Chemical Studies on Insecticides: Over 2,000 compounds were subjected to screening tests in an attempt to discover materials which might act as synergistic activators of DDT residual deposits and make them effective against resistant flies. Some 25 of the 2,000 showed sufficient promise to merit more detailed field and laboratory tests.

Tests made to determine the volatility of various insecticides showed BHC to be the most volatile; aldrin, chlordan, and lindane followed in that order. Dieldrin showed the least volatility, and DDT ranked below the others named.

A modification was made in the Davidow method of isolation of DDT from fats, and the Schechter-Haller method of DDT analysis was improved so as to make it more rapid and less subject to manipulative losses.

Fly Resting Habits: Observations on fly resting habits were made in connection with established Center activities at Phoenix, Ariz., Charleston, W. Va., Savannah, Ga., Pharr, Tex., and other places. In rural areas around Savannah, 97 percent of flies observed around farm premises were house flies, and most of them rested during the day on surfaces not usually treated in residual spray operations. At night, 88 percent of all flies observed on unscreened premises were found inside of houses during the peak summer temperatures, and the percentage increased to virtually 100 percent during the late fall, winter, and early spring. Most flies not inside of unscreened buildings at night were resting in the lower limbs of trees and shrubs during warm weather. On screened premises, during warm weather, the favored night resting places were shrubs and unscreened porches.

In the lower Rio Grande Valley, ground surfaces, particularly where waste water had been thrown, were found to be the principal daytime resting places of both house flies and *Phaenicia*. The principal nighttime resting places were tree limbs and bushes for house flies, and grasses and weeds for *Phaenicia*. Observations on *Drosophila* indicated that these flies move extensively during late afternoon and early morning and are found in

large numbers in pit privies, garbage cans, and houses.

At Phoenix, periodic observations of fall fly activity revealed that the selection of a daytime resting site is governed more by its proximity to a feeding or breeding source than by a specific type of surface. At night the majority of flies (principally house flies) congregate inside of shelters, where 50 percent rest upon ceilings and small cylindrical surfaces.

Fly Dispersal Habits: Dispersal studies at Savannah, using radioactive material to tag the flies, revealed what appeared to be a tendency to disperse at random in both urban and rural areas, with some inclination toward areas where there are more attractants. Although, in these studies, house flies were found as far as 8 miles from the release point, in rural areas this species evidenced a high interchange of population on premises within a radius of 1 mile of release point and considerable interchange at a distance of 3 miles. A similar pattern was observed in urban areas, with flies moving in all directions simultaneously.

Studies in the Pharr, Tex., area of the lower Rio Grande Valley showed that *Drosophila melanogaster* and *Drosophila repleta* disperse rapidly from privy pit to other privies and to houses in the adjacent area, a pattern that suggests profuse migration from privy to houses.

Environmental Sanitation: The relation of the level of sanitation to the production and abundance of flies in the community or area has been explored in numerous studies, always with results supporting the principle that poor sanitation fosters flies and good sanitation lowers fly populations. In all such studies, findings have pointed to garbage, animal shelters, and a variety of substrates as being of primary importance both as fly attractants and as breeding media. There is some variation in the relative importance of type of breeding media and attractants with respect to species and geographical area. Industrial waste, particularly that associated with canneries and with vegetable and fruit-packing establishments, is a major problem in many areas.

Table 10 and figure 6 summarize some of the findings of a 15-month study of the relation of various sanitation factors to fly abundance in the lower Rio Grande Valley of Texas.

Bio-assay Techniques: Studies were made on techniques for the bio-assay of insecticides from the standpoint of evaluation of insecticidal action and for the detection of insecticides in animal tissues. Adult house flies were used for quantitative detection of dieldrin in fatty tissues. The extract was applied to test insects by means of micro-loops. Calibration of the delivery rates of a series of micro-loops was made spectrophotometrically, employing the Bouger-Beer relationship.

A rapid and sensitive method for the quantitative determination of dieldrin concentrations in acetone extracts also was developed. Amounts of dieldrin as low as 0.5 to 3.0 micrograms per vial can be detected by the new method.

Radioisotope Studies: Satisfactory methods for the use of radioactive phosphorus (P^{32}) in tagging flies were developed in the laboratory and tested in the field. The radioactive iodine analog of DDT was synthesized and used in toxicological studies.

Aircraft Disinsectization: Studies included the testing of both aerosol formulations and residual sprays. With respect to aerosols, particular attention was given to the development of formulations containing reduced amounts of pyrethrum. Residual sprays were considered for possible use in treating the baggage compartments of intercontinental aircraft. Limited field tests suggested the need for further investigations on the methods of dispersal of aerosols. Tests with melted DDT offered promise as a residual for treating baggage compartments, but more work in this field is indicated.

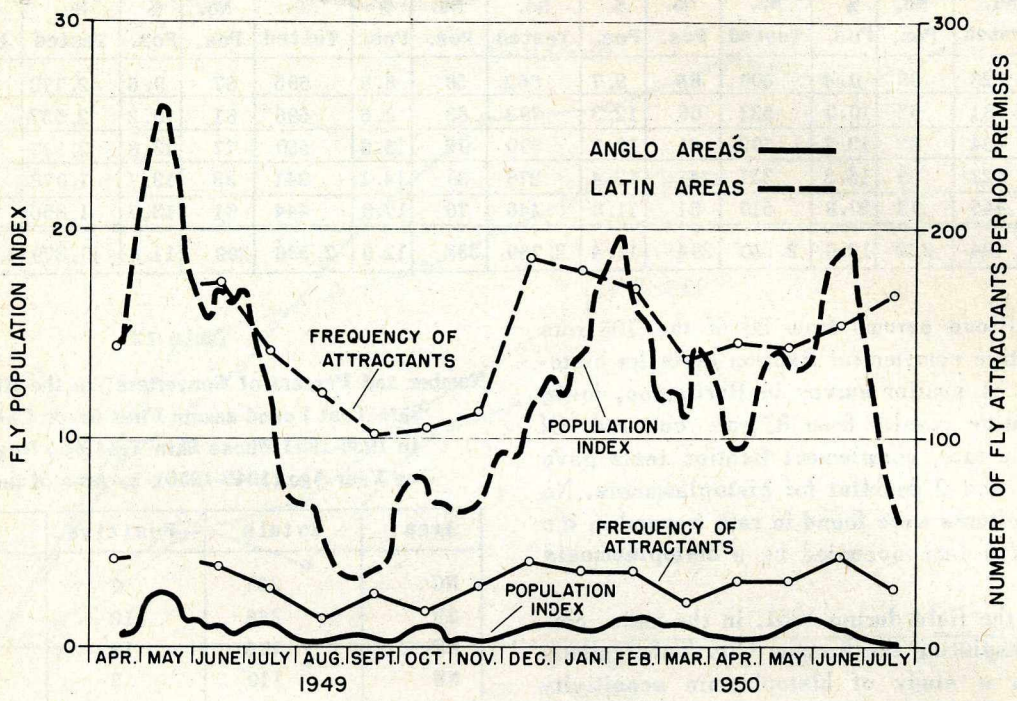
Table 10

COMPARISON OF THE SANITATION FACILITIES OBSERVED IN ANGLO AND LATIN AREAS OVER A 15-MONTH PERIOD

Type of Facility	Average Frequencies Per 100 Premises	
	Anglo	Latin
Approved garbage containers	69	28
Non-approved garbage containers	35	93
Garbage scattered on ground	3	15
City sewer connections for waste water	91	27
Waste water scattered on ground	2	78

FIGURE 6

DIFFERENCES IN FLY POPULATION INDEXES AND FREQUENCIES OF FLY ATTRACTANTS IN THE LATIN AND ANGLO AREAS OF THREE SANITATION STUDY TOWNS IN THE LOWER RIO GRANDE VALLEY OF TEXAS



FSA-PHS-CDC

ATLANTA, GA. MAY 1951

HISTOPLASMOSIS

Nearly 1,000 histoplasmosis complement fixation tests were performed on serums collected through Center field studies. Most of the specimens were from animal reservoirs and human diagnostic collections forwarded to Center laboratories through investigators stationed at Kansas City.

Histoplasma capsulatum was recovered four times from soil samples taken in Williamson County, Tenn., where 50 percent of the persons tested reacted to histoplasmin. The first recorded isolation of *Allescheria boydii* from a nonliving source was achieved while soil samples from this county were being examined culturally. *A. boydii* produces mycetoma and systemic infection of humans.

Center mycology laboratories isolated 598 pathogens in processing 1,946 specimens submitted for diagnostic study by 38 States, Canada, England, France, and Hawaii.

During laboratory diagnostic studies, it has been found that laboratories must specifically culture sputum for the detection of mycosis, since concentration techniques for tubercle bacillus are lethal or inhibitory to fungi.

In connection with histoplasmosis diagnostic studies, evaluation was made of such factors and methods as: temperature and humidity requirements of histoplasmosis organisms; significance of the size of the spores; wind velocity necessary to disseminate spores; use of eggs and mice as diagnostic tools; and the use of antibiotics in culture media for improving sensitivty.

In cooperation with the Illinois Department of Public Health, cultures for *Histoplasma* were run on 105 rats captured during June, July, August, and September, 1950. No pathogenic fungi were

Table 11

NUMBER AND PERCENT OF POSITIVE REACTORS TO HISTOPLASMIN BY YEAR IN KANSAS CITY KINDERGARTENS DURING EACH SCHOOL YEAR 1947-1951, TABULATED BY AREA OF THE CITY IN WHICH THE SCHOOLS ARE LOCATED

Area	1947-1948			1948-1949			1949-1950			1950-1951			Total 1947-1951		
	No. Tested	No. Pos.	% Pos.	No. Tested	No. Pos.	% Pos.	No. Tested	No. Pos.	% Pos.	No. Tested	No. Pos.	% Pos.	No. Tested	No. Pos.	% Pos.
SW	726	68	9.4	690	65	9.7	662	58	8.8	695	67	9.6	2,773	258	9.3
SE	631	63	10.0	537	66	12.3	793	68	8.6	596	61	10.2	2,557	258	10.1
NC	464	63	13.6	503	61	12.1	590	92	15.6	560	77	13.8	2,117	293	13.8
NW	228	35	15.3	331	41	12.4	276	39	14.1	241	33	13.7	1,076	148	13.8
NE	445	93	20.9	519	61	11.8	448	76	17.0	444	61	13.7	1,856	291	15.7
Total	2,494	322	12.9	2,580	294	11.4	2,769	333	12.0	2,536	299	11.8	10,379	1,248	12.0

isolated. Blood serums from 28 of the 105 rats gave negative complement fixation tests for histoplasmosis. A similar survey in Burlington, Iowa, gave negative results from 87 rats cultured. Of 38 of these rats, complement fixation tests gave 1 positive and 2 doubtful for histoplasmosis. No positive cultures were found in rats trapped in the vicinity of a farm occupied by a histoplasmosis patient.

Work in the field during 1951, in the main, consisted of assisting the Kansas City Tuberculosis Society in a study of histoplasmin sensitivity among school children in different sections of the city – a study that has been carried on for 4 years. As indicated in table 11, marked differences in sensitivity rates have been found in different sections of the city each year and the differences have been rather consistent. The number of persons who changed from negative to positive, as measured by histoplasmin skin tests during the year, are shown in table 12. It will be observed that the conversion rate (table 12) was 3.1 percent, virtually the same rate arrived at through theoretical calculations, made some 3 years previously on the basis of a cross section study of 17,000 Kansas City children.

In Boone County, Mo., histoplasmin and tuberculin skin tests were run on 2,534 children, 385 cattle, 185 sheep, 129 swine, 98 chickens, 25 turkeys, and 69 horses. A comparison of the histoplasmin part of the survey is shown in figure 7.

Other field activities during the year included follow-up observations of patients involved in an outbreak of pneumonitis among military personnel at Camp Gruber, Okla., in 1943, and cooperation with the U. S. Weather Bureau and Navy Department in studies to correlate the prevalence of histoplasmin sensitivity with certain weather conditions.

Table 12

Number and Percent of Converters* to the Histoplasmin Skin Test Found among First Grade Children in 1950-1951 Whose Skin Test Was Negative One Year Ago (1949-1950), by Area of the City

Area	Totals	Positive	Percent
NC	227	9	3.9
SW	268	10	3.7
NE	196	12	6.1
NW	110	3	2.7
SE	329	11	3.0
Total	1,130	45	3.1%

*A converter is a person whose skin reaction changes from negative to positive.

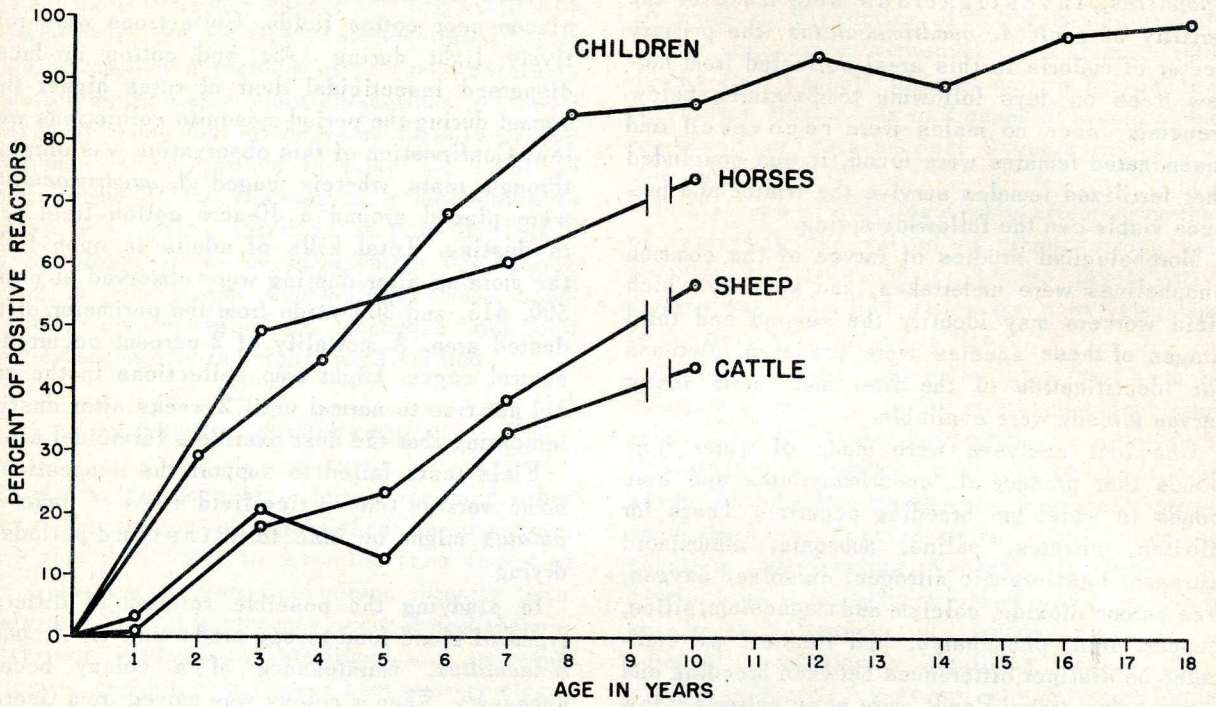
The Camp Gruber investigations produced evidence indicating that the 1943 outbreak was caused by *H. capsulatum.* Examination of soil and bark from the storm cellar where the men apparently contracted illness produced isolation of *H. capsulatum.* Of 20 blood samples obtained from victims of the outbreak, 2 yielded positive complement fixation tests for histoplasmosis; and 14 of 15 patients were found positive in histoplasmin skin tests.

LEPROSY

The staff member in charge of leprosy studies accompanied the Director of the Leonard Wood Memorial Foundation on an extended trip to South Africa, Egypt, India, Ceylon, the Philippines, Japan, and Hawaii in behalf of a program of evaluation of therapeutic agents used in the treatment

FIGURE 7

PERCENT POSITIVE REACTORS TO HISTOPLASMIN AMONG CHILDREN BY AGE COMPARED TO HORSES, CATTLE, AND SHEEP IN BOONE COUNTY, MO.



of leprosy. This exchange of information and assessment of techniques and methods used in different parts of the world is expected to help in the development of sounder control procedures.

MALARIA

Investigations were continued through field stations at Newton, Ga., Manning, S. C., and Helena, Ark. Studies encompassed: (1) measurement of malaria in man; (2) observations of the abundance of anopheline mosquitoes; (3) blood-feeding habits of *Anopheles*; (4) exploration of some of the more basic factors concerned with the local recession of malaria, bionomics of *Anopheles*, and malaria transmission.

Center laboratories at Chamblee, Ga., examined 24,888 blood films from South Carolina, Arkansas, and Georgia without detecting evidence of human infection. These laboratories, upon recommendation of the National Malaria Society, were designated the national depository for positive malaria slides. Blood films considered positive or controversial are processed by Center laboratories prior to filing in the national depository. Almost all slides submitted since the establishment of the depository have come from soldiers returned from Korea who have evidenced relapse with *Plasmodium vivax* malaria. Evaluation of the techniques used in conducting the precipitin test has been completed by Center serologic laboratories. This test identifies the animal on which collected mosquitoes have fed immediately prior to their capture.

NEWTON, GA., STATION: Since 1939, at monthly intervals, surveys for the detection of malaria have been conducted on approximately 1,100 residents of a 40-square-mile area. The last case of malaria in this area which was confirmed by blood film examination was found in 1944. During the past year blood films were collected from 57 persons with clinical indications of malaria and from 749 other persons contacted during routine house-to-house surveys; all films were negative.

Drought conditions during 1951, most severe during the 12 years that climatic records have been kept at the station, resulted in the virtual nonexistence of *Anopheles* at index stations, where they were abundant in previous years.

As part of a study of overwintering habits of *Anopheles*, investigations were made of the fertility of adult *A. quadrimaculatus* (the primary vector of malaria in this area) collected from hollow trees on days following temperatures below freezing. Since no males were recovered and inseminated females were found, it was concluded that fertilized females survive the winter and produce viable ova the following spring.

Morphological studies of larvae of the common anophelines were undertaken, and keys by which field workers may identify the second and third stages of these species were prepared. Methods for identification of the first and fourth instar larvae already were available.

Chemical analyses were made of water from ponds that produce *A. quadrimaculatus* and from ponds in which no breeding occurred. Tests for nitrites, nitrates, saline, ammonia, albuminoid nitrogen, total organic nitrogen, dissolved oxygen, free carbon dioxide, calcium and magnesium, silica, copper, iron, phosphates, and residual pH indicated no distinct differences between breeding and nonbreeding areas. Ponds were at an extremely low level during most of the investigation, however, and this abnormality may have masked chemical differences.

HELENA, ARK., STATION: Two general methods were used in surveys for the detection of human malaria in this area: (1) approximately 1,000 residents were visited by a nurse who recorded evidence of symptoms of malaria; and (2) blood surveys were made of other groups. Blood films also were collected from new residents (the population turnover was about 30 percent in both 1950 and 1951), from school children in several counties, and from Mexican nationals imported to work in agriculture. All films proved negative for malaria parasites.

A. quadrimaculatus host preference studies indicated that the highest percentage of blood meals by engorged mosquitoes came from horses, with cattle second, and human blood very rarely involved. During the first quarter of the fiscal year, 45 percent of 1,183 mosquitoes engorged horse blood while only 2 of the total consumed human blood. Second quarter findings showed horses to be the commonest host with 35 percent, and bovines second with 34 percent; none of the mosquitoes tested exhibited human blood.

Investigations on the bionomics of *quadrimaculatus* developed information indicating that the dispersal of insecticidal dust by cotton producers reduced the numbers of *Anopheles* in collecting places near cotton fields. Collections were relatively light during 1951 and cotton producers dispersed insecticidal dust at rates higher than normal during the period mosquito collections were low. Confirmation of this observation was obtained through tests wherein caged *A. quadrimaculatus* were placed around a 30-acre cotton field prior to dusting. Total kills of adults in open fields the morning after dusting were observed at points 500, 415, and 300 yards from the perimeter of the dusted area. A mortality of 2 percent occurred in control cages. Light trap collections in the area did not rise to normal until 2 weeks after dusting, indicating that the dust exerted a larvicidal effect.

Field tests failed to support the suggestion of some workers that in rice field areas *A. quadrimaculatus* might be able to withstand periods of drying.

In studying the possible relation of different types of blood food to egg production in *A. quadrimaculatus*, maintenance of a colony became necessary. When a colony was moved from Georgia to Arkansas, through the transfer of 40,000 eggs, the larvae were reared successfully, adults emerged on schedule, females fed as expected, but eggs were not obtained at the normal time. The first eggs failed to hatch, suggesting that the females had not been fertilized. Conditions of temperature and humidity under which the colony was kept were the same as in Georgia; but the Arkansas insectary was windowless which resulted in abrupt transition from bright light to total darkness, thereby precluding the crepuscular period thought to be necessary for normal mating and oviposition. A red light bulb was installed in the insectary and allowed to burn when bright light was absent, and within a few days fertile eggs were obtained from the colony.

MANNING, S. C., STATION: A survey for the detection of human malaria has been carried on in this area, which is adjacent to the Santee-Cooper reservoir, since October 1944. This past year, as previously, blood films were collected at monthly intervals from 85 percent of the population of about 2,000. In addition, twice during

the year, intensive surveys were conducted in the surrounding area (blood samples from 84 percent of 1,000 persons). Examinations of 19,800 blood films revealed no malaria positives. Malaria was last detected in this area in February 1949.

The continued presence of sporozoites in *Anopheles* in the absence of demonstrated human malaria remains a problem of primary concern to malariologists. Large-scale dissections of *Anopheles* were made during the year. Results of dissections are summarized in table 13. Table 14 shows some of the findings of a blood-parasite survey of animals carried on as part of a study on the possible source of unknown sporozoites found in wild-caught anophelines. Some 1,600 animals, encompassing all domestic and wild species common in the areas, were studied.

NURSING TECHNIQUES

Negligent handling of hospital ware and other unhygienic lapses in established nursing practices may well serve to favor the transport of infectious agents from one person directly to a new victim. Such transfer may occur if oral thermometers are inadequately sterilized and are used with a succession of patients. Thermometer cleaning and disinfection was the subject of 2,628 tests run in Center laboratories, involving mechanical cleansing and disinfection in alcohols, formalin, and iodine preparations. There were 50 streptococci, 214 "plemorphic rod" bacteria, and 221 other bacteria recovered from thermometers sterilized in accordance with procedural manuals; all the thermometers tested had come from immediate contact with sputum and saliva.

PLAGUE

Through the laboratory examination of 31,961 rodents, 62,351 fleas, 8,349 ticks, and 1,410 lice from 106 counties of 14 States and the Territory of Hawaii, wild rodent plague was demonstrated 16 times in 8 counties of 5 States and Hawaii. Center laboratory personnel investigated three deaths from bubonic plague, one in Arizona and two in New Mexico. Six of 7 cases of human plague recorded during the past 2 years occurred in New Mexico.

In the hope of evolving a more effective method of limiting the spread of plague among wild rodents, the approach to plague investigative studies was modified during the past year, both in the United States and in Hawaii.

During the past 16 years, there has been no substantial evidence of the spread of plague eastward. However, rather comprehensive surveys, by Public Health Service workers and crews from seven State health departments, have been carried on in the known infected areas. In 1950, four new counties, representing Kansas, Oklahoma, and Texas, were found to have foci of plague infection; but in each instance the county involved was adjacent to previously identified foci and there was no evidence of eastward spread. Accordingly, it was decided that the determination of the extent of the plague problem in the Western States, though important, does not in itself necessarily produce specific knowledge upon which to base effective plague control or eradication measures. Rather, it was decided, a sounder approach would be to make an extensive search for a weak link in the plague transmission chain. Studies employing this approach were inaugurated during 1951 in

Table 13

ROUTINE DISSECTIONS OF WILD-CAUGHT "ANOPHELES"

Species	Cumulative Total - FY 1951	Cumulative Total - FY 1950
No. *crucians* dissected	4,816	9,755
No. *crucians* with sporozoites	4	8
% *crucians* with sporozoites	0.08	0.08
No. *quadrimaculatus* dissected	6,300	5,307
No. *quadrimaculatus* with sporozoites	0	4
% *quadrimaculatus* with sporozoites	0	0.08
No. *punctipennis* dissected	97	76
No. *punctipennis* with sporozoites	0	0

Table 14

SUMMARY OF BLOOD PARASITE SURVEYS

DOMESTIC ANIMALS

	Total Animals Sampled	Microfilaria	Trypanosomes	Leucocytozoon	Haemoproteus
Equine	300	3[a]	-	-	-
Bovine	400	8[b]	4[c]	-	-
Canine	400	91[d]	-	-	-
Porcine	106	-	-	-	-
Avian					
Chicken	400	-	-	61[e]	-
Duck	13	-	-	-	-
Goose	7	-	-	-	-
Guinea	2	-	-	-	-
Turkey	10	-	-	10[f]	3
Totals	1,638	102	4	71	3

[a] *Setaria equina* (?)
[b] *Setaria cervi* (?)
[c] *Trypanosoma theileri*
[d] *Dirofilaria immitis*
[e] *Leucocytozoon andrewsi*
[f] *Leucocytozoon smithi*

WILD ANIMALS

	Total No. Specimens Sampled	Results
Amphibians		
Salamanders (4 Genera, 5 species)	53	No parasites found
Toads and Frogs (4 Genera, 9 species)	43	3 Haemogregarine infections, 6 Trypanosome
Reptiles		
Snakes (10 Genera, 15 species)	57	21 Haemogregarine infections, 2 Trypanosome
Lizards (5 Genera, 7 species)	41	No parasites found
Turtles (7 Genera, 7 species)	53	25 Haemogregarine infections
Mammals		
Assorted (6 Genera, 6 species)	25	1 Microfilaria infection
Total	272	

Santa Fe County, N. Mex., where wild rodent plague is endemic. The hope is that sustained investigations in this restricted area will produce, in time, sufficient knowledge to permit the detection of the weak link in the infection chain and the initiation of successful attack at this point.

In Hawaii, recent cases of plague have been of the rural, nonepidemic, wild rodent type. However, the rodents involved are those generally thought of (at least in the United States) as domestic species, which are attracted to and live in agricultural areas where harborage and food are plentiful. In the Hamakua District of Hawaii, some 112 cases of human plague and 1,148 positive rodents have been confirmed during the past 42 years. Human cases occurred in 27 of the 42 years and positive

rodents were found repeatedly each year. Rat control methods have been employed throughout this period, but have succeeded only in reducing the infestation, not in eliminating the rodent population. Since 1948, DDT has been used to spray and dust buildings as a preventive of human infection. This limited use of DDT is not enough to destroy the opportunity of infection, although it probably prevents some human cases. On the other hand, intensive and widespread attack on the plague-transmitting flea (*Xenopsylla cheopis*) with DDT might interfere with the chain of infection in the circumscribed infected area in Hawaii to such an extent as to prevent the transmission of plague from rodents to rodents and rodents to man. Inauguration of a program of this character requires information that is not now available on such points as the effect of DDT on sugar cane agriculture. To acquire this and other information essential to the proper guidance of the type of program envisioned, the Center has joined with the Territorial Health Department in exploratory studies. Once the necessary information is obtained, it is proposed that a full-scale vector control program, using DDT, be initiated with the objective of eradicating plague from the Islands.

POLIOMYELITIS

Exploring and evaluating the role of flies in the spread of poliomyelitis has been a Center activity since 1946. In that year at Florence, Ala., and in 1947 at Wilmington, Del., an attempt was made to measure the influence of fly control on epidemics of poliomyelitis by intensive fly control in the epidemic area. It was readily apparent that this was not practical because of the difficulty of predicting the extent of epidemics in advance; and furthermore, there was the magnitude of the problem of achieving effective fly control within the short period of time necessary to correlate control with the trend of the epidemic. A second approach was adopted in 1948 when continuous fly control was initiated in five representative cities in different parts of the country (Charleston, W. Va.; Muskegon, Mich.; Phoenix, Ariz.; Topeka, Kans.; and Troy, N. Y.) with the objective of comparing the poliomyelitis experinece in these cities with that in comparable cities wherein fly control was not practiced. While theoretically sound, this approach proved to be beyond the resources of the Center by reason of economic and other factors. However, much valuable information was accumulated, particularly with respect to fly control methods and techniques, which has been profitable in various Center operations. A study of data accumulated through 3 years of experience with the approach adopted in 1948 made it clear that comprehensive epidemiological studies, extending beyond the counting and verification of reported cases of poliomyelitis in the fly control cities, are essential to the success of the basic study of the role of flies in spreading poliomyelitis.

Accordingly, the program now has been limited to Charleston, W. Va., and Phoenix, Ariz. (two of the 5 original cities), where fly control operations and epidemiological investigations are carried on in parallel. This approach provides for the integration of intensive fly control operations, measurement of the fly densities within the control cities, and studies of fly biology, and epidemiological and clinical studies of the human population using the cross section technique. The epidemiological phase includes: (1) the detailed clinical and epidemiological investigation of each reported and suspected case of poliomyelitis, during epidemic and endemic periods, with the collection of appropriate specimens for laboratory determination. Medical or nurse epidemiologists, operating in the field, compile a record of illnesses among family contacts; (2) the carrying on of repetitive morbidity surveys, using trained lay enumerators, in certain contact areas selected for their homogeneity as epidemiological units; (3) follow-up studies by the epidemiologists of samples of individual cases and of family and small community outbreaks of all types of minor illness recorded by the lay enumerators; (4) the undertaking of special studies as opportunities present themselves; (5) the correlation of the findings in all epidemiological studies with extensive and intensive studies on fly population, fly breeding, and fly control activities in the control cities; (6) systematic collection of large numbers of fly specimens and of sewage samples for virus isolation.

The Poliomyelitis Study Unit of Yale University Medical School and the National Foundation for Infantile Paralysis are collaborating with the Center in these studies.

The purpose of the composite study, in general terms, is to attempt to achieve a more complete description of the occurrence and spread of poliomyelitis infections in representative American cities than has been feasible heretofore; and to

evaluate the role of flies in the transmission of the infection.

In Charleston, efforts are directed toward the quantitative determination of the incidence of poliomyelitis and Coxsackie virus over a continuing period of time. Specimens of different types are collected and forwarded to the Poliomyelitis Study Unit of Yale University Medical School which is processing them for virus isolation.

Two areas of Charleston were selected for intensive study: District I, consisting of a population of 900 individuals in 220 families residing in the Chandler Branch section; and District IV, consisting of a population of 1,300 individuals in 430 families residing in Kanawha City. District I is situated in the north central part of Charleston where socioeconomic conditions are low, families are relatively large, the usual facility for disposal of human excrement is the insanitary privy, wastes from nonstandard septic tanks find their way into a stream flowing through the community, and garbage handling is inadequate. The fly breeding potential is high and the opportunity for the spread of infectious agents by flies is excellent. District IV, on the other hand, is located in an area of relatively high socioeconomic status, it is completely sewered, the fly breeding potential is low, and a minimum of human excrement is accessible to the fly population. Families in this area are relatively small and hygienic habits of the population are generally good.

Preliminary reports from the Yale workers, who have processed some of the specimens received from Districts I and IV, are encouraging but incomplete. Blood specimens from family groups in the two districts, collected in May and June, have been subjected to preliminary laboratory examination for neutralization antibodies to Lansing type poliomyelitis virus. In District I, 50 percent of 1-year-olds exhibited antibodies to Lansing virus and the proportion rose progressively with increasing age until age 9. In contrast, in District IV only 14 percent of children in the 1- to 2-year bracket exhibited antibodies to Lansing virus and the proportion did not reach 50 percent at age 8. Thus, there is the suggestion of a substantial difference in the prevalence of Lansing antibodies among the populations of the two different economic status sections of Charleston. Studies of the same blood specimens yielded data indicating that the prevalence of Lansing antibodies is related to the size of the family. In District I, children from 1 to 4 years of age showed a progressive increase of antibodies, 25 to 75 percent, if they lived in families with increasing numbers of children. In District IV, the same trend was apparent but the prevalence ratios were consistently lower.

These preliminary findings, it must be emphasized, are indicative of the type of information being accumulated. They are too fragmentary to warrant forecasts.

During a part of the year, both laboratory and epidemiological support were available in the Phoenix studies and considerable progress was made toward reorienting activities to the new approach. Center laboratories, for example, processed 1,570 specimens with a yield of 45 *Shigella* isolates, 12 *Salmonella* species, and 235 paracolon strains. However, the Phoenix study has not reached the stage where significant results are available.

FLY CONTROL OPERATIONS: This phase of the program, like the epidemiological phase, was materially altered during 1951, to conform to the decision to limit poliomyelitis studies to two cities, Charleston and Phoenix. However, limited control activities were conducted in each of the three other cities, Muskegon, Topeka, and Troy, through the 1950 fly season. In Muskegon and Troy, chlordan and dieldrin, respectively, were applied to garbage stations and animal shelters to ascertain the efficacy and duration of fly control resulting from a single application. At Muskegon, chlordan applied at rates of 200 and 100 mg./sq. ft. produced satisfactory fly control but its effectiveness was short lived – 3 to 4 weeks. At Troy, dieldrin at 50 mg./sq. ft., applied in June, gave effective fly control through the fly season, holding grill counts to 2.8 compared to 11.6 in an adjacent town. Thus, it appears that in the Troy area, where the fly season is relatively short and the predominant species is the blow fly, fly control through the application of dieldrin is advantageous and economically feasible.

Operational fly control activities at Topeka were carried on through the summer of 1950 with a degree of effectiveness that prompted the community to continue the program on its own when the Center was forced to discontinue operations there.

Charleston: Discontinuance of operational activities at Muskegon, Topeka, and Troy made it possible to augment control personnel at Charleston and Phoenix. In Charleston a sanitary

engineer was added to survey problems related to the handling of garbage and industrial waste. Added emphasis was placed on an educational-informational program designed to enlist public support of sanitation and thereby encourage municipal officials to utilize the services of Center specialists in improving and expanding sanitational activities. Although the sanitation program is still inadequate, for example garbage is collected only once a week in many areas, considerable progress was made during 1951 and effective fly control was obtained through a combination of sanitation and chemical sprays. Project personnel contacted householders in support of efforts to remedy defects noted by the sanitation survey, and spray personnel received special instructions in the placement of chemical sprays. Grill counts were held to approximately 2 throughout the 1950 season. That this degree of fly control was maintained must be attributed, at least in large part, to the fact that in the Charleston area insecticidal resistance was not encountered. Another contributing factor was the guidance entomological personnel were able to provide through parellel observations which produced information of immediate operational application.

Phoenix: In contrast to the situation in Charleston, resistance to insecticides was a major complication in Phoenix, which, combined with multiple sanitation problems, made 1951 operations both frustrating and interesting. House flies, predominant species in Phoenix, developed such a degree of resistance to dieldrin that in late August chemical applications were abandoned, even though the fly season normally lasts through October. However, by the close of the fiscal year fly control efforts were meeting with encouraging success. Factors leading to this success included the appointment of a city health officer to that long-vacant position. The appointee was in full sympathy with the aims of the project and gave aggressive leadership in convincing municipal authorities that greater support of an improved sanitation program was essential to its success. Largely through the health officer's leadership, the city inaugurated the sanitary landfill method of garbage disposal, purchased new garbage collection equipment, extended garbage collection services on a two-times-a-week schedule to the entire substandard area of Phoenix, and sponsored an intensive drive to encourage the use of proper garbage containers.

Concomitantly, new experimental chemicals were employed on a selective basis with encouraging results. A water-wettable suspension of BHC was used as a larvicide. It is relatively inexpensive and proved more effective than DDT. Dilan, a new compound not yet fully tested, was used for residual treatment with promising results. It is relatively expensive, however, and use on a large scale is not economically feasible. A synergist, DMC, added to 5 percent DDT formulations and applied as a space spray, gave results comparable to the DDT space sprays of 2 years ago.

As in Charleston, entomological field personnel provided helpful guidance in adapting operations to changing conditions and in evaluation of results. For a short period during the 1951 fly season, the city-wide grill count rose to approximately 10, compared to 45 in the control town, but control efforts withstood the spring fly peak without a disastrous breakthrough.

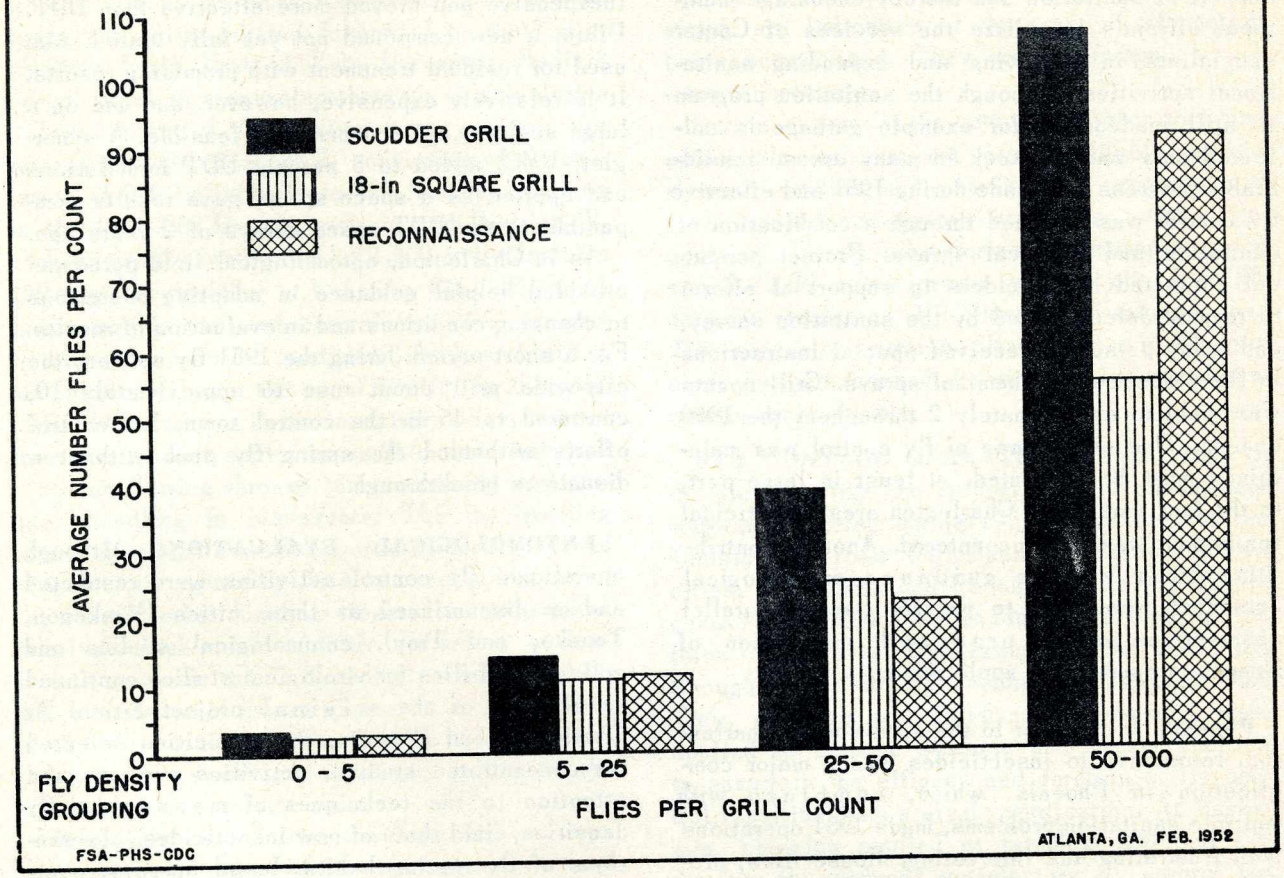
ENTOMOLOGICAL EVALUATION: Although operational fly control activities were restricted and/or discontinued at three cities (Muskegon, Topeka, and Troy), entomological studies and collection of flies for virological studies continued at all five of the original project cities. At Charleston and Phoenix, the two cities selected for concentrated studies, activities encompassed attention to the techniques of measuring fly densities, field tests of new insecticides, observations of fly resting habits, larval surveys, overwintering behavior of flies, and fly dispersal experiments.

In fly density measurement studies, three different techniques were tested in Charleston, Phoenix, and Topeka. Results indicate that all three methods (Scudder grill, an experimental 18-in. square, and the reconnaissance method) are acceptable in the evaluation of fly densities for guidance in operational programs. Perhaps the most significant finding was that the reconnaissance method, which entails the estimation of numbers of flies visually and is the most rapid, yielded average fly indexes almost identical with those obtained with the Scudder grill method, particularly at lower density levels. As shown in figure 8, relatively minor differences resulted from the reconnaissance method in relation to the Scudder grill, indicating that this method holds promise of considerable import if it can be adapted to use by inexperienced personnel.

Analyses of the present sampling pattern of

FIGURE 8

AVERAGE FLY DENSITIES IN AREAS OF DIFFERING FLY POTENTIALS AS DETERMINED BY THREE METHODS OF SURVEILLANCE.



fixed station and random station inspections revealed that indexes obtained from either type were of similar magnitude in units composed of areas of comparable fly potential. In heterogeneous units, fixed station indexes averaged higher than random station indexes. In some instances random station indexes indicating a need for control measures lagged 6 to 7 weeks behind similar indexes obtained from fixed stations. Thus, since early reflection of any upsurge in fly densities is desirable, it is concluded that the fixed station technique is the more sensitive and practical indicator for use in fly control programs.

Entomological evaluation of the effectiveness of control operations in the respective project cities during 1951 is summarized on pages 38-39 of this report, under Fly Control Operations.

Studies of fly overwintering at Phoenix indicated breeding of house flies (*Musca domestica*) in all sections of the city in a wide variety of substrates – cow, horse, fowl, and pig excreta; and vegetable wastes. At Charleston, breeding of *Ophyra aenescens* was found to occurr continuously in a dump area where temperatures ranged well above air temperatures. Periodic examination of selected dump stations showed the presence of fly larvae throughout the winter season.

Q FEVER

Investigative studies on Q fever, carried on in cooperation with the California Department of Public Health and other agencies, are reported in a series of papers published* during 1951. Among other things, serologic tests to ascertain the prevalence of antibodies to *Coxiella burnetii* (causative agent of Q fever) in sheep, goats, and cattle showed a variation in the distribution of

*Pub. Health Rep. 66(45): 1473-1477 (1951); Am. J. Hyg. 54(1): 1-14 (1951); Am. J. Hyg. 54(1): 25-34 (1951).

antibodies in these animals in two major geographic areas of California. In northern California, the highest prevalence of antibodies was encountered in sheep and goats, while in southern California, the highest prevalence was found in dairy cattle. This finding conforms to previous epidemiological observations of human Q fever, namely, in a majority of instances cases in southern California had a history of contact with dairy cattle and in northern California the contact usually was with sheep.

Lactating cattle concurrently exposed to *C. burnetii* and *Streptoccus agalactiae*, by dipping their teats in milk containing both agents, failed to contract Q fever. Three of five cows involved did contract *Streptococcus mastitidis*. Thus, it appears that lactating cows do not acquire Q fever infections from contamination through the milking process. The five cows subsequently were exposed to *C. burnetii* by ingestion of contaminated bran at weekly intervals for a month. Each animal ingested a total of about $2x10^9$ minimal infectious guinea pig doses. At 5 months postexposure none of the cows developed serologic evidence of infection through ingestion, indicating that cattle likely do not acquire Q fever by ingestion. Cattle exposed to *C. burnetii* by inhalation usually exhibit evidence of infection by a rise in complement fixing antibody and/or the localization of infection in the mammary gland or placentae. These data suggest that natural infection of cattle is acquired through inhalation of *C. burnetti*.

Sixteen cases of human Q fever were diagnosed in an investigation of an outbreak in central Idaho. Most of the cases had a history of contact with sheep. Definite serologic evidence of infection in one herd of sheep was demonstrated and other herds contained sheep with low serum levels of complement fixing antibodies.

RABIES

Comparative evaluation studies on dog rabies vaccines were carried forward at Center laboratories in Montgomery, Ala. Vaccines under test include chick embyro, phenolized, ultraviolet irradiated, and benzene-ether extracted calcium washed products. In January 1950, the four groups of test animals, aggregating 350 dogs, were immunized. The animals have been under daily observation since that time and blood specimens for neutralization tests have been collected from all vaccinated dogs at 6-month intervals. Results of the neutralization testing thus far have shown a uniformly significant rise in neutralization index that has persisted at substantial titer for a period of 12 months after vaccination.

In order to check the possibility of inapparent infection from the use of live virus vaccine, saliva, whole blood, and serum specimens were collected from dogs vaccinated with chick embryo vaccine and pooled samples were injected intracerebrally into mice. Specimens were taken from the mice each day for 10 days following vaccination, and then on the thirteenth day and the twenty-first day. At no time was virus recovered from the specimens.

Experiments conducted in cooperation with Harvard University to measure the possibility of inapparent reservoirs of rabies in wild rodents yielded negative results. Animals used in intramuscular titration and straight challenge were cotton rats, guinea pigs, and rabbits.

SALMONELLOSIS

Many *Salmonella* infections are considered primary infections of animals which may be transmitted to humans, and there are reports tending to incriminate the dog as the source of human salmonellosis. Center personnel cooperated with the Florida Bureau of Laboratories in studies designed to assemble further information on this question.

In a semirural area where *Salmonella* infection was unusually high in dogs, a survey was conducted to explore the relationship of infection in animals to that in humans. Isolations were common in dogs but relatively few infections were detected in the human population. A similar study in urban Duval County, Fla., gave comparable results. Cultures taken on dogs at rabies clinics, which it was deemed would provide the most reliable information as to the prevalence of *Salmonella* infection in normal dog populations, yielded an average isolation of about 12 percent. Prevalence studies dealing specifically with greyhounds, dogs in veterinary hospital pounds, dogs in boarding kennels, and normal dogs are reported in four papers scheduled for publication in the Journal of Infectious Diseases. In these studies, cultural examinations were made of 8,157 dogs, 27.6 percent of which were found positive for *Salmonella*. The proportion of positives in different groups and/or different communities ranged from very low to very high. Of 1,602 cultures from greyhounds in the Jacksonville area, 43.6 percent were positive, while 15 percent of 1,626 specimens from normal

dogs were found positive. Examinations of 2,438 hospitalized dogs revealed 21.5 percent positive.

During the studies 53 serologic types of *Salmonella* organisms were encountered, including 3 new types and 7 types not previously found in Florida.

Three *Salmonella* types were isolated from 5 of 16 turkeys submitted for examination by a local breeder. An outbreak of *Salmonella california* in his flock of 1,300 birds had caused 25 percent mortality.

In an examination of retail meat samples for *Salmonella* organisms, 12 percent of sausage and 2 percent of hamburger samples were found to be positive. Results of tests on materials from abattoirs and rectal swab cultures taken on 1,200 slaughtered swine indicate that a wide variety of *Salmonella* infections is prevalent in swine.

Approximately 6 percent of rats trapped in restaurants in Jacksonville, Fla., that have been examined were found to harbor *Salmonella* Thus far, a study of the prevalence of *Salmonella* in dairy cows has shown a very low percentage of positives.

STREPTOCOCCUS

During 1951, Center laboratories undertook the manufacture of *Streptococcus* typing antiserums, outside contract for supplies of this biological having been terminated. Approximately 10,000 ml. of serums were produced, 4,000 ml. of which were distributed to the Army. Other quantities were made available to rheumatic fever research workers.

Center laboratories also provided type identification for 422 *Streptococcus* cultures from rheumatic fever studies, from veterinary medicine studies, and from other sources in 18 States and Alaska.

TICK-BORNE DISEASE

Tick-tularemia investigations undertaken in cooperation with the Arkansas Board of Health in 1950 were expanded during 1951. Reported cases of tularemia in the United States averaged 1,608 per year for the period 1946-1950, and in Arkansas 56 percent of recorded human cases were caused by tick bite rather than by contact with infected rabbits. There are indications that in other areas, there is a similar relationship between tick bite and incidence of tularemia. Observations in certain areas also suggest a correlation of high warm season prevalence of tularemia with the distribution of certain species of ticks and of deerflies.

In 1950, a survey team, consisting of Center and Arkansas Board of Health personnel collected 2,302 adult ticks and some 2,500 nymphal ticks in 31 counties. The most numerous and most frequently encountered species was the lone-star tick (*Amblyomma americanum*), followed in order by the American dog tick (*Dermacentor variabilis*), and the blacklegged tick (*Ixodes scapularis*). The latter was fairly numerous during the fall and winter months. The rabbit tick (*Haemaphysalis leporispalustris*) was common on rabbits and quail, and a few specimens of the Gulf Coast tick (*Amblyomma maculatum*) were found on cattle in the southern part of the State.

Dragging was the predominant method of collecting, but collections were also made from dogs and cattle, and a smaller number from pigs, rabbits, quail, and tree squirrels. Deer appear to be the principal natural host of *A. americanum*, this species being numerous on all deer examined. On dogs, *D. variabilis* was the most common.

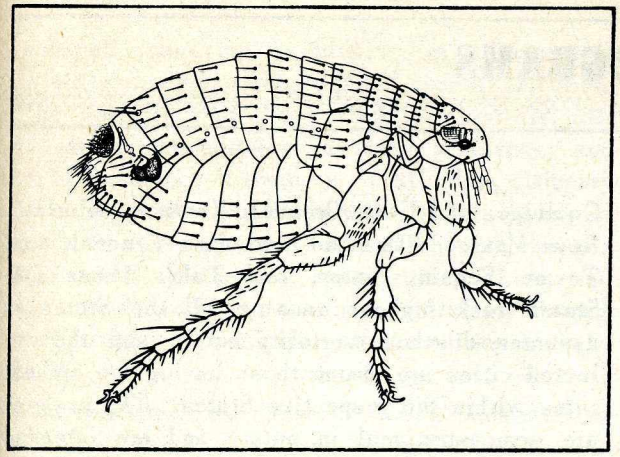
A. americanum was abundant in April through July, *D. variabilis* was found only in July, and *I. scapularis* only in the fall.

A pool of ticks collected from Marion County, Ark., in July 1951 yielded positives when tested by Center laboratories.

An average of 538 cases of Rocky Mountain spotted fever per year was reported during the period 1946-1950. Contrary to what the name implies, this disease is most common in the South Atlantic States, and the East Central part of the United States rather than in the Rocky Mountains area. In cooperation with the Ohio Department of Health and FSA Regions IV and V, a brief survey of Rocky Mountain spotted fever was made in southern Ohio. Some 950 ticks, mostly *D. variabilis*, found on dogs and taken by dragging, were collected and forwarded for laboratory examination.

TYPHUS

Since 1946, the Center has carried on in southwest Georgia field studies and investigations concerning the effectiveness of murine typhus control methods, particularly DDT dusting of rat runs, and the relation thereto of such epidemiological aspects of the disease as human incidence, rat (reservoir) prevalence, and abundance of rat ectoparasites. Rat runs and harborages in Thomas and Brooks Counties were treated with



X. cheopis, the oriental rat flea.

10 percent DDT dust (five rounds over a period of approximately 18 months). Grady County functioned as a control.

Dusting operations in Brooks and Thomas Counties resulted in a satisfactory control of the oriental rat flea (*X. cheopis*), the chief vector of murine typhus. Reduction of this flea was accompanied by a marked reduction in the prevalence of typhus complement-fixing antibodies in rats and a decrease in the incidence of human cases of typhus. Observations have continued and many of the accumulated findings have been reported in published papers.*

Since 1948, there has been a general upward trend in both oriental rat flea abundance and in the prevalence of typhus antibodies in rats in the dusted counties. However, both flea abundance and antibody prevalence in the dusted counties continue significantly lower than in the control county. A 1950 trapping survey of rats revealed that the treated counties were still far below the untreated county, both in percentage of rats infested with fleas and in rats infected with typhus. A slight increase was noted in both categories in the treated counties as compared to earlier years, but a comparable increase ratio was noted in the untreated county. These data, coupled with a sharply decreasing rate of typhus in humans, indicate the need for studying the rickettsial reservoir in rats in cases where the influence of antibiotics, currently used in treating human cases, would not intervene to mask the results.

During 1950, 11 cases of human typhus (confirmed) were recorded in undusted Grady County. One case was recognized in Thomas County and one in Brooks County, (both dusted). From January through June 1951, only one case was recognized, which is a substantial reduction in the number of detected cases during the first 6 months of any calendar year since the beginning of the study.

Center laboratories, in support of field studies and also in quest of improved diagnostic methods and techniques, devoted considerable effort to murine typhus during the year.

The isolation of typhus rickettsiae from rats is expensive, which has caused the use of indirect methods to measure the incidence of infected rats in study areas. Moreover, isolation from rat blood, if attempted, should be performed soon after capture of the animal, and the problem of moving the necessary laboratory equipment about and setting it up in the field is considerable.

The usual practice, therefore, is to send the blood from captured rats to serology laboratories where complement fixation tests for antibodies are run, using murine typhus antigens. Positive tests are considered good evidence that at one time, at least, the rat was infected with typhus. When the percentage of positives in rats from any collection site drops, it is considered that the typhus reservoir has dropped and the likelihood of human cases much lessened. In practice, positive serologic tests decline following ectoparasite and rat control in the area from whence the tested rats are collected.

Center laboratories tested 8,778 rat serums submitted by field teams operating in Alabama, Arkansas, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and Hawaii. In addition, Center laboratories evaluated three authors' versions of the complement fixation tests and found that the Kolmer technique seemed best for usual diagnostic use. Author-variations of the complement fixation tests can be confusing; some laboratories are even lax in applying the protocols of the classical Weil-Felix test.

*Pub. Health Rep. 63: 1635-1653 (1948); Pub. Health Rep. 65: 57-63 (1950); Pub. Health Rep. 66: 1052-1057 (1951); Am. J. Pub. Health 41: 396-401 (1951).

OPERATIONAL CONTROL PROGRAMS

Cooperating with States in the operational phase of communicable disease control programs continues to be a major Center activity, although in recent years an increasing proportion of total effort has been directed toward applied research, investigations, studies, and the training of State and local health personnel. Center participation in operational control activities in the field which involve established programs, such as malaria control and typhus control, is through organizations known as "CDC Activities" set up within State health departments. In other instances, for example diarrhea-dysentery control projects, appropriate modus operandi are worked out prior to the initiation of projects so that objectives and responsibilities of cooperating principals are known in advance. This formula, which evolved out of experience, permits the application of broad general policies and enables the Center to make available to the respective States, and to local health agencies therein, the techniques and technological information developed over the years. It also enables the Center, through the loan of personnel and continuous interchange of experiences, to add to its store of knowledge concerning communicable disease control, and thereby increases its competence to render consultation services in this area.

DIARRHEA-DYSENTERY

Late in fiscal year 1950 the Center initiated a program of cooperating with State and local health authorities in fly control for the specific purpose of reducing mortality and infection from dysentery and diarrheal diseases in selected areas of high endemicity. Investigative studies* in Hidalgo County, Tex., and in the vicinity of Thomasville, Ga., afforded substantial proof that flies are important vectors of dysentery-diarrheal organisms, and that effective fly control reduces the prevalence rates of infections due to *Shigella.*

During 1951, in cooperation with State and local health departments concerned, projects of this type were operated in Arizona (Yuma, Coolidge, and Casa Grande), Kentucky (Harlan), New Mexico (Carlsbad and Las Cruces), and Texas (Seguin, Sinton, and Taft). These four States rank highest among all the States in dysentery-diarrhea mortality rates, and the selected cities are among those having the highest rates within the respective States. The projects are demonstrational in nature and are intended to show the people of the operational cities that excessive fly populations can be reduced and that lowering the fly populations usually results in a reduction in the fly-borne dysentery-diarrhea prevalence rates.

Under the cooperative arrangement, the Center provides a project supervisor, a part-time assistant supervisor, vehicles, and spray equipment; the local community provides chemicals, spray labor, and funds for necessary sanitation improvements; and at the State level a program supervisor guides project supervisors and renders consultation services to communities interested in inaugurating fly control programs. It is anticipated that effecting the necessary improvements in sanitation practices will require a minimum of 3 years, and the projects are set up on the basis that Center support will continue for that period of time. Once the necessary sanitational level is attained, each community, it is believed, should be able to finance minimal spray and sanitation maintenance activities essential to a high level of fly control. Thus, as each community project becomes firmly established and is integrated into the normal health program, new demonstration projects are undertaken by the Center and the war against fly-borne diarrheal organisms is extended to new fronts.

By the close of fiscal year 1951, most of the activated projects had progressed to the point where problems and objectives peculiar to each had been defined and cataloged as to priority and capacity of the respective communities to deal with them. Sanitation, the foundation of sustained fly control, was emphasized in each instance and proved to be the most difficult problem encountered. In some of the project cities, animal shelters constituted a major problem; in others, raising the sanitational level

*Page 17 of this report.

involved improving or eliminating privies; and in all, garbage handling required special attention. The correction of these situations entails considerable expenditures in many instances, and in all instances it requires an articulate citizenry and cooperative public health officials. Lack of funds to cover necessary sanitation work was the big stumbling block in some project cities, and in others public apathy, manifested through indifference of municipal officials, was a drawback.

ARIZONA: Two projects were operated in Arizona: Yuma, and Coolidge and Casa Grande under a single supervisor.

Yuma, a community of many privies, of poor garbage handling facilities, and a tremendous seasonal problem in packing house wastes, presented a stubborn problem. In addition to aggravating sanitational problems, flies in the area developed resistance to DDT, chlordan, and dieldrin. However, efforts to improve environmental sanitation were continued. A solution was found to the cantaloupe waste problem, progress was made toward the elimination of privies, garbage handling was improved, and some success was registered in controlling fly breeding in lettuce and citrus wastes.

Fly counts in the Coolidge areas were held in check by spraying operations, and a drive to encourage the use of proper garbage containers was reasonably successful. Garbage collection services were improved by the purchase of new equipment. Fortunately, Coolidge has no major industrial waste problem and the community is relatively free of privies.

Good progress in improving sanitation was made in Casa Grande. A recently constructed sewage treatment plant is helping eliminate privies and there has been general improvement in the garbage handling program. Local officials and civic groups are behind the project, and local financial support has been increased by 10 percent.

KENTUCKY: In Harlan, the project city in Kentucky, control operations commenced concurrently with the fly breeding season, which resulted in attention being given first to spraying and second to sanitation. This approach proved effective inasmuch as flies in the area are not resistant to chemical sprays. By the middle of the year both the health officials and the general population had become aware of the community's sanitation shortcomings. A permanent sanitation committee was formed and remedial action initiated. Problems of immediate concern include insanitary privies and inadequate garbage storage and collection facilities.

NEW MEXICO: In Carlsbad, city officials have extended excellent cooperation in such areas of activity as: (1) acquisition of additional garbage collection equipment; (2) enforcement of animal shelter sanitation regulations; (3) elimination of privies from sewered areas and improving privy construction in unsewered areas; and (4) sponsoring a garbage container drive.

Garbage collection service in Las Cruces has been extended to all parts of the city on a two-times-a-week schedule, and improvements have been made with respect to animal shelters, garbage storage, and related problems.

TEXAS: The program in Texas embraces Seguin, Sinton, and Taft, the latter two under a single project supervisor.

Seguin has established a sanitary landfill for garbage disposal, eliminating an open dump at the edge of the city, and has extended garbage collection service to all parts of the community on a two-times-a-week basis. Work is going forward on a program to eliminate 1,095 privies.

In Sinton the following actions have been taken in behalf of a higher sanitation level: (1) funds have been provided for the purchase of equipment required to improve garbage collection service; (2) plans have been perfected for the orderly elimination of privies from sewered areas; and (3) an organized community-wide clean-up campaign has been executed.

Taft has substituted a sanitary landfill for open-dump garbage disposal, has extended garbage collection service on a two-times-a-week schedule, and has blueprinted plans for ridding the community of privies.

In each of the States, the respective projects were the source of fly control activities of Statewide impact, confirming the soundness of the demonstrational approach. In Arizona six nonproject cities (Douglas, Eloy, Florence, Holbrook, Miami, and Winslow) initiated specific activities to improve the sanitational level, with particular emphasis on fly control. In New Mexico the City of Roswell adopted the fly control program, in part, relying entirely on local finances; and Gallup, Clovis, and Artesia requested and received consultation services in the inauguration

of measures to cope with troublesome fly breeding problems. Three Texas cities, Atlanta, Olney, and San Marcos, appropriated local funds to support complete fly control programs.

RELATED ACTIVITIES: Utilizing experience and information gained through the diarrhea-dysentery control and the poliomyelitis-fly control projects, the Center has developed a competence that has enabled it to serve as a clearing house for general and technical information pertaining to fly control. Out of these activities, too, has developed an inventory of chemicals, sanitation equipment, scientific data, and operational practices which has clearly shown the need for an educational-informational program in support of fly control programs. Accordingly, the Center has assembled and made available a "Fly Control Packet" containing a composite of technical, organizational, and educational information designed to serve as a guide to communities undertaking locally sponsored fly control programs. This packet or kit includes an outline of fly control tools, devices, concepts, a variety of educational releases, list of available training films, materials explaining the "How" of organizing programs, and forms useful in recording data for evaluation of operations.

MALARIA

The Center continued to participate in the malaria eradication program, but on a somewhat reduced scale. Effective July 1, 1950, support of the operational phase of the residual spray program was discontinued in six of the 13 southeastern States (Florida, Kentucky, Missouri, North Carolina, Oklahoma, and Tennessee) and support of the programs in the other seven (Alabama, Arkansas, Georgia, Louisiana, Mississippi, South Carolina, and Texas) was on a reduced scale. However, State and local authorities provided increased support of the program, and effective control of the malaria-transmitting mosquito (*A. quadrimaculatus*) was maintained throughout the historically malarious area.

Coincident with curtailment of Center participation in the residual spray program, State health departments were accorded support in the activation of a malaria surveillance and prevention program designed to safeguard gains which have been attained, and to complete the task of eradicating malaria from the United States. The Center made allocations to the six nonoperational States to be used exclusively for surveillance and prevention work, and a portion of the funds allotted each of the other seven States was earmarked for surveillance and prevention purposes.

Residual spray operations carried on during 1951 are summarized in table 15. It will be observed that spraying was conducted in 243 counties in 13 States, representing 457,067 applications (Center supported and non-Center supported). Both DDT (423,005 lb.) and chlordan (62,745 lb.) were used. In addition, most States reported an increase in general insect control programs financed entirely locally, particularly fly control programs. Much of this added local support of insect control activities is traceable to promotional work and the loan of basic equipment by the Center. Seven States and Hawaii conducted larvicidal and ditch maintenance operations which, in the aggregate, included 5,217 acres and 23,448,136 linear feet of larviciding and 12,422,921 feet of ditch maintenance.

Since the malaria-transmitting mosquito (*A. quadrimaculatus*) is a necessary link in the transmission of the disease to man, lessening the chances for this mosquito to bite man by reducing its prevalence in man's normal environment yields malaria control. The residual spray program is aimed at suppressing the population of malarial mosquitoes. Thus, the effectiveness of control operations (residual spray program) may be measured in terms of reduction in the prevalence of mosquitoes.

Figure 9 is a graphic presentation of data obtained from entomological inspections of sprayed houses, selected at random, for the presence or absence of *A. quadrimaculatus*. These data, covering inspections in the southeastern States 1945 through 1950, indicate the percentage of sprayed houses found to be free of *A. quadrimaculatus* in the afternoon. The percentages, it will be noted, vary from 97.2 in 1945 and 1948 to 99.4 in 1950, with an average percentage of 98.5 for the 6-year period. Figure 10 shows the average percentage of sprayed houses free of *A. quadrimaculatus* in the afternoon, by months after spraying, and the indicated percentages of control. A comparison of sprayed and unsprayed houses harboring *A. quadrimaculatus* and indicated percentages of control over a 5-year period (1946-1950) is shown in figure 11. As indicated, a considerably greater year-to-year variation in percentages of houses harboring *A. quadrimaculatus* was recorded in unsprayed houses inspected than in the sprayed

TABLE 15

SUMMARY OF RESIDUAL SPRAY OPERATIONS - 1951

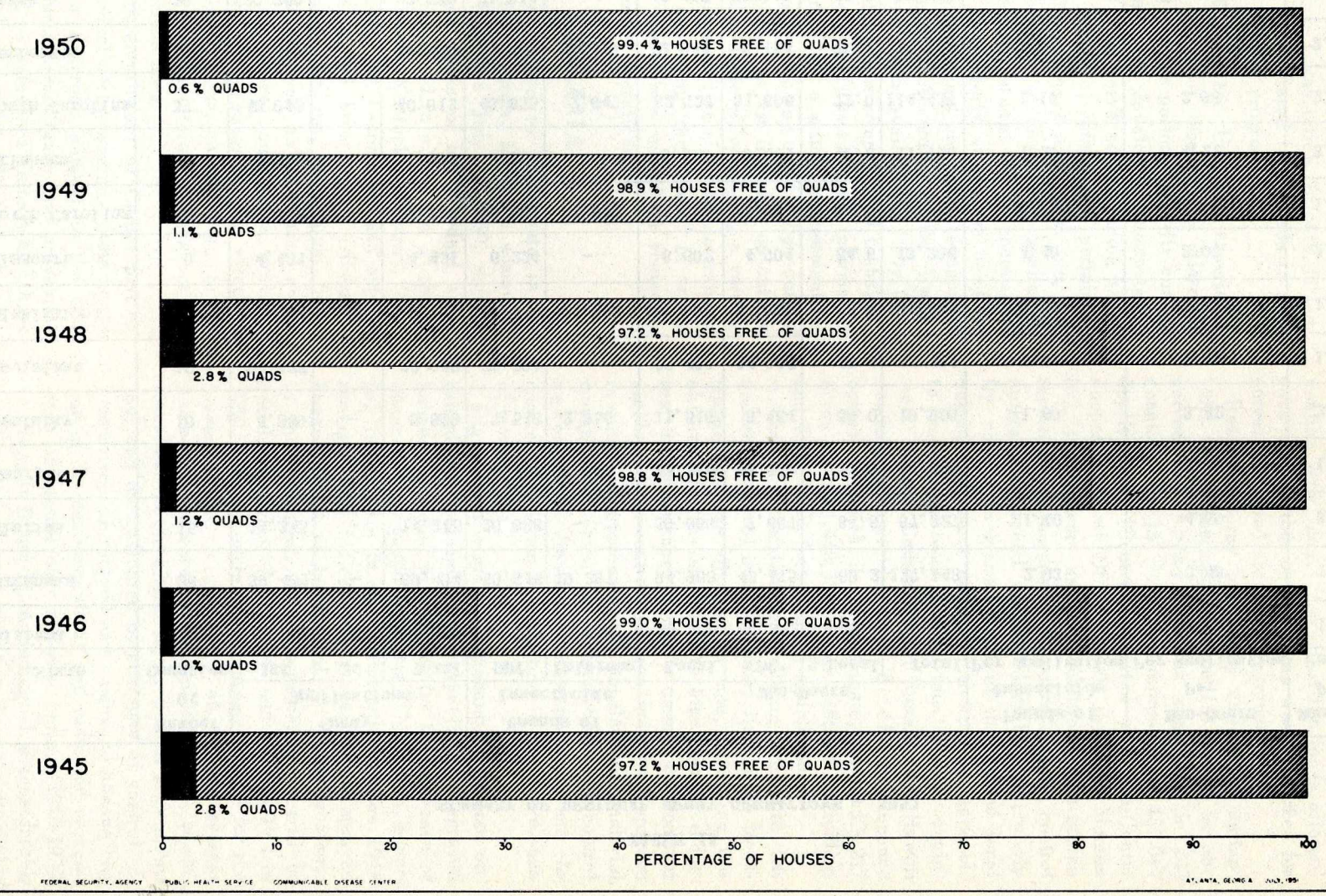
State	Number Of Counties	Spray Applications			Pounds of Insecticide		Man-Hours				Pounds of Insecticide Per Application	Man-Hours Per Per Application	Man-Hours Per Pound
		1st	2d	Total	DDT	Chlordan	Local	CDC*	% Local	Total			
Alabama	18	45,503	-	45,503	51,275	2,827	28,326	42,362	40.1	70,688	1.19	1.55	1.31
Arkansas	36	39,404	-	39,404	60,616	19,367	94,968	42,175	69.2	137,143	2.03	3.48	1.71
Florida	15	14,345	-	14,345	20,888	-	59,660	7,667	88.6	67,327	1.46	4.69	3.22
Georgia	19	45,144	31,236	76,380	58,463	1,703	48,336	36,550	57.0	84,886	0.79	1.11	1.41
Kentucky	10	5,839	-	5,839	7,518	2,356	11,516	8,464	58.0	19,980	1.69	3.42	2.02
Louisiana	10	33,027	-	33,027	33,204	-	23,457	24,962	48.4	48,419	1.01	1.47	1.46
Mississippi	18	108,723	661	109,384	84,413	22,683	107,096	35,738	75.0	142,834	0.98	1.30	1.33
Missouri	5	4,431	-	4,431	6,224	-	8,602	4,704	64.6	13,306	1.40	3.00	2.14
North Carolina	19	26,714	-	26,714	19,985	1,619	23,926	4,736	84.0	28,662	0.81	1.06	1.32
Oklahoma	7	2,795	-	2,795	3,350	-	8,320	3,434	70.8	11,754	1.20	4.21	3.51
South Carolina	37	40,013	-	40,013	43,875	2,643	82,731	31,696	72.0	114,427	1.16	2.86	2.46
Tennessee	23	19,440	-	19,440	2,180	9,547	21,981	6,184	78.0	28,165	0.60	1.45	2.40
Texas	26	39,789	-	39,789	31,014	-	42,450	38,441	52.5	80,891	0.78	2.03	2.61
Total Average	243	425,167	31,987	457,064	423,005	62,745	561,369	287,113	66.0	848,482	1.16	2.43	2.07

*Professional, technical, and supervisory personnel

FIGURE 9

RESIDUAL SPRAY PROGRAM

PERCENTAGES OF SPRAYED HOUSES FREE OF QUADS
BY YEARS, 1945–1950



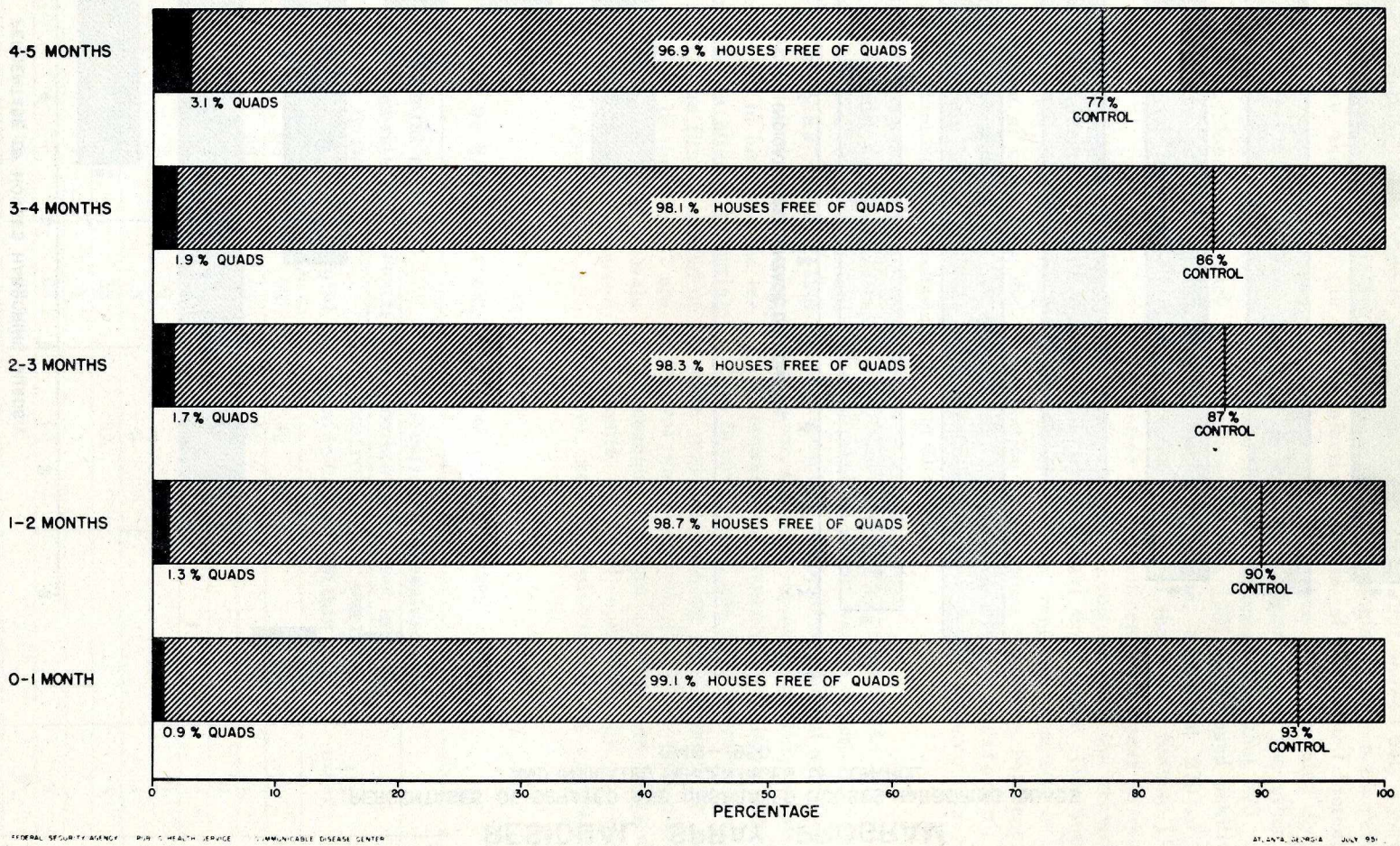
FEDERAL SECURITY AGENCY — PUBLIC HEALTH SERVICE — COMMUNICABLE DISEASE CENTER

ATLANTA, GEORGIA — JULY, 1951

FIGURE 10

RESIDUAL SPRAY PROGRAM

PERCENTAGES OF SPRAYED HOUSES FREE OF QUADS
BY MONTHS AFTER SPRAYING
WITH INDICATED PERCENTAGE OF CONTROL
1945 – 1950

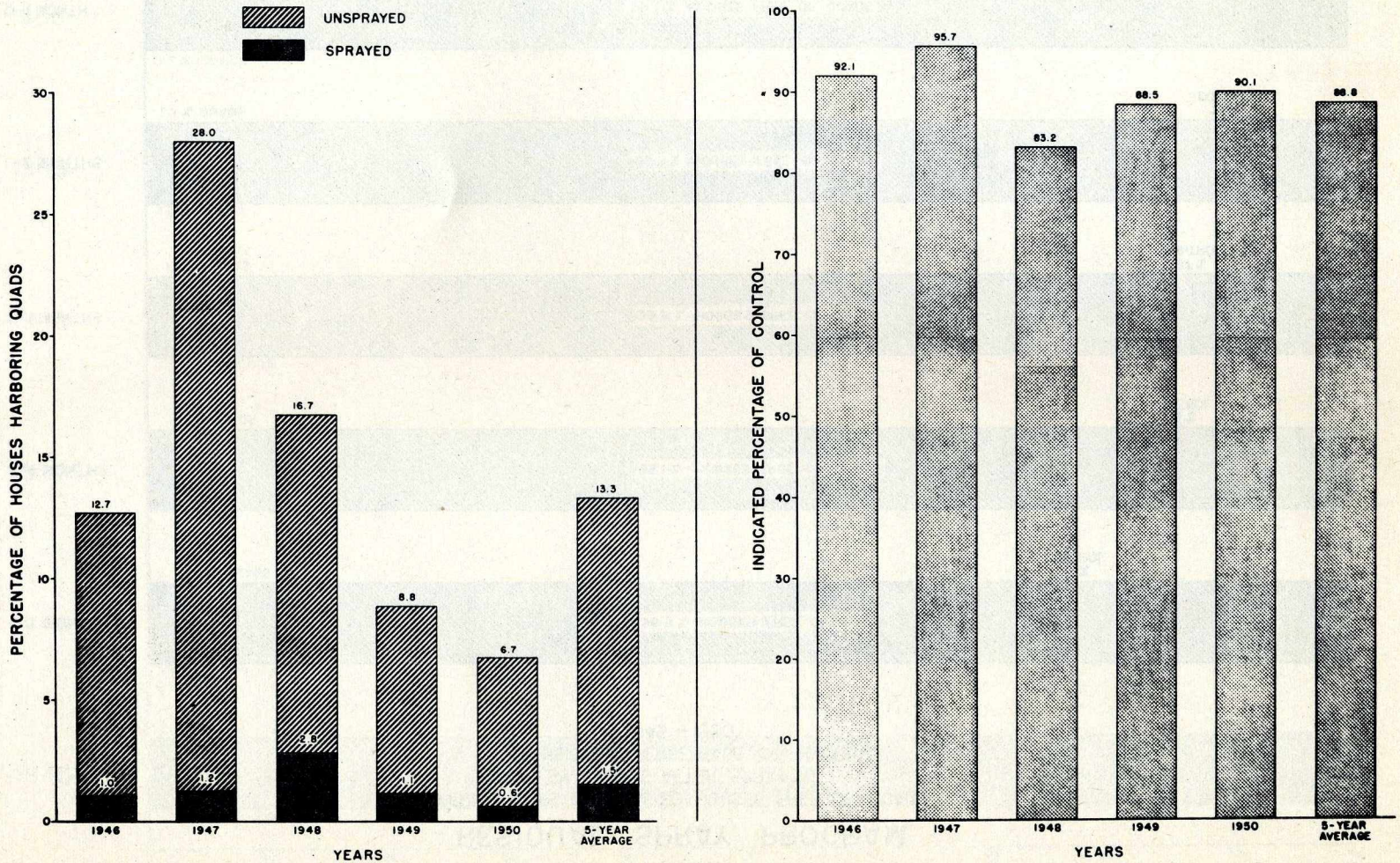


FEDERAL SECURITY AGENCY — PUBLIC HEALTH SERVICE — COMMUNICABLE DISEASE CENTER — ATLANTA, GEORGIA — JULY 195

FIGURE 11

RESIDUAL SPRAY PROGRAM

PERCENTAGES OF SPRAYED AND UNSPRAYED HOUSES HARBORING QUADS
AND INDICATED PERCENTAGES OF CONTROL
1946 – 1950



houses inspected. This differential is believed to reflect the year-to-year variations in the natural population level of this mosquito in the southeastern States. If this is true, the size of the control problem is related to the annual variations in the mosquito population. The 1947 control problem, for example, when 28 percent of unsprayed houses harbored *A. quadrimaculatus*, was much greater than it was in 1950 when only 6.7 percent of unsprayed houses inspected contained this mosquito.

The relatively high level of indicated control (fig. 11), an average of 88.8 percent for the 1946-1950 period, suggests that the residual spray program is an effective means of controlling the malarial mosquito in the southeastern States. Further evidence of the efficacy of the residual spray program in the southeastern States is found in the fact that malaria transmission within this area has declined tremendously during the life of the program. The malaria case appraisal program, initiated in 1948, has revealed that malaria transmission in the United States during 1951 was at its lowest point in history. The results of appraisals of malaria attacks occurring in the United States during the first 9 months of 1951 are summarized in table 16. In table 17 are summaries by years of the results of appraisals in relation to case reports. It will be observed (table 16) that epidemiological appraisal of 449 cases in 10 heretofore malarious States during the first 9 months of 1951 showed only 3 parasite-positive cases unassociated with a clear source of infection outside of the United States. Two of these three cases were recorded by State epidemiologists as primaries and the other as a relapse. It is of interest, too, that 273 of 449 cases appraised in 1951 were found positive by approved laboratories, and that 270 of these originated outside of the United States. This is reflective of the noticeable increase in reported malaria that has occurred with the repatriation of military personnel from Korea. This increase in number of cases reported continued in direct proportion to the return of military personnel from abroad, and the Center has alerted all State epidemiologists to exercise vigilance in regard to this situation.

CONCURRENT FLY CONTROL: Fly Control, as in previous years, was an important by-product of the malaria eradication residual spray program. However, the rapid replacement of fly populations, the presence of insecticide-resistant strains of flies in many areas, and other intermediate factors, make residual spraying as practiced for malaria control unsatisfactory for fly control purposes. Tremendous numbers of flies are killed during mosquito control operations by the chemical sprays, and the reduction in fly populations in

Table 16

APPRAISAL* OF MALARIA OCCURRING IN THE UNITED STATES - 1951

State	Total Case Appraisals in Each State	Classification of Appraised Cases			
		Positive in Laboratory Approved by State			All Other
		Total	Acquired Outside U.S.	Acquired Within U.S.	
Alabama	93	32	32		61
Arkansas	83	42	42		41
Florida	23	14	14		9
Georgia	95	17	16	1	78
Kentucky	1	0			1
Louisiana	6	5	5		1
Mississippi	37	32	32		5
Missouri	1	1	1		
South Carolina	77	68	68		9
Tennessee	83	62	60	2	21
Total	499	273	270	3	226

*Received through October 10, 1951. The contributions of State, Public Health Service, and Tennessee Valley Authority epidemiologists are acknowledged.

Table 17

APPRAISAL OF MALARIA CASES REPORTED OR DISCOVERED IN 13 ERADICATION STATES

Malaria Cases	Year			
	1948	1949	1950	1951*
Reported	9,317	4,012	2,099	2,379
Appraised	770	514	713	499
Positive**	242***	62	30	273
Primary	— Undetermined —	17	6	2
Relapses		8	6	1
Introduced		29	13	270
Transfusion		2	1	0
Induced		1	2	0
Source Unknown		5	2	0

*Data through September only, provisional and subject to correction.

**By year of attack.

***Also includes "Presumptives," i.e., consistent histories but not confirmed by approved laboratories.

many instances is significant, particularly in areas of relatively high sanitary conditions. For example, in 1950, only 7 percent of sprayed houses inspected showed fly densities above 50 compared with 28 percent of unsprayed houses (figure 12). Data for 1948 and 1949 show a comparable relationship.

RABIES

Since neither the causative organisms nor the animals, principally dogs, responsible for its dissemination are respecters of geographical or administrative boundary lines, effective rabies control in the United States is contingent upon the coordination of State and local control activities to a degree that results in the equivalent of a national program. Considerable progress has been made toward this goal and the Center has played, and is playing, a role by assisting States to organize and implement control measures. The approach is through the assignment of trained personnel to States, by conducting training courses for State and local personnel, by providing professional and technical guidance, by developing and making available improved control techniques and methods, and by cooperating in the investigation and suppression of outbreaks of the disease. Experience gained through this cooperative formula supports the thesis that rabies control based on a State level program under the direction of a public health veterinarian is the sound approach.

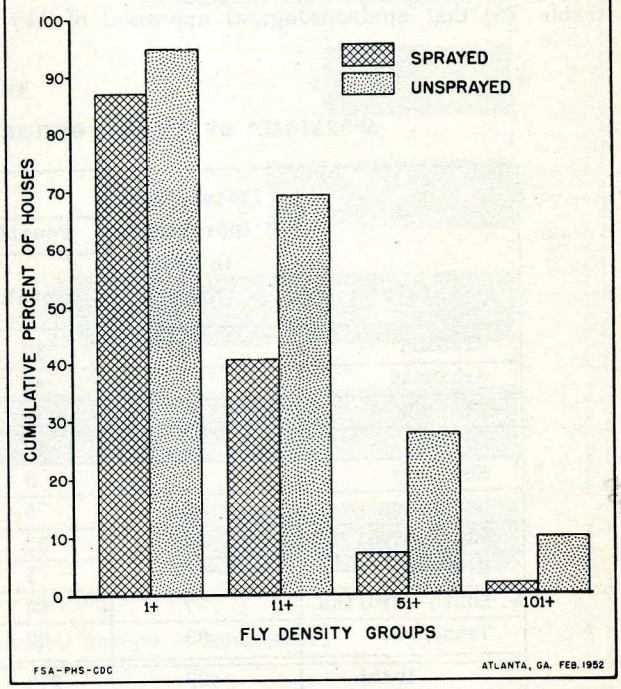
During the early spring of 1951, outbreaks of rabies in animals occurred in areas which had been free of the disease for many years. Isolated outbreaks in dogs were reported from Wyoming and Montana, and a sizable outbreak occurred in Spokane, Wash. Perhaps the most serious in its implications was the epizootic that touched several Midwestern and North Central States. There are indications that the epizootic in Iowa, where a high endemic level of rabies in skunks has been observed during the past 2 years, has spread into southern Minnesota, North Dakota, South Dakota, and Nebraska. Both the striped skunk and the small spotted skunk are implicated. An increase of rabies in skunks also has been reported in Missouri and Kansas.

As a part of a concerted effort to forestall outbreaks of the disease in disastrous proportions, and to coordinate remedial action, a rabies con-

FIGURE 12

FLY CONTROL BY RESIDUAL SPRAYS FOR ANOPHELINE CONTROL

CUMULATIVE PERCENT OF HOUSES INSPECTED HAVING INDICATED FLY DENSITIES 1950



ference* was held at Omaha, Nebr., in May 1951. Representatives from Colorado, Iowa, Minnesota, Missouri, Montana, Nebraska, and North Dakota, together with personnel from the Center, U. S. Fish and Wildlife Service, U. S. Bureau of Animal Industry, and FSA Regional Office VII participated in the conference. In substance, the conference recommended that each of the States concerned inaugurate coordinated programs for the control of rabies, and that each State create a committee at the State level to supervise its program, including thereon representatives of public health, livestock disease control, and wildlife conservation agencies. It also recommended that the States utilize the assistance of the several Federal agencies available in developing their control programs, and that these agencies honor every reasonable request for aid.

The rabies outbreak in Spokane, Wash., an area formerly rabies free, began in March 1951. Eighteen positive dog cases and two positive cat cases were recorded, laboratory confirmation being furnished by Center laboratories. Mass immunization of dogs (16,500 during the emergency), a general area quarantine, and control of the stray dog population produced control within a reasonable period of time. In an outbreak in St. Louis, Mo., 18 dog immunization clinics operated over a 7-day period handled 38,000 dogs. Practicing veterinarians, who participated in the immunization clinics, immunized perhaps another 20,000 dogs. The number of cases of rabies in dogs dropped from 79 in May to 5 in July, and no rabid dog has been detected in the St. Louis area since July 18.

During the spring and summer of 1950, the Center was requested to aid in dealing with an outbreak of rabies in Puerto Rico. Emergency control measures, including mass immunization of dogs and control of the stray dog population, were initiated pending studies to ascertain the source of the infection. Subsequently, studies on rabies developed epidemiological evidence suggesting that infected dogs and farm animals had been in contact with mongooses, a small predatory carnivore imported to the Island from Jamacia by sugar growers as a means of combating rodents. This incrimination of the mongoose was confirmed, and measures were contrived to effectively cope with the situation. The Puerto Rico outbreak and how it was brought under control is described in a paper published in Public Health Reports.*

The insidiously endemic rabies situation in Indiana showed improvement during 1951. There was an 18 percent decrease in positive animal cases during the last quarter of the year compared with the same period of the preceding year. One fatal human case occurred in Knox County.

Other outbreaks encountered during the year included an epizootic in foxes in Texas, involving 10 counties, which manifested evidence of moving toward Louisiana. Health authorities, with other agencies cooperating, succeeded in bringing the outbreak under control through the application of the usual emergency measures supplemented by a program of fox population reduction.

TYPHUS AND RODENT CONTROL

Murine typhus is endemic in 11 southern States, at least in wide areas of the respective States, where domestic rat populations are considerable and where climatic conditions are favorable for the rat ectoparasites, principally the oriental rat flea (*X. cheopis*), responsible for the transmission of typhus from rat to man. The Center has cooperated with the health authorities in these States over a period of years in activities specifically directed toward the control of typhus. In addition, through the loan of professional and technical personnel and a broad program of consultation services, the Center cooperates in rodent control activities in cities of 25 States, the District of Columbia, and in Hawaii where rats abound and their control is of public health importance.

TYPHUS CONTROL: During the calendar year 1950, reported cases of murine typhus in the United States totaled 683 compared with 984 in in 1949. For the first 8 months of 1951 (January through August), 284 cases were reported, indicating a continuation of the downward trend begun in 1945, when 5,179 cases were reported. Table 18 shows reported cases by years for the period 1941-1950. Evaluation studies show that typhus foci in domestic rats also are declining, but indications are that they are still widespread.

*Copies of Proceedings of the Conference are available through the Center.

*Pub. Health Rep. 67: 274-277 (1952).

Table 18

ANNUAL TOTAL OF REPORTED MURINE TYPHUS FEVER CASES IN THE UNITED STATES*
1941 - 1950

Year	Reported Cases
1941	2,781
1942	3,731
1943	4,522
1944	5,338
1945	5,179
1946	3,367
1947	2,034
1948	1,184
1949	984
1950	683
1951	284**

*Over 95% of all reported cases occurred in 9 southeastern States.

**Total number of cases January through August 1951.

Control activities, as practiced in the endemic typhus area, include DDT dusting of rat runs and harborage for the control of oriental rat fleas, the typhus vector; antirat sanitation, to control rat populations by denying them food and places of harborage; ratproofing, to keep rats out of buildings where opportunities for contact with humans are numerous; and by mass eradication of rats by poisoning. This multiple attack has proved effective and is adaptable to requirements in the different areas which is in keeping with the autonomous nature of the cooperative program. DDT dusting, for example, is a means of bringing a detected focus of typhus under control in a relatively short time, whereas rat control requires considerable time, even under favorable conditions. On the other hand, reducing the rat population by the application of antirat sanitation and ratproofing offers an approach to a more basic type of control.

A statistical summary of typhus control activities, in terms of man-hours expended and percentage of time devoted to different types of control work, is presented in table 19. These data encompass operations in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. As shown in table 19, on the average, State and local man-hours amounted to 80 percent of the total expended. In one State 95 percent of total man-hours expended were State and local and in no State was the State and local contribution less than 75 percent of the total man-hours expended within the State. Arkansas and Virginia did not apply DDT dust on an organized scale and Louisiana omitted antirat sanitation, as such, from its program. However, in the 11 States 14 percent of total man-hours was devoted to dusting and 6 percent to antirat sanitation. Rat poisoning, which accounted for 29 percent of total man-hours expended in the 11 States, was practiced in all 11 States, and accounted for 55 percent of total man-hours in Mississippi and 53 percent in Alabama. Two of the 11 States did not practice ratproofing and initial rat eradication as such, but in the 11 States this activity consumed 18 percent of all man-hours expended.

Entomological evaluation studies show that several species of rat ectoparasites, including fleas, mites, and lice, are common among rat populations in the 11 southern States embracing the typhus endemic area of the United States. In their order of abundance, most numerous on rats and most frequently present, they are: the rat louse, *Polyplax spinulosa*; the mites, *Liponyssus bacoti*, *Laelaps echidninus*, and *Laelaps nuttalli*; the sticktight flea, *Echidnophaga gallinacea*; the oriental rat flea, *X. cheopis*; the mouse flea, *Leptopsylla segnis*; the cat flea, *Ctenocephalides felis*; and the northern rat flea, *Nosopsyllus fasciatus*. The importance of most of these ectoparasites in the transmission of murine typhus from rat-to-rat and from rat-to-man is not fully known. It has been established, however, that the oriental rat flea is the chief vector of typhus to man, and studies have shown that the incidence of typhus in human population is directly related to the abundance of the oriental rat flea in the domestic rat population (CDC ACTIVITIES 1949-1950, pp.12-17). It also is a confirmed thesis that reducing the prevalence of the oriental rat flea in the domestic rat populations within the normal human environment reduces the incidence of typhus in humans by a comparable ratio. Thus, measures which are effective in reducing the prevalence of oriental rat fleas in rat population also are effective in protecting the human population against typhus. And since DDT dusting reduces the prevalence of oriental rat fleas in domestic rat populations, dusting is the method of choice where suppression of known foci of typhus is the immediate objective. By trapping

Table 19

TIME AND PERCENTAGE OF TOTAL WORK DEVOTED TO MURINE TYPHUS CONTROL
FISCAL YEAR 1951, 11 SOUTHERN STATES

Source	Man-Hours	Percentage of Total Time
State and Local	432,712	80
Public Health Service	109,816	20
Total	542,538	100
TYPE OF ACTIVITY		
State and District Supervision, Shop and Entomological Service (USPHS)		12
State and District Supervision (State and Local)		6
Antirat Sanitation Activities		6
Residual DDT Dusting		14
Evaluation Activities		9
Ratproofing and Initial Eradications		18
Maintenance of Ratproofing		2
Rat Poisoning and Gassing Operations		29
Miscellaneous and Leave		4
SUMMARIES		
Number of Meetings	137	
Number in Attendance	3,120	
Number Persons, On-the-job Training	1,108	
Average Man-hours per Trainee	11	
Communities with Ratproofing Projects	26	
Establishments Ratproofed	2,483	
Communities with Poisoning Projects	210	
Establishments Poisoned	353,681	

rats from dusted and undusted premises, combing them for ectoparasites, and tabulating the results in terms of oriental rat flea indexes, it is possible to determine the measure of typhus control obtained. A summary of findings resulting from the application of this principle (based on examinations of 8,578 rats caught in 9 southern States during 1950) is presented in table 20. As indicated, rats from undusted premises harbored fewer fleas, both in percentage of rats infested and in number of fleas per rat, than did rats from undusted areas. This has been a consistent finding in data collected over a period of years and is construed as substantive evidence that DDT dusting has contributed to the decline of typhus in humans within the control area. And out of this development has emerged the concept that while pursuing this control formula in areas

Table 20

CONTROL OF "X. CHEOPIS" BY DDT DUSTING - 1950
BASED ON DATA FROM 8,578 RAT EXAMINATIONS - 9 SOUTHERN STATES

	Undusted Premises	Dusted Premises		
		1-180 days	181-365 days	Over 1 year
Percentages of rats infested by *X. cheopis*	32	7.7	9.5	19
Reduction due to DDT dusting		76%	71%	43%
Average number of *X. cheopis* per rat	1.6	0.24	0.72	0.92
Reduction due to DDT dusting		84%	55%	42%

where typhus is endemic, it is well to explore the practicability of substituting typhus eradication for typhus control as the goal of cooperative efforts.

The observed prevalence of typhus antibodies in rats taken from undusted premises rose sharply during the last half of 1950, but during the first half of 1951 dropped back to about the June 1949-1950 level. Data available at the end of fiscal year 1951 are insufficient to permit determination of whether or not the July-December 1950 rise represents a real upswing in the natural prevalence of typhus in rats. DDT dusting operations were very successful during 1950, as shown in table 20. However, even though dusting operations are effective, control thus obtained is not permanent and sustained control through this method requires repetition of the operation periodically. Similarly, reducing the rat populations by poisoning and trapping, at best, lessens the density of rats only temporarily, and there is evidence that ordinary poisoning may increase rather than decrease the prevalence of typhus in rats. Rat control attained through sanitation, on the other hand, is permanent in the degree that sanitation measures are sustained, which makes this method of control highly desirable. Accordingly, considerable effort is devoted to studies of the basic factors which determine the prevalence of typhus in rats, with the view of developing a better method for attacking the problem of reducing typhus in rats.

The effectiveness of control by DDT dust, as ordinarily applied, varies greatly with different species of rat ectoparasites, which suggest some further inquiry in this area. Control of the primary vector, *X. cheopis*, has been, and continues to be good. Present methods also yield good control of *L. segnis*, *N. fasciatus*, and *L. nuttalli*; they give fair control of *L. bacoti*; slight or variable reduction of *P. spinulosa* and *L. echidninus*. Due to small numbers of specimens examined, data on *E. gallinacea* and *C. felis* are not reliable. Figure 13 reflects data accumulated on this point during

FIGURE 13

CONTROL OF THE DIFFERENT SPECIES OF RAT ECTOPARASITES BY DDT DUSTING 1950 - PERCENTAGE OF RATS INFESTED

BASED ON DATA FROM EXAMINATION OF 8,617 RATS, FROM 9 SOUTHERN STATES

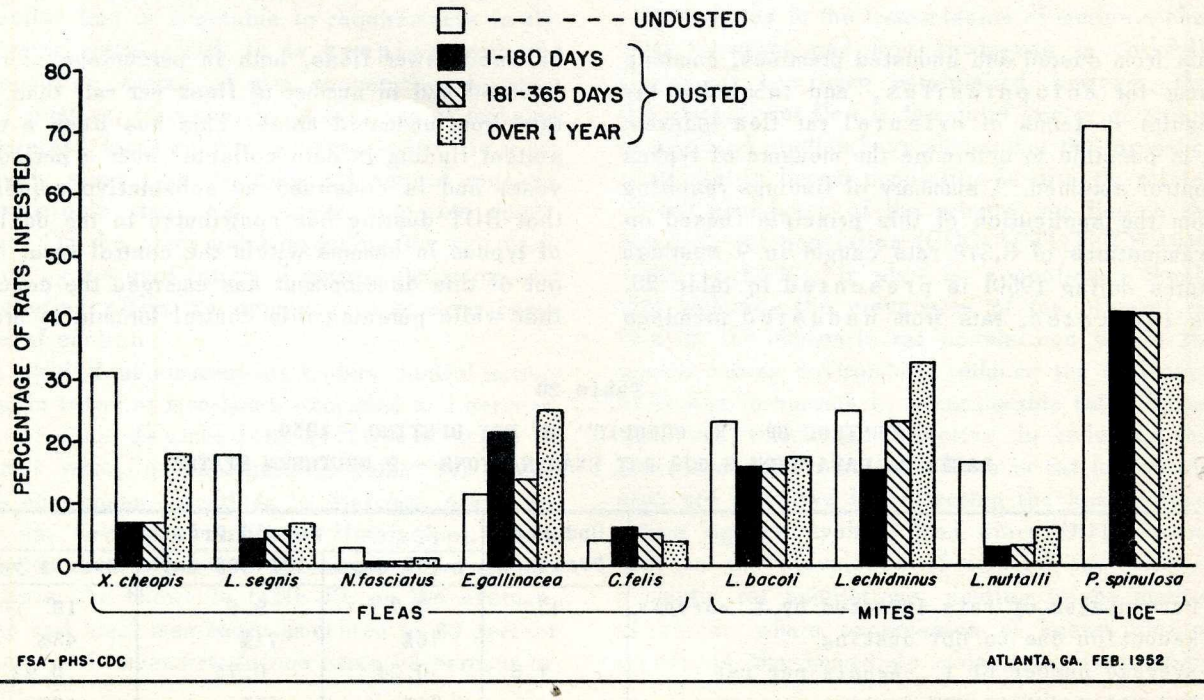


FIGURE 14

CORRELATION OF MURINE TYPHUS SEASONAL INCIDENCE IN RATS WITH *Xenopsylla cheopis* ABUNDANCE

1946-1949

UNDUSTED AREAS ONLY

X. cheopis Abundance Based on 55,775 *R. rattus* and *R. norvegicus* From 11 Southern States. Typhus in Rats Based on 24,502 *R. rattus* and *R. norvegicus* From 13 Southern and Central States

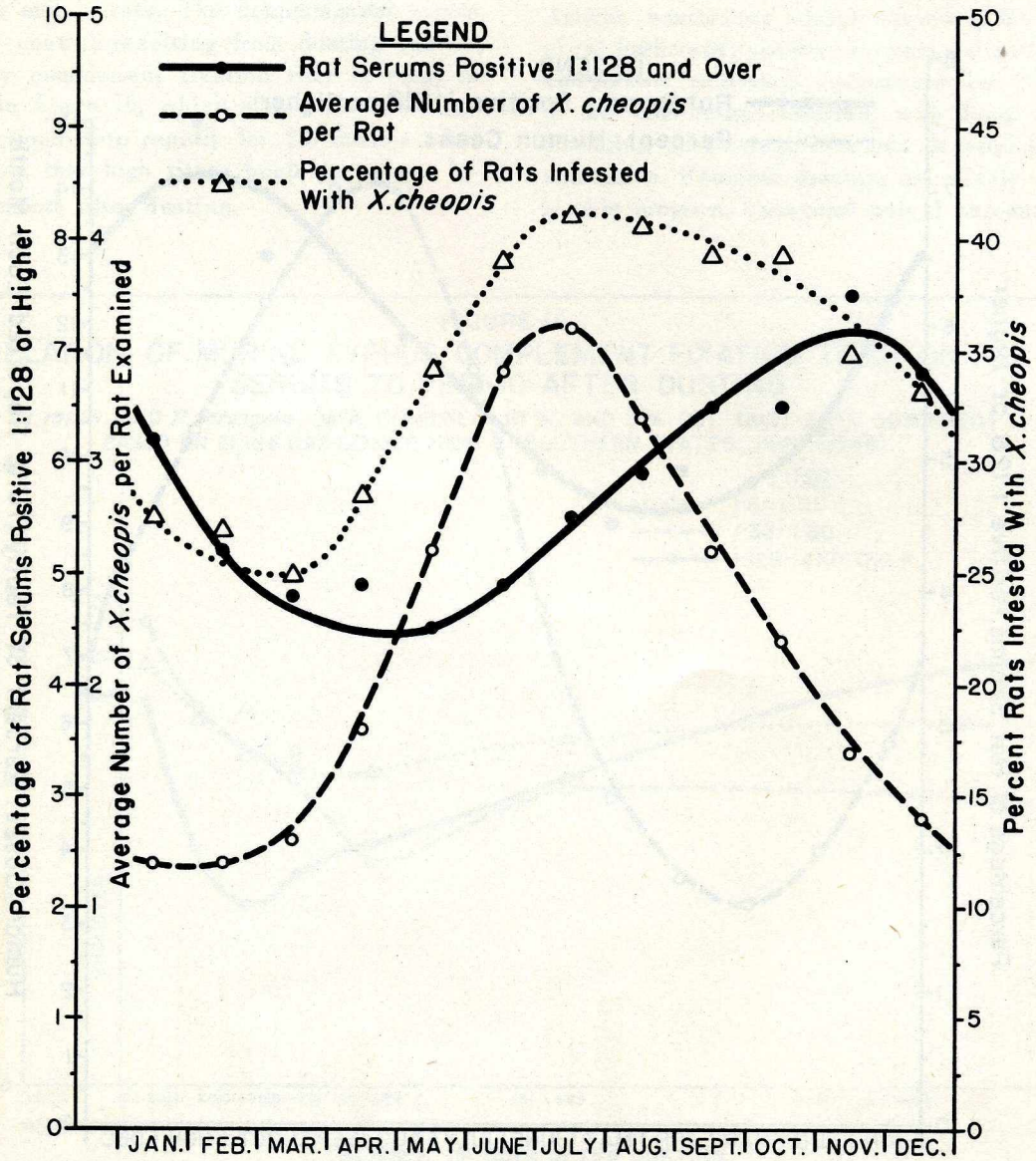


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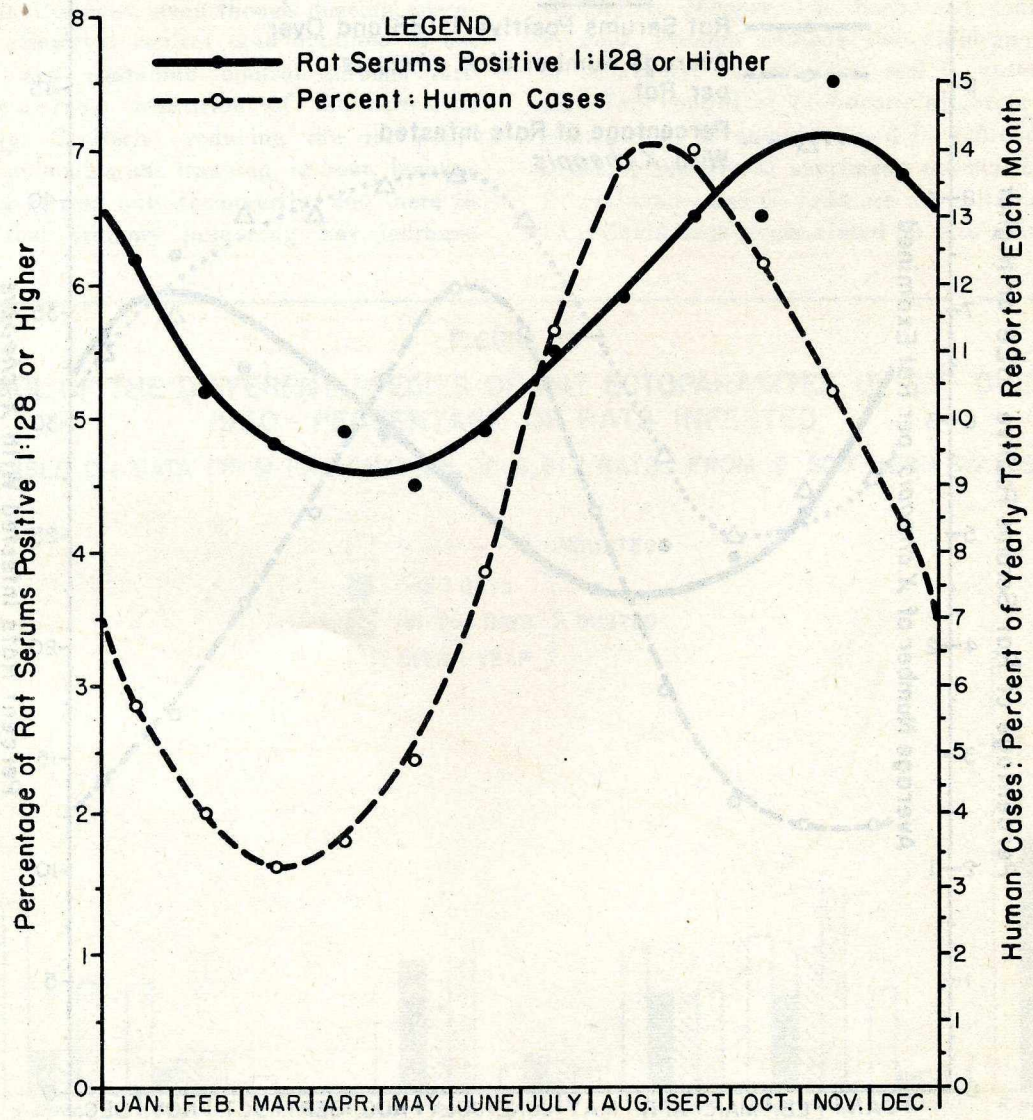
FIGURE 15

COMPARISON OF THE SEASONAL INCIDENCE OF MURINE TYPHUS IN HUMANS AND IN RATS

13 SOUTHERN AND CENTRAL STATES

Percentage of Human Cases Occurring each Month 1941-1945
and percentage of Rat Serums Positive at High Titers
Based on 24,502 *R. rattus* and *R. norvegicus* Rats 1946-1949
3-Month Moving Average



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

1950 investigations. Comparable data for 1949 are recorded in table 10, page 17, of CDC ACTIVITIES 1949-1950. Factors which may account for the poor control of *P. spinulosa* and *L. echidninus* include: (1) ordinary application methods do not ensure contact of the insecticide with the ectoparasite; (2) particular habitat features; and (3) possibly these ectoparasites have a naturally low susceptibility to DDT.

The definite correlation that exists between the seasonal incidence of typhus in rats and the abundance of the primary vector, *X. cheopis*, is shown in figure 14, and in figure 15 is shown a comparison of the seasonable incidence of typhus in humans and in rats. The nonpermanent nature of typhus control resulting from dusting (as indicated by complement fixation titer in rats) is depicted in figure 16, which shows that the high titer infections drop rapidly for 2.5 months after dusting, but that high titers begin to appear by the third month after dusting.

RAT CONTROL IN CITIES: During 1951 this program encompassed rodent control activities in Hawaii, the District of Columbia, and in one or more cities of 25 eastern and western States. Center participation, in the main, consisted of the assigning of rodent control specialists to cooperate with State and local health departments in organizing rodent control programs, and in the providing of training opportunities for State and local health department personnel. The type of activities pursued is outlined in table 21. It will be observed that 81 percent of total man-hours expended was supplied by State and local health agencies compared with 19 percent by the Center. Antirat sanitation, which includes the removal of rat harborage, sanitary handling of garbage, and comparable activities, accounted for 29 percent of all man-hours invested, with local agencies providing 83 percent of effort devoted to antirat sanitation. Residual dusting, not widely practiced in this program, consumed only 1 percent of total

FIGURE 16

RELATION OF MURINE TYPHUS COMPLEMENT FIXATION TITER ON RAT SERUMS TO PERIOD AFTER DUSTING

(*R. rattus* AND *R. norvegicus* DATA COMBINED; 10% AND 5% DDT DUST DATA COMBINED)
BASED ON 51,186 RAT SERUMS FROM 9 SOUTHERN STATES, 1946–1949)

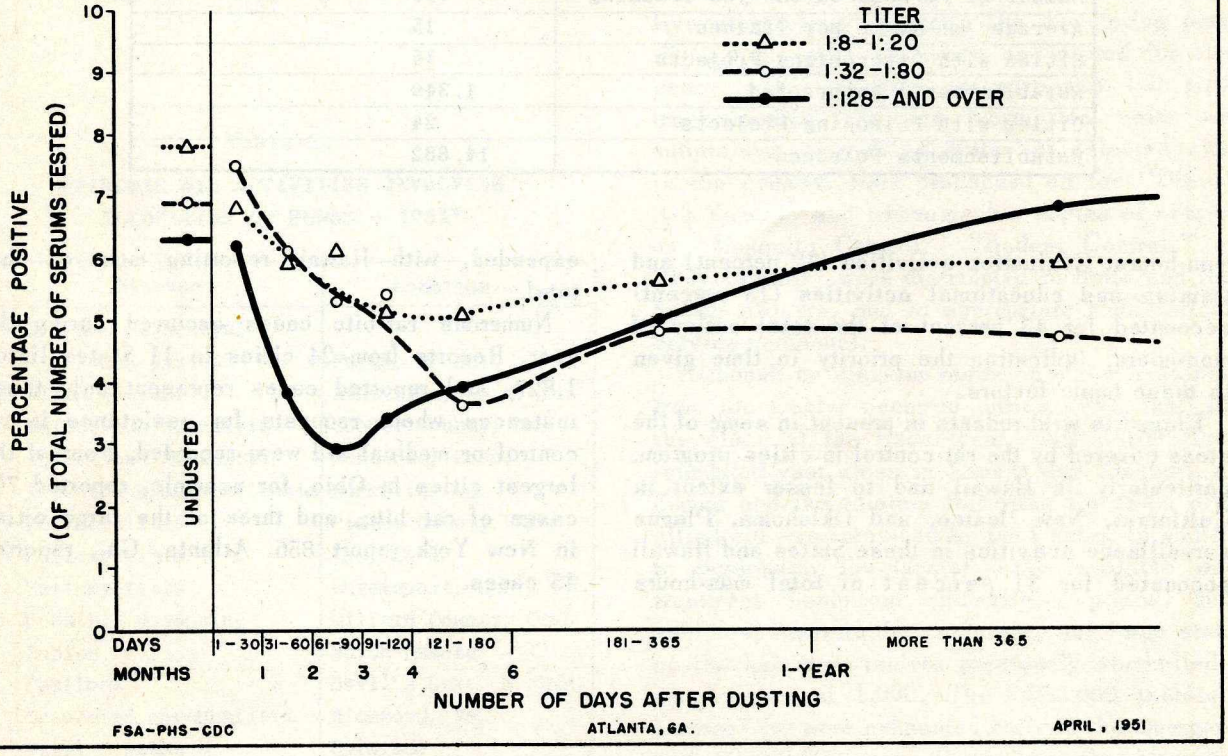


Table 21

TIME AND PERCENTAGE OF WORK DEVOTED TO RODENT CONTROL
JULY 1, 1950 - JUNE 30, 1951

Source	Man-Hours	Percentage of Total Time
State and Local	202,992	81
Public Health Service	47,235	19
Total	250,227	100
TYPE OF ACTIVITY		
State and District Supervision, Shop and Entomological Service (PHS)		4
State and District Supervision (State and Local)		3
Evaluation Activities		32
Ratproofing		4
Maintenance of Ratproofing		1
Rat Poisoning and Gassing Operations		9
Training and Educational Activities		13
Antirat Sanitation Activities		29
Surveys		3
Residual DDT Dusting		1
Miscellaneous and Leave		1
SUMMARIES		
Number of Meetings	385	
Number in Attendance	7,486	
Number of Persons on-the-job Training	733	
Average Man-hours per Trainee	15	
Cities with Ratproofing Projects	15	
Establishments Ratproofed	1,349	
Cities with Poisoning Projects	24	
Establishments Poisoned	14,882	

man-hours. Evaluation activities (32 percent) and training and educational activities (13 percent) accounted for 45 percent of the total outlay of man-hours, indicating the priority in time given to these basic factors.

Plague in wild rodents is present in some of the areas covered by the rat control in cities program, particularly in Hawaii and to lesser extent in California, New Mexico, and Oklahoma. Plague surveillance activities in these States and Hawaii accounted for 31 percent of total man-hours expended, with Hawaii reporting most of that total.

Numerous rat-bite cases occurred during the year. Reports from 24 cities in 11 States listed 1,827, and reported cases represent only those instances where requests for assistance in rat control or medical aid were recorded. Four of the largest cities in Ohio, for example, reported 791 cases of rat bite, and three of the large cities in New York report 856. Atlanta, Ga., reported 45 cases.

EPIDEMIC AND DISASTER AID

The Center is the component of the Public Health Service responsible for aiding State and local health authorities with epidemic and disaster situations which overtax their normal resources. The degree of assistance, rendered upon request, is governed by the size and type of problem involved. The Center maintains a diversified staff of specialists, and when a request for epidemic or disaster aid is received appropriate personnel is dispatched to the scene of the epidemic or disaster.

During 1951, the Center expanded its facilities for providing epidemic aid by the activation of the Epidemic Intelligence Service.*

Table 22 indicates something of the scope of epidemic aid requests received and responded to during 1951. In some instances Center specialists, working with State and local health authorities, were able to discover the causes of epidemics and to recommend effective remedial action. In others, such as poliomyelitis, thorough investigations were made and through them information was accumulated which may help to develop a better understanding of the infection than now obtains.

*Page 3 of this report.

Table 22

EPIDEMIC AID ACTIVITIES INVOLVING ALLOCATION OF FUNDS - 1951*

Disease	Location
Disease of central nervous system	Fargo, N. Dak.
Fifth Disease	Asheville, N. C.
Infectious hepatitis	Cooper County, Mo.
Infectious hepatitis	Montrose, Colo.
Infectious mononucleosis	Danville, Va.
Poliomyelitis	Platte County, Wyo.
Poliomyelitis	Rye, Colo.
Poliomyelitis	Shreveport, La.
Possible poisoning	Millard County, Utah
Rabies	North Dakota
Smallpox	Devil's Lake, N. Dak.
Suspected encephalitis	Richmond, Va.
Viral disease	Colorado

*Calendar year

In addition to epidemic aid activities listed in table 22, assistance which did not involve allocation of special epidemic aid funds was rendered on a formal or informal basis in a number of instances where outbreaks of disease occurred, or where unusual diagnostic problems arose. Usually this type of aid included epidemiological consultation and laboratory assistance in identifying the infection and/or causative agent.

Activities associated with disaster aid, in the main, concerned the stockpiling of appropriate materials and equipment in strategically located warehouses, and the conditioning of water treatment equipment.

Twenty-three million halazone tablets (chlorine compound for sterilizing water), previously acquired without cost from the New York State Department of Education, were packaged in containers of 1,000 tablets and distributed among five stockpiling stations. Ten dewatering pumps (90 g.p.m.) were purchased and stored for emergency call, and five reconditioned 100 g.p.m. truck-mounted filtration-chlorination units were maintained in working status at selected cities in the country. Work proceeded on the "Disaster Aid Manual" and mimeographic copies of sections of "Mosquito Control," "Rodent Control," and "Fly Control" were distributed to State and local health officers, and to appropriate Public Health Service personnel.

Although no disaster requiring major assistance from the Center occurred during 1951, just after the close of the fiscal year (July 1951) floods inundated vast areas in Kansas and Missouri, and during and immediately following the flood diversified aid was furnished by the Center. In addition to personnel, the Center made available water treatment equipment, dewatering pumps, motor vehicles, insecticides, solvents, and large stocks of the halazone tablets previously stockpiled in packages of 1,000. The 5,000,000 tablets in Kansas City were exhausted early in the emergency and 20,000,000 were flown into the emergency area by Air Force planes.

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