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Filariasis Control by DDT Residual House Spraying, Saint Croix, Virgin Islands

I. Operational Aspects

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DDT applied as a residual spray has been used successfully for the control of adult *Anopheles* in malaria control programs in many parts of the world. Up to the present time, however, data on its effectiveness against mosquitoes of other genera have been scanty, and have been collected incidental to anopheline control work. Reeves, Washburn, and Hammon (*1*) reported results from the experimental spraying of natural resting places of *Culex tarsalis* in California. De Caires (*2*) indicated that control of *Aedes aegypti* was easily achieved by spraying houses with DDT in British Guiana but that *Culex quinquefasciatus* was far less susceptible to DDT. Giglioli (*3*) demonstrated that adult *Culex* are the most resistant to DDT of the species studied by the Malaria Service in British Guiana. This same author (*4*) reports that in British Guiana *A. aegypti* is at present under control by routine measures but that the control of *C. quinquefasciatus* (*fatigans*) presents a more difficult problem. The present work constitutes the first attempt to use DDT residual house spraying for the control of *C. quinquefasciatus* to prevent transmission of *Wuchereria bancrofti*, the causative organism of human filariasis in the Caribbean region.

This program was initiated on St. Croix, Virgin Islands, October 9, 1946, as a cooperative project of the School of Public Health of Columbia University, the Public Health Service, and the Municipal Health Department of St. Croix. During blood surveys conducted by Dr. H. W. Brown, and his associates of Columbia University, it was found that 13.3 percent of 1,311 children of school age had microfilariae of *W. bancrofti*. A concurrent mosquito dissection survey of 2,244 *C. quinquefasciatus* revealed that 7.9 percent were positive for *W. bancrofti* and 2.3 percent of 867 *A. aegypti* were positive. The accompanying report, Results, by Dr. H. W. Brown and Dr. Roger W. Williams gives detailed medical and entomological informa-

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tion with a discussion of the results and effectiveness of the program discussed here.

The island of St. Croix is located in the American tropics and is the largest of the American Virgin Islands group. It is approximately 21 miles long with a maximum width of 6 miles and a total area of about 84 square miles. The low east coast of the island receives only 20 to 30 inches of rain a year and is almost desert-like with cacti and other xerophytic vegetation predominating. The north coast with a mountain range culminating in Blue Mountain, 1,099 feet above sea level, has 60 or more inches of rain a year. The average rainfall for the island varies from 30 to 60 inches a year with a mean of 46 inches. There are definite dry and rainy seasons, the rainy season extending from May or June to November or December. Some rainfall is recorded during each month of the year. There is very little natural surface water due to the erratic rainfall, the porous soils, the high rate of evaporation caused by the constant trade winds, and the presence of relatively few natural stream systems. Irrigation of sugarcane is practiced to a limited extent.

The population of St. Croix in 1940 was 12,902. Of this total 9,381, or 72.4 percent, were Negroes, and 3,521, or 27.6 percent, were from other races, predominantly Anglo-Saxon and Latin American. The principal cities of the island are Christiansted, with a population of 4,495, and Frederiksted, with a population of 2,498. The remainder of the population lives on scattered estates distributed over the island and may be classed as rural. Most of the houses in the rural area are located adjacent to the highway that traverses the long axis of the island between the two towns, and are grouped on the estates which are confined mainly to the center of the coastal plain. Few houses are found on the southern coast near the sea or in the mountains which border the northern coast. The eastern third of the island is very sparsely settled.

The housing, for the most part, is substandard, and sanitary facilities are in keeping with the low economic level of the people. The domestic water supply is obtained principally from rain water caught in cisterns, wooden tubs, lard cans, and oil drums. According to the 1940 census, 94 percent of the houses had water stored in cisterns and miscellaneous containers. An idea of the primitive conditions under which the people exist is gained from the fact that about 75 percent of the people depend on privies and facilities other than flush toilets, while 20 percent have no toilet facilities. Only 2 percent of the houses have screens.

The houses in the towns of Frederiksted and Christiansted are mostly of wooden construction, while in the rural areas stone houses predominate. These stone houses were built from material found in the ruins of the old Danish estates. The following table shows the

number of houses in the towns and rural areas on the island and the type of interior finish. The latter is important since it has a bearing on the duration of effectiveness of the DDT deposits. Most of the stone houses are calcimined, while a large number of the wooden houses have painted walls.

Type of finish	Number of Houses			
	Frederiksted	Christiansted	Rural	Total
Paint	327	611	269	1,207
Calcimine	130	118	461	709
Paper	35	42	5	82
Plaster	----	1	----	1
Unfinished:				
Wood	142	188	168	498
Wood and stone	12	2	16	30
Stone	6	4	130	140
Concrete	2	4	32	38
Galvanized iron	3	----	58	61
Other	7	22	----	29
Total	664	992	1,139	2,795

C. quinquefasciatus breeds in artificial containers (such as tin cans, cisterns, and water barrels) and in polluted water found in privies, ditches, etc., closely associated with human habitations. The adults are found resting in and around houses. Usually associated with it in the Tropics is *A. aegypti*, the vector of urban yellow fever and dengue.

The majority of domestic mosquito breeding on the island occurs in water stored around houses. During the principal part of the rainy season, which occurs in September, October, and November, some *Culex* and other mosquito breeding takes place in swampy areas where drainage to the sea is interrupted. Few of the areas, however, are located near the towns.

Methods and Procedures

When the DDT residual spraying program was started in October 1946, the personnel consisted of a local supervisor, who was trained in Puerto Rico by the Public Health Service, and a spray crew consisting of 1 foreman, 1 truck driver, and 5 spraymen. Concurrent with the beginning of spraying operations, houses in the two towns and on the larger rural estates were spotted on maps and numbered, and a census of the population was made. Also, data on the type of house construction, the number and dimensions of the rooms, and the type of inside finish were recorded for use in determining the amounts of spray required. During the first treatment all buildings were sprayed, but in subsequent sprayings only occupied houses and schools were treated.

Initially, hand sprayers fitted with flat atomizing nozzles were used. When an orchard type sprayer of 50-gallon capacity became available, this equipment and the hand sprayers were used for the three subsequent applications.

During the initial spraying various formulations of DDT isomer in kerosene were used. This material later was replaced by a 35-percent DDT-Xylene concentrate, with Triton X–100 added as an emulsifier, diluted with water to form a 5-percent spray. Since some difficulty was encountered with this material due to its chemical reaction with the metal in the drums which resulted in its staining certain types of wall surfaces, a 25-percent DDT-Xylene-Triton concentrate was substituted.

Applications were made to the wall surfaces at the rate of 200 mg. of DDT per square foot. This was achieved by applying the 5-percent spray at a rate of 190 square feet per minute with the hand sprayers and about 230 square feet per minute with the power sprayer. This rate could be approximated easily by spraying the surface to the point of saturation without allowing the material to run. The walls and ceilings of the rooms, the porches, and privies were sprayed. Furniture was not treated, and extra care was taken in the finer homes to protect the furniture. In a few cases chicken houses were treated upon the request of the municipal physician, but routinely only living quarters and schools were included.

During the fiscal year 1947 an effort was made to reduce the cost of spraying to determine how much per house it would cost to achieve maximum results with a minimum of labor and materials. It was found that, after the initial mapping and organizational activities had been completed, a crew composed of one foreman to contact householders, supervise the work, and make reports; a chauffeur to drive the truck and operate the power sprayer; and three spraymen were all that were necessary to make a round of treatment three times a year. Also, means were devised to organize work procedures more efficiently.

While the entire cost of the project was borne initially by the Public Health Service, it was desirable to have the island government share as much of the cost as possible, looking forward to the time when the project could be made self-sustaining. With this in mind, a revolving fund was set up and assessments were made against the householders. This phase of the work was entirely independent of the operational phases, but as the second spraying progressed, it was noted that a sizeable number of refusals were being encountered. To counteract this, the aid of the municipal physician was solicited. During the third spraying, the project foreman made a record of each such refusal, including the name and address and reasons for refusing (predominantly inability to pay). These records were turned

over to the municipal physician. The municipal physician obtained the necessary cooperation with the result that very few refusals were encountered during the fourth spraying.

Accomplishments

Table 1 gives a summary of pertinent data for the four sprayings. These were compiled from the daily reports of the spray foreman and from the pay roll records and represent actual expenditures. Records of the first two sprayings are based on the actual number of square feet per house. However, after it was determined that the average house contained 1,900 square feet, this figure was used in the

Table 1. *Summary of the four DDT residual sprayings of premises on St. Croix, V. I., October 1946 to May 1948*

[Based on actual expenditures]

	First	Second	Third	Fourth	Total
Number of houses sprayed	2,883	2,530	2,731	2,934	11,078
Total square feet treated	5,382,700	4,933,500	5,188,900	5,574,600	21,079,700
Total gallons 5% DDT spray solution used	5,999	4,895	5,078	5,660	21,632
Total working days	109	88	100	103	400
Total man-hours	7,334	5,680	4,602	4,014	21,630
Cost of materials	$1,663.16	$1,224.82	$1,366.31	$1,618.76	$5,873.05
Cost of labor	$3,464.99	$3,891.12	$2,853.46	$2,232.54	$12,442.11
Cost of gas, oil, etc. (transportation)	$179.85	$212.85	$330.00	$339.90	$1,062.60
Total cost	$5,308.00	$5,328.79	$4,549.77	$4,191.20	$19,377.76
Average number square feet per house	1,900	1,900	1,900	1,900	1,900
Average number gallons of spray solution per house	2.12	1.93	1.86	1.93	----------
Average deposit of DDT (mg./sq. foot)	337	197	194	201	----------
Average number houses sprayed per working day	26.0	25.3	27.3	28.5	----------
Average number man-hours per house	2.59	2.25	1.68	1.37	----------
Average number man-hours per 1,000 sq. feet	1.36	1.15	0.89	0.72	----------
Average cost per house	$1.81	$2.11	$1.67	$1.46	----------

First spraying: October 9, 1946, to March 16, 1947.
Second spraying: March 17, 1947, to July 18, 1947.
Third spraying: July 21, 1947, to December 10, 1947.
Fourth spraying: December 11, 1947, to May 10, 1948.

summation of the data. It will be noted that the cost of materials remained about the same for the four sprayings. The relatively high personnel costs during the second spraying were caused by the placing of employees under classified civil service at annual salary rates. Since continuous employment could not be provided, arrangements were made during the third spraying to return the foreman and spraymen to an hourly rate. Also, the program no longer required full-time local supervision, and the technical supervision and direction thereafter were furnished by periodic visits of personnel from the District U. S. Public Health Service Office in San Juan, Puerto Rico. By demonstrating the feasibility of these economical methods of operation, it was hoped that the entire cost of the project soon could be assumed by the local government. The reduction in the spraying crew resulted in a gradual lowering of the average number of man-hours per house and a slight rise in the average number of houses sprayed per working day. The cost per house during the

fourth spraying was only $1.46 as compared to $1.81, $2.11, and $1.67, respectively, for the first three sprayings.

Based on experience in operating the program to date, the following recommendations for continued operations are indicated:

1. Use a spray crew consisting of one foreman and two sprayers.
2. Make two complete sprayings of the island each year.
3. Use new transportation; the time lost in maintaining old trucks is considerable. The remoteness of the island makes mechanical failures difficult to remedy.
4. Most of the houses on the island are poorly constructed and about 80 percent have absorbent interior surfaces. Therefore, 50 percent wettable DDT, since it is applied in particulate form, may be more suitable than solutions or emulsions, and its effectiveness should be determined. Modification of present equipment or the securing of new equipment which would be suitable for applying water suspensions would be necessary.

Summary

The operational phases of an island-wide DDT spraying program to control filariasis transmission by destroying its mosquito vectors on St. Croix, Virgin Islands, are discussed. The medical and entomological phases of the program were carried out by the staff of the School of Public Health, Columbia University, and are reported in the article which follows. The residual spraying was under the direction of the Communicable Disease Center of the Public Health Service, San Juan, Puerto Rico.

ACKNOWLEDGMENTS

The following officers of the Public Health Service initiated and set up the procedures of the spraying program: Porter A. Stephens, sanitary engineer (R); Arthur H. Neill, sanitary engineer; Howard W. Spence, S. A. sanitary engineer; and George A. Thompson, S. A. sanitarian (R). The original survey made by Dr. Harry D. Pratt, scientist, was of great help in conducting the program.

REFERENCES

(*1*) Reeves, W. C., Washburn, G. E., and Hammon, W. McD.: Western equine encephalitis control studies in Kern County, California, 1945. The effectiveness of residual DDT deposits on adult *Culex* populations. Am. J. Hyg. **47**: 82–93 (1947).

(*2*) De Caires, P. R.: DDT and *Aedes aegypti* control in British Guiana. Puerto Rico J. Pub. Health & Trop. Med. **22**: 405–415 (1947).

(*3*) Giglioli, G.: Annual Report of the Malaria Service, British Guiana, 1945.

(*4*) Giglioli, G.: An investigation of the house-frequenting habits of mosquitoes of the British Guiana coastland in relation to the use of DDT. Am. J. Trop. Med. **28**: 43–70 (1948).

Filariasis Control by DDT Residual House Spraying, St. Croix, Virgin Islands

II. Results

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The control of Bancroftian filariasis, malaria, or yellow fever may be achieved by two methods: (1) by reducing the mosquito vectors to a number that will minimize transmission of the parasites to man; (2) by shortening the life of the adult mosquito and thus preventing complete development of the parasite in the mosquito.

Soper, Wilson, Lima, and Antunes (*1*) have demonstrated the workability of the first method, and have detailed the procedures involved. But such a program is expensive and necessitates continued effort. The success of DDT residual spray programs in malaria control suggests the second as a cheaper, less complicated method of controlling filariasis, although it is not as permanent.

While a program of spraying each habitation with a residual DDT solution has the advantage of simplicity and cheapness, its efficacy is unknown. The purpose of this study was to ascertain its effects over a period of 5 to 10 years on the filaria incidence of St. Croix, Virgin Islands. The island was chosen because of its high filaria rate, convenient size, and cooperativeness. After 2 years of the spray program, an attempt at control of filariasis through treatment of every individual on the island was instituted by another research group; it was therefore considered useless to continue this study.

The details of the DDT spray technique used and frequency of application are given by Kohler in the preceding report, Operational Aspects. Our assessment of the effectiveness of this measure consisted of pre- and post-DDT spray mosquito surveys, and nocturnal blood smears on the school population.

Mosquito Surveys

To ascertain the effectiveness of the residual DDT spray, when applied to the interior of houses, in reducing the transmission of *Wuchereria bancrofti*, a prespray mosquito survey was made, and a survey subsequent to the spray program was compared with it. The purpose of these surveys was to determine what mosquito species were involved in the transmission, what percentage of each species was infected with the parasite, the number of houses which harbored

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mosquitoes, and the number of each species to be found in the dwellings.

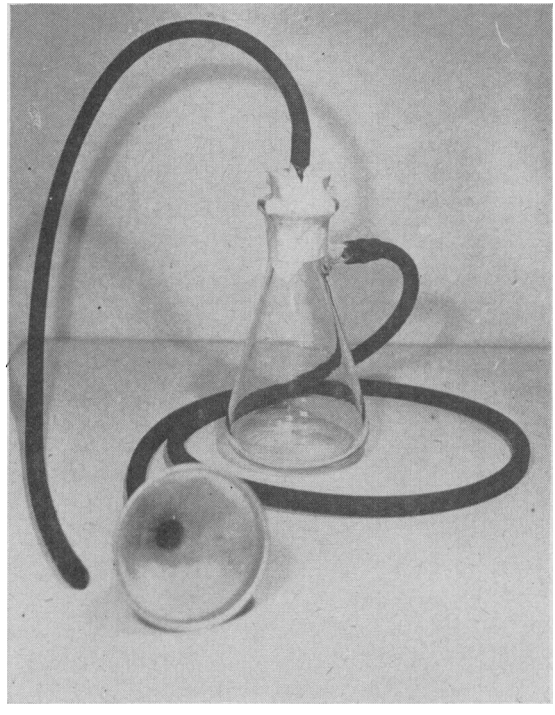
It is the custom of the majority of the inhabitants of the island to retire early, closing all window shutters and doors. Screens are rarely used. *Culex quinquefasciatus* Say (*fatigans* Wiedemann), the chief vector of filariasis on the island, readily enters houses through the shutters and other openings, feeds on man at night when the microfilariae of *W. bancrofti* are most abundant in the peripheral blood, and usually remains in the houses throughout the night. Giglioli (*2*) found that in British Guiana *C. quinquefasciatus* accounted for 66 percent of all mosquitoes found resting in houses after dawn. This mosquito frequents dark portions of the rooms throughout the day on St. Croix, but may leave in the morning when the shutters are opened or when otherwise disturbed by the occupants or blown out by the strong trade wind. Some never enter houses since they are also zoophilous and feed on chickens, dogs, mules, goats, cattle, etc. They may remain in outdoor resting places throughout the day. Since this program was not intended to eradicate mosquitoes but to determine what effect residual DDT has on the transmission of *W. bancrofti*, mosquito collections were made only in houses, where the majority of mosquitoes caught probably had fed on human blood.

The entire island was divided into three major collecting centers: the towns of Christiansted and Frederiksted, and the sugarcane estates. The towns were further divided into a number of sections more or less equal in size. It was possible for two crews of two men each to visit every house in two such sections during the course of a day's work. The two crews began at adjacent houses and worked in opposite directions around a block, searching for mosquitoes in each house they entered. When the occupants of a house were not at home, collecting was not attempted, and on a few occasions permission to enter was not granted. One section of a town could be covered in 2 to 3 hours. The mosquitoes were then brought into the laboratory, dissected, and examined for developing forms of *W. bancrofti*.

Only two species of mosquitoes were found in the houses, *C. quinquefasciatus* and *A. aegypti*. No anopheline problem has existed on St. Croix since 1934 when a vigorous campaign virtually eliminated this genus. *C. quinquefasciatus* was found in greatest numbers in bedrooms. For the most part they were found resting in the darker regions of the room such as in clothes presses, behind furniture standing close to the wall, on dark or black clothes, umbrellas, etc., hanging on wall hooks, under tables, desks, and dressers, and behind open doors. One notable exception to a dark resting place was the white lace fringe hanging from the canopies over the beds, a material comparable to cobwebs and mosquito netting which are recognized as attractive

resting places for this species. *A. aegypti*, although more common in the bedrooms, could be found more frequently in the other rooms of the houses than could *C. quinquefasciatus*. For the most part they were found in the resting places preferred by *C. quinquefasciatus*.

Collecting was done with an aspirator, made from a 250 cc. filter flask with tubulature, and a flashlight. The flask could be kept in a pocket or could be held conveniently in the hand. The mosquito intake hose was 3 feet in length tipped with a 2¾-inch (diameter)



Mosquito collecting aspirator.

aluminum funnel. The suction hose was of a sufficient length to permit ample freedom of movement of the head when the flask was in a pocket. The long hose permitted the collectors to reach at arm's length into narrow spaces between furniture and the walls, bend the intake hose, and place the funnel over a resting mosquito, thus collecting specimens which otherwise would have been unobtainable with conventional types of mosquito-collecting apparatus. The mosquitoes were brought alive into the laboratory, killed with ether fumes, and dissected.

Two men did the dissecting. The first removed the legs and wings, placed the mosquito on a clean slide and passed it to his co-worker

who divided the insect into its three body regions in a saline solution. A plastic coverslip, capable of withstanding considerable pressure, was applied rather firmly onto the arthropod, rupturing it at various places. The slide was then passed to the observer who examined each body region through a binocular dissecting microscope having 15x eyepieces and 3x and 6x objectives. The muscle fibers of the thorax or pieces of body wall, etc., could be rolled and maneuvered by applying pressure to the coverslip with the eraser end of a pencil, thus exposing hidden worms. With proper illumination, all forms of the parasite could be seen. The more or less immobile sausage forms in the thorax could readily be distingusihed from muscle fibers by the difference in refractive index. The fourth member of the crew notified the sections of town which would be covered in the following day's work.

It is conceivable that filaria larvae found in wild *C. quinquefasciatus* or *A. aegypti* might be from animals other than man. However, O'Connor and Beatty (*3*), in an excellent study of *W. bancrofti* on St. Croix, failed to find microfilariae in the blood of cats, rats, mice, goats, bats, chickens, ducks, turkeys, domestic pigeons, wild mongooses, and several species of lizards. Thirty-three percent of the dogs examined by them contained microfilariae of *Dirofilaria immitis*. However, they found that this parasite did not develop readily under experimental conditions in either *C. quinquefasciatus* or *A. aegypti* and concluded that although these mosquitoes may become infected under natural conditions, neither of these insects is the main vector in the transmission of canine infection on St. Croix. The development of this parasite usually takes place in the malpighian tubules rather than in the thoracic muscles as does *W. bancrofti*. Of nearly 4,000 wild mosquitoes which were caught and examined, none contained developing filariae in or near these tubules. O'Connor (*4*) found ground doves infected with *Vagrifilaria columbigallinae*, and a similar parasite was more rarely found in both the white and the redheaded pigeons as well as in the mountain dove. Efforts to infect *C. quinquefasciatus* with this parasite were unsuccessful, and O'Connor and Beatty (*3*) concluded that since these birds do not nest or roost close to human habitations it is improbable that they would infect domestic mosquitoes within the areas studied. It therefore seems reasonably safe to assume that the developing filariae found in either *C. quinquefasciatus* or *A. aegypti* were forms of *W. bancrofti*, with few, if any, exceptions.

The prespray mosquito survey was made during June and July 1946. At this time the mosquito population was so small that many individuals who as a rule slept under bed nets no longer did so, and reported little annoyance from the mosquitoes. Two factors appeared

to be important in explaining this phenomenon. The precipitation from June 1945 to June 1946 was only 32.37 inches, about 13 inches below normal. Cattle were dying in the fields for lack of water. A reservoir in the hills, which normally held 9,000,000 gallons of water, contained an estimated maximum of 150,000 gallons. There was little, if any, standing water and very little water in rain barrels since it was used from these containers about as fast as collected. Secondly, an educational program on DDT was inaugurated about the turn of the year. A series of public lectures and motion pictures was presented by the sanitation department, and in March 1946 commercial DDT was introduced and sold in grocery, drug, and other stores. A store-to-store canvass disclosed that about 450 gallons of 5 percent DDT had been sold between March 1 and June 17, 1946. Of the houses entered in 1946, 47.6 percent had a pint or quart can of 5 percent DDT, and the residents of an additional 19.1 percent used other insecticides (table 1). Although this commercial DDT was applied inefficiently as a space spray with small hand sprayers, it was used so frequently (in many instances every night) that over a period of weeks and months a certain residual deposit would be built up. The spraying was usually done in the bedrooms just before retiring.

Following four sprayings from October 1946 to June 1948, a second survey was made in June 1948. Rainfall for the year, June 1947 to June 1948, was about normal, and the precipitation between March 1948 and June 1948 was 3.31 inches greater than for the same period in 1946. It was found that 1,240 gallons of commercial DDT had been sold in the stores between June 1946 and June 1948, so approximately this amount had been applied inside of dwellings in addition to that applied by the spray crew.

In the prespray survey, *A. aegypti* were abundant, and no attempt was made to collect all those seen in the houses. An attempt was made to capture all of the *C. quinquefasciatus* in each house, since they were the most important vector of *W. bancrofti* and were not nearly as numerous as the *aegypti*. There were a few houses with high populations of *quinquefasciatus*, and from these the catch was limited to 10 or less.

Table 1 summarizes the information on the number of houses entered, the number of houses from which mosquitoes were collected, the number of houses in which commercial DDT was used, etc. In each of the three survey areas the number and percentage of houses with *C. quinquefasciatus* mosquitoes was considerably reduced following the sprayings; however, the average number of mosquitoes collected per house in those houses harboring mosquitoes was not greatly changed. It would appear that *A. aegypti* was successfully eliminated from the houses in our experiment, for no specimens of this species

Table 1. *Summary of mosquito collections before and after the DDT spray program and data on home spraying by the inhabitants*

Houses	Frederiksted		Christiansted		Estates*		
	1946	1948	1946	1948	1946	1946	1948
Total number entered	480	559	861	814	681	169	178
Number not entered	176	208	310	383	564	151	148
Total number visited	656	767	1,171	1,197	1,245	320	326
Number in which mosquitoes were collected	328	151	541	223	422	146	62
Percent of total number visited from which mosquitoes were collected	50.1	19.5	45	18.5	33.9	45.6	19.0
Percent of total number entered from which mosquitoes were collected	78.6	27.0	62.8	27.4	74.8	82.2	34.8
Number *Culex* collected	518	237	768	492	958	396	117
Number *Aedes* collected	307	0	337	0	223	97	0
Average number *Culex* caught per house from which mosquitoes were collected	1.6	1.6	1.4	2.2	2.3	2.7	1.9
Using DDT	212(44.1%)	230(41.1%)	441(51.2%)	336(41.3%)	311(45.6%)	103(60.9%)	71(39.8%)
Using other insecticide	89(18.1%)	36(6.4%)	194(22.5%)	57(7.0%)	104(15.2%)	22(13.0%)	11(6.2%)
Using no insecticide	179(37.3%)	293(52.4%)	226(26.2%)	421(51.7%)	266(39.1%)	44(26.0%)	96(53.9%)

*Due to circumstances beyond our control, it was inadvisable in 1948 to survey all of the estates covered in 1946. The left 1946 column represents the results of the survey of all the estates covered in that year. The right 1946 column includes only those estates from the 1946 survey which were resurveyed in 1948.

were found in the 1948 survey. Eradication of *A. aegypti* was reported by de Caires (*5*) within 13 weeks after a single spraying of 5 percent DDT in kerosene and was maintained for 10 months.

Some 2,244 *C. quinquefasciatus* mosquitoes were caught in the three collecting areas in 1946. Of this number 177, or 7.9 percent, were infected with developing forms of *W. bancrofti* of which 9, or 5.1 percent (0.40 percent of all *quinquefasciatus*), contained infective stages of the parasite. In 1948 only 846 *C. quinquefasciatus* were collected in the houses, of which 31, or 3.65 percent, contained developing worms and none were found with infective forms of the nematode. Thus, about a 50-percent reduction in the percentage of infected mosquitoes [1] and a 57-percent reduction in the number of houses harboring *C. quinquefasciatus* mosquitoes was effected by the application of 5 percent DDT to the interior of the houses in spite of the fact that in 1948 the rainfall was again back to normal and conditions were more favorable for high mosquito populations than in 1946. Table 2 breaks these figures down by collection centers. Of some 867 *A. aegypti* examined in 1946, 20, or 2.3 percent, contained developing forms of *W. bancrofti*. No infective stages of the parasite were found in this species of mosquito. In 1948 not one *A. aegypti* was seen in the houses.

Eighty-six immature forms of *W. bancrofti* were the largest number found in any one mosquito. All of these were presausage forms.

[1] A reduction from 7.9 percent to 3.7 percent is statistically significant.

Table 2. *Filaria infection rates of* Culex quinquefasciatus *and* Aedes aegypti *before and after the DDT spray program*

	Frederiksted		Christiansted		Estates*		
	1946	1948	1946	1948	1946	1946	1948
Culex quinquefasciatus							
Number:							
Examined	518	237	768	492	958	396	117
Infected	48	15	61	12	68	24	4
Infective	4	0	3	0	2	0	0
Percent:							
Infected	9.5	6.3	8.0	2.4	7.0	6.1	3.4
With infective forms	8.3	0.0	4.9	0.0	2.9	0.0	0.0
Of all *Culex* infective	0.8	0.0	0.4	0.0	0.2	0.0	0.0
Aedes aegypti							
Number:							
Examined	307	0	337	0	223	97	0
Infected	7	0	9	0	3	1	0
Infective	0	-------	0	-------	0	0	-------
Percent infected	2.3	-------	2.6	-------	1.8	1.0	-------

*Due to circumstances beyond our control, it was inadvisable in 1948 to survey all of the estates covered in 1946. The left 1946 column represents the results of the survey of all the estates covered in that year. The right 1946 column includes only those estates from the 1946 survey which were resurveyed in 1948.

One mosquito contained 16 preinfective stages in the thorax, another harbored five infective forms in the head and proboscis. The number and percent of mosquitoes containing larvae in various phases of development are given in table 3. In 1946 only 37 percent of the 177 infected *C. quinquefasciatus* contained recently ingested microfilariae; whereas in 1948, 68 percent of the 31 infected *C. quinquefasciatus*

Table 3. *Stages of larval development of* W. bancrofti *in mosquitoes*

	Stomach	I*	II*	III*	IV*	V*	Head†	Proboscis†	Total
C. quinquefasciatus, 1946:									
Fredcriksted	11	9	14	4	6	1	2	1	48
Christiansted	13	5	19	6	15	1	1	1	61
Estates	11	17	27	7	4	1	1	0	68
Total	35	31	60	17	25	3	4	2	177
Percent	19.77	17.51	33.63	9.60	14.12	1.69	2.26	1.33	99.93
C. quinquefasciatus, 1948:									
Frederiksted	9	0	3	2	1	0	0	0	15
Christiansted	8	1	2	1	0	0	0	0	12
Estates	3	0	1	0	0	0	0	0	4
Total	20	1	6	3	1	0	0	0	31
Percent	64.5	3.2	19.3	9.7	3.2	0.0	0.0	0.0	99.9
A. aegypti, 1946:									
Frederiksted	4	3	0	0	0	0	0	0	7
Christiansted	2	7	0	0	0	0	0	0	9
Estates	0	3	0	0	1	0	0	0	4
Total	6	13	0	0	1	0	0	0	20
Percent	30.0	65.0	0.0	0.0	5.0	0.0	0.0	0.0	100

*I. Microfilariae in thorax. II. Presausage form in thorax. III. Typical sausage form in thorax. IV. Preinfective forms in thorax. V. Infective forms in thorax. †Infective forms.

contained similar forms.[2] This situation indicates that many of the adults were not living long enough after feeding on human blood for the worms to mature. The fact that no *C. quinquefasciatus* mosquitoes with infective stages of *W. bancrofti* could be found in the houses in 1948 bears out this hypothesis.

In 1946 many of the smaller houses harbored numerous fleas and bedbugs, as well as roaches and centipedes, whereas in 1948 nobody complained of fleas or bedbugs, and a majority of the people felt that the populations of roaches and centipedes had been materially reduced.

Discussion of Spray Program

The use of 5 percent DDT as a residual spray within the houses on St. Croix in the Virgin Islands had a marked effect on the transmission of *Wuchereria bancrofti* by *Culex quinquefasciatus* Say. This mosquito apparently does not live long enough in the presence of DDT for the complete development of the microfilariae to the infective form, although it lives sufficiently long to perpetuate the mosquito species. Also, the zoophilous habits of *C. quinquefasciatus* will keep some of them from entering houses and thus from coming in contact with the DDT. Therefore, the use of DDT alone as a residual spray cannot be considered as an effective measure for eradication of this species. However, the residual spray appears to be very effective in reducing the transmission of filariasis, if indeed not eliminating it, as evidenced by the significant reduction in the percentage of mosquitoes infected and the percentage containing forms in advanced stages of development.

The mosquitoes which do not enter the houses probably are of no great import in the transmission of the disease, although it is conceivable that a few *C. quinquefasciatus* might pick up and pass on an infection without entering a house. Certainly the number falling into this category would be small, for it has been shown that only 0.40 percent of this house-loving species collected from within houses contained infective forms of the parasite. This percentage, small as it is, probably is infinitely larger than the percentage developing infective forms without ever entering a house, since those that do enter feed during the time when microfilariae are most abundant in the peripheral blood, a matter of several hours, as compared to the relatively short time-interval that people might be outdoors during the evening before retiring and at a time when the number of microfilariae in the blood would be relatively low. The possibility that any great number of this domestic mosquito could live as adults 2 or 3 weeks, and feed on human blood at least twice without entering a house, appears rather remote.

[2] This difference is statistically significant.

Blood Surveys

The best proof of the effectiveness of filaria control by the use of DDT would be the finding through periodic microfilaria surveys that young children were no longer acquiring the infection, for an individual once infected will continue to exhibit microfilariae in his blood for years, despite the absence of reinfection. However, it is possible that the death of some adult worms, in the absence of new infection, would be reflected in diminution of microfilaria counts at intervals of 1 to 2 years. Since the prepatent period in filariasis may be as long as a year, new infections appearing within this period should not be ascribed to the failure of control measures.

Our data are based on microfilaria surveys made prior to the DDT program and after 21 months of spraying. Since a study of the younger age groups gives most information, blood smears were made only on children of school age or younger. Children were attracted back to the school by a movie that was shown from 8 to 9:45 p.m., and at its conclusion fingertip blood specimens of 0.04 ml. were obtained. Thick smears of these were made, stained with Giemsa, and the microfilariae on the smears counted. Unfortunately, since the return to school at night often meant walking 3 to 6 miles, the preschool and younger school children came only in small numbers. A night house-to-house survey would have been of great value as young children could have been examined, but it presented insurmountable difficulties. The prespray blood examinations were made early in October 1946, and the postspray examinations in June 1948.

Before the first application of DDT, nocturnal blood smears were obtained from 1,311 children, or approximately one-half of the school population. Although children are probably exposed to infection from birth, a total of 79 children from 3 to 5 years of age were examined without detecting a single infection. The first infections were found in 6-year-olds, and, in this group, 6.2 percent harbored microfilariae. The infection rate gradually increased with age, reaching a maximum of 25.5 percent in the 13-year-olds (table 4). It appears that the acquisition of filaria is a gradual though continual process, and in time it is probably accompanied by a slow loss of some of the worms. Of the 1,311 examined, a total of 164 (13.3 percent) individuals under 15 years of age were found to harbor microfilariae, the counts ranging from 1 to 741 per 0.04 ml. of blood, or in the proportion of 25 to 18,525 per ml. of blood.

After 21 months of DDT spraying of habitations, a resurvey of 906 children gave an infection rate of 10.6 percent. The difference between the 13.3 percent infection rate in 1946 and the 10.6 percent infection rate in 1948 is not quite statistically significant. However,

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Table 4. *Filaria infections* (W. bancrofti) *in children of St. Croix, Virgin Islands, before and after the DDT spray program*

Age	Number examined		Percent positive	
	1946 Pre-DDT	1948 Post-DDT	1946 Pre-DDT	1948 Post-DDT
3	16	2	0	0
4	17	9	0	0
5	46	12	0	0
6	145	67	6.2	2.9
7	145	85	8.9	3.5
8	151	104	11.9	6.7
9	149	118	11.4	9.3
10	177	101	14.4	13.8
11	142	116	14.1	12.9
12	139	101	15.9	17.8
13	106	85	25.5	25.8
14	78	106	16.7	16.0
Total	1,311	906	13.3	10.6

an examination of table 4 shows that the 1948 rates in the 6-to-11-year age group are all noticeably lower than those of 1946.

Microfilaria counts from the same individual may vary considerably from day to day. For example, one individual whose count was made daily over 34 days varied from 172 to 557, about an average of 353 per 0.1 ml. of night blood. Further, the relationship of the number of microfilariae in the circulating blood to the number of adults in the lymphatics is unknown. It is probably safe to assume, however, that in a group of infected individuals, the microfilaria count gives an approximation of the size of the infection, and if in a period of 2 years the microfilaria count is greatly diminished, it is probable that more worms have been lost during this period than have been acquired. The average microfilaria counts by age group for 1946 and 1948 are given in table 5. It will be noted that in the majority of age groups the 1948 microfilaria count was less than that of 1946. The average microfilaria count for the whole group was 74.1 in 1946 and 45.8 in 1948. The difference is not quite statistically significant by conservative criteria.

Another way to compare the data in table 5 is to take into consideration the fact that the children in 1948 were 2 years older than they were in 1946. Using this for comparison, the average microfilaria count of the 6-year-olds in 1946 is compared to that of the 8-year-olds in 1946. On this basis, a drop in microfilaria count in 1948 is noted for each age group in comparison to its count 2 years previously. The average difference noted this way may be adjudged significant.

We should like to emphasize, however, that the counts compared in table 5 refer to those individuals noted as positive either in 1946 or in 1948. A more rigorous comparison may be made by considering only the children present in both surveys.

Table 5. *Microfilaria counts of school children before and after the DDT spray program*

Age years	1946—Prespray			1948—Postspray		
	Number infected	Total count	Average count	Number infected	Total count	Average count
6	9	709	78.7	2	98	49.0
7	12	1,159	96.5	2	38	19.0
8	18	936	52.0	6	432	72.0
9	17	1,486	87.4	10	229	22.9
10	25	2,215	88.6	12	401	33.4
11	21	2,069	98.5	13	901	69.3
12	22	1,242	56.4	18	615	34.1
13	27	1,658	61.4	17	1,356	79.7
14	13	683	52.5	16	333	20.8
Total	164	12,157	74.1	96	4,398	45.8

A total of 504 of the children had their blood examined both in the 1946 and 1948 surveys. Of this number, 454 were negative on both examinations. There were 50 who were positive at one or the other, or both examinations. The total microfilaria counts of 20 individuals went up from 506 to 783 per 0.04 ml. during the spray program. This is an average increase of 14 per 0.04 ml. of blood per individual. Since the date these individuals experienced their rise in microfilaria count is unknown, it is impossible to state whether or not the infection was acquired before the spray program. The total microfilaria count of 30 individuals went down from 3,268 to 1,892 per 0.04 ml. of blood during the spray program. This is an average individual reduction of 46 microfilariae per 0.04 ml. of blood. These data suggest that worm loss was greater than accumulation during the spray program. While the average change for the 50 individuals whose count changed from one survey to the next may be considered statistically significant, we must emphasize that the individual variation was very large.

Discussion of the Blood Surveys

The long prepatent period of *W. bancrofti* makes difficult early assessment of the effect of a DDT spray program by blood microfilaria survey. In addition to the pre-DDT microfilaria base line, an additional blood survey a year later would be of value, for it would detect infections acquired before the spray program but which exhibited microfilariae for the first time during this period.

The microfilaria count of a long-lived infection such as *W. bancrofti* will be affected only slowly by the prevention of additional infection. Assembled mosquito data indicate that the chance of infection after the DDT spray program must have been slight indeed. The blood surveys in general also suggest that new infection was reduced. Both the infection rate in the various age groups and the intensity of the infection as judged by microfilaria counts point to less infection.

The failure of the young children to acquire infection during the spray program is additional proof of the value of this method of control. Taken as a whole, the data suggest that a 21-month spray program was already beginning to affect the filaria infections in children both as to the number of these infections and also their intensity.

If additional studies on the control of filariasis by various techniques are made, it would be highly advantageous to make them in areas where large numbers of children of preschool age could be followed. Studies in areas where the microfilariae are diurnal would also be highly advantageous, as all the school children could be easily examined in school and large numbers of preschool children could also be followed conveniently. Since the mosquito vector would be different, reasonable care would have to be exercised in applying these results to areas of nocturnal microfilaria periodicity. Data from this study suggest that it probably would be of value to make microfilaria counts at perhaps 6-month intervals of all persons found positive.

Summary

The control of *Wuchereria bancrofti* by a DDT spray program of human habitations over a 21-month period was carried out on the island of St. Croix, Virgin Islands, with the following results:

1. The population of *Culex quinquefasciatus*, the vector of filariasis, was reduced approximately 50 percent in the houses.

2. The number of houses in which *C. quinquefasciatus* could be found was reduced by 57 percent.

3. There was a 50 percent reduction of *C. quinquefasciatus* containing forms of *W. bancrofti* which had advanced in development beyond the ex-sheathing of the microfilariae.

4. Before the spray program, 0.40 percent of all *C. quinquefasciatus* examined harbored infective stages of *W. bancrofti*. After the spray program, not a single infective-stage larva was found in any mosquito.

5. *Aedes aegypti* was completely eliminated from the houses.

6. The *W. bancrofti* infection rate in school children dropped from 13.3 percent to 10.6 percent during the spray program, and the average microfilaria count fell from 74.1 per 0.04 ml. of blood to 45.8. The differences are not quite statistically significant by conservative criteria.

7. Of 504 children examined in 1946 and again in 1948, a total of 454 were negative both times. Twenty individuals experienced increases in microfilaria counts, averaging 14 per 0.04 ml. of blood, while the counts of 30 individuals decreased an average of 46 per 0.04 ml. during the spray period.

ACKNOWLEDGMENT

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REFERENCES

(*1*) Soper, F. L., Wilson, D. B., Lima, S., and Antunes, W.: The organization of permanent nation-wide anti-*Aedes aegypti* measures in Brazil. Rockefeller Foundation Publication, 1943.

(*2*) Giglioli, G.: An investigation of the house-frequenting habits of mosquitoes of British Guiana coastland in relation to the use of DDT. Am. J. Trop. Med **28**: 43–70 (1948).

(*3*) O'Connor, F. W. and Beatty, H. A.: *Wuchereria bancrofti* in mosquitoes of St. Croix. Tr. Roy. Soc. Trop. Med. and Hyg. **31**: 413–430 (1938).

(*4*) O'Connor, F. W.: Microfilariae in the blood of the ground dove of St. Croix. Tr. Roy. Soc. Trop. Med. and Hyg. **30**: 6 (1936).

(*5*) de Caires, P. F.: DDT and *Aedes aegypti* control in British Guiana, Puerto Rico J. Pub. Health & Trop. Med. **22**: 405–415 (1947).

Salmonella Types Encountered in Maryland Between 1944 and 1948

By A. A. Hajna, M.S.*

Since the report in 1945 (*1*) of the Salmonella types isolated in Maryland between 1936 and 1943, data have been compiled for the years 1944 to 1948, inclusive. The results obtained in this second series are summarized here and shown in the accompanying table.

All of the cultures were isolated in the Bureau of Bacteriology of the Maryland State Department of Health, or in Maryland hospitals (particularly in the Johns Hopkins Hospital) to which State service for serologic typing was extended. This afforded (*1*) an opportunity to determine the occurrence and distribution of this group of organisms on a larger scale than was possible in the first report; (*2*) a chance to study the frequency of type occurrence, and (*3*) an opportunity to devise new and more rapid techniques for isolation and identification of Salmonella organisms and related types, using Edwards and Bruner's technique of antigenic analysis (*2*).

The preponderance of cultures, a total of 701, were of human fecal origin, as compared to 47 from human blood. The rest, a total of 49, were isolated either from human disease, or from animals (see table).

There is reason to believe that certain of these organisms may cause septicemia. The desirability for better methods of rapid identification and also for media to be used in the isolation of types, particularly from blood, is indicated. Studies are being made with this in view.

It is now generally believed that the old technique of routine agglutination with known *Salmonella typhosa* O, *Salmonella paratyphi* A, and *Salmonella paratyphi* B antisera is inadequate. This is due to the complex antigenic structures of the Salmonella group organisms.

Bornstein (*4*) suggested the use of three O and four H antigens for routine agglutination tests with sera of patients suspected of having Salmonella infections.

In this study, trial of five O antigens—Groups B to E and *S. minnesota*—with known cases and carriers indicated that not all sera obtained from the studied cases or carriers exhibited the same agglutinins for the organisms isolated. One frank typhoid carrier exhibited no agglutinins for the *Salmonella typhosa* recovered.

For preliminary typing of Salmonellas, Kauffmann and Edwards (*3*) recently suggested the use of five O sera, covering groups A to E,

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on the basis of their own observations of frequency of types found. Our compilation has shown these to be inadequate for identification of types prevalent in Maryland, particularly for *Salmonella minnesota*.

Of the total number, 797, *Salmonella typhosa* leads with 420 isolations. All of these cultures exhibited the antigen, Vi, whether from cases or carriers. Most of the organisms were, however, from carriers. The reason for the inclusion of *Salmonella typhosa* in the compilation was to show the relative frequency of occurrence of this organism as compared to the rest of the Salmonella types.

The cultures studied were divisible into 24 serologic types based on the 1948 revision of the Kauffman and White scheme.

Data obtained in this study are, however, not figures for frequency of incidence of infections based on cases since, in some instances, duplicate or even triplicate specimens came from a single case.

Source and identification of Salmonella cultures

Salmonella type	Group	Source of cultures		
		Feces	Blood	Other
S. paratyphi A	A	3		
S. paratyphi B	B	9		
S. typhimurium	B	94	5	Peritoneum 1; rat 2; cervical abscess 1; guinea pigs 4; mouse 31.
S. saint-paul	B	3		
S. derby	B	46	1	Abdomen 1.
S. bredeny	B	2	2	
S. choleraesuis	C-1	4	14	Pleural fluid 1.
S. oranienburg	C-1	13	1	
S. bareilly	C-1	9		
S. montevideo	C-1	14	1	Hand abscess 2.
S. tennessee	C-1	2		
S. newport	C-2	35		
S. muenchen	C-2	13		
S. manhattan	C-2	4		
S. typhosa	D	401	19	
S. enteritidis	D	6		Rat 1; guinea pig 1.
S. panama	D	8	1	
S. give	E	1		
S. anatum	E	11		Rat 1.
S. meleagridis	E	2		
S. newington	E	3		
S. poona	G	1		
S. worthington	G	2		
S. minnesota	Further	15	3	Subdural 1; cervical abscess 1.
Total		701	47	49.

REFERENCES

(*1*) Hajna, A. A. and Perry, C. A.: Salmonella types isolated in Maryland between 1936 and 1943. J. Bact. **49**: 518 (1945).

(*2*) Edwards, P. R. and Bruner, W. B.: Serological Identification of Salmonella Cultures. Kentucky Agricultural Experiment Station. Circular No. 54 (1942).

(*3*) Kauffmann, F. and Edwards, P. R.: A simplification of the serologic diagnosis of Salmonella cultures. J. Lab. & Clin. Med. **32**: 548 (1947).

(*4*) Bornstein, S.: A practical suggestion for the serological type determination of Salmonella organisms. J. Bact. **44**: 719 (1942).

INCIDENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED JUNE 18, 1949

For the current week, 278 cases of poliomyelitis were reported, as compared with 243 last week, 252 for the corresponding week last year, and 96 for the 5-year (1944–48) median. Only 13 States reported currently more than 3 cases, and only 5, reporting as follows (last week's figures in parentheses), showed increases of more than 3 cases: Texas 106 (94), California 23 (12), Oklahoma 29 (22), Idaho 7 (2), Pennsylvania 4 (0). Since March 19 (average week of seasonal low incidence of past years), 1,385 cases have been reported (as compared with 1,349 for the same period last year and a 5-year median of 602). The 3 States reporting during the 13-week period more than 45 cases each (aggregating approximately half the total for the period) are Texas (464), California (139), and Oklahoma (92).

Although a net decline occurred in the reported incidence of measles (from 16,813 cases last week to 14,095 currently), both current and cumulative figures continued above the corresponding 5-year medians. The total for the year to date is 550,187, as compared with a 5-year median of 489,214 and 586,748, the highest corresponding figure of the past 5 years, reported in 1946.

Of 25 cases of Rocky Mountain spotted fever, reported in 10 States, 12 cases occurred in the South Atlantic area (7 in Virginia, 3 in North Carolina), 8 in the Mountain area (7 in Colorado), 2 in Oklahoma, and 1 each in South Dakota, Mississippi, and Oregon. The total for the year to date is 180, as compared with 124 for the 5-year median and 147, the largest figure reported for a corresponding period of the past 5 years, reported last year.

During the week, Michigan and North Carolina each reported one case of psittacosis, and New York and New Jersey each one case of anthrax.

Deaths recorded during the week in 94 large cities in the United States totaled 8,851, as compared with 9,025 last week, 8,632 and 8,527, respectively, for the corresponding weeks of 1948 and 1947, and a 3-year (1946–48) median of 8,632. The total for the year to date is 228,920, as compared with 232,605 for the corresponding period last year. Infant deaths totaled 652, last week 590, 3-year median 646. The cumulative figure is 15,584, same period last year 16,379.

Telegraphic case reports from State health officers for week ended June 18, 1949

[Leaders indicate that no cases were reported]

Division and State	Diphtheria	Encephalitis, infectious	Influenza	Measles	Meningitis, meningococcal	Pneumonia	Poliomyelitis	Rocky Mountain spotted fever	Scarlet fever	Smallpox	Tularemia	Typhoid and paratyphoid fever	Whooping cough	Rabies in animals
NEW ENGLAND														
Maine				96		7	1		11			1	5	
New Hampshire				13		1			1					
Vermont				42										
Massachusetts	12			303			8		81				84	
Rhode Island				23		1			2				1	
Connecticut				628	2	36			16				21	1
MIDDLE ATLANTIC														
New York	10	4	(c)	1,596	4	155	3		[d] 117			1	201	3
New Jersey	2		1	1,417		35			32				93	1
Pennsylvania	9		(c)	1,267	7		4		83			7	97	
EAST NORTH CENTRAL														
Ohio	2		1	1,185	3	27	1		81			2	48	13
Indiana	4		1	93	1	2	3		13		1	2	29	21
Illinois		2	6	408	2	63	6		47		2	4	78	2
Michigan	3	1		697	2	45	2		128			1	24	
Wisconsin			2	1,722	1	3	1		35				40	
WEST NORTH CENTRAL														
Minnesota		1		31	2	14	3		11				2	
Iowa				56		1	5		16				2	6
Missouri				52		13	3		4		4	1	2	
North Dakota				22			4		1					
South Dakota				16	1		3	1	1	(2)		1		
Nebraska	1		2	55			5		8					
Kansas				142		4	3		4			2	7	
SOUTH ATLANTIC														
Delaware				11			1		4					
Maryland	2		2	57	(1)	17	(1)	[1] 1	18			1	19	
Dist. of Col				27		13		1	6					
Virginia			65	374		33		7	15		1	2	43	
West Virginia	2			53		2	3		8				51	
North Carolina	6			470	1		2	3	5				18	
South Carolina		1	123	388	1	69			1			2	39	7
Georgia	1			98		14	3	(2)	3		1	3		13
Florida	4			80	2	5	2		2		1		2	1
EAST SOUTH CENTRAL														
Kentucky	2			73	4	14	3		4			4	14	17
Tennessee	2		13	147	3	47	3		6		1	4	43	
Alabama			1	63		10	3		11		1	2	15	
Mississippi	3		1	41	2	12	8	1	5			4	6	

See footnotes at end of table.

Telegraphic case reports from State health officers for week ended June 18, 1949—Continued

Division and State	Diphtheria	Encephalitis, infectious	Influenza	Measles	Meningitis, meningococcal	Pneumonia	Poliomyelitis	Rocky Mountain spotted fever	Scarlet fever	Smallpox	Tularemia	Typhoid and paratyphoid fever •	Whooping cough	Rabies in animals
WEST SOUTH CENTRAL														
Arkansas	2		2	119	1	12	14		1		11	4	39	5
Louisiana	6		3	11		83	5					2		
Oklahoma			6	154	1	16	29	2	1				7	3
Texas	8	2	289	431	6	167	[1] 106		8		3	5	93	24
MOUNTAIN														
Montana		1		140					4			1	3	
Idaho			6	66	1	5	7		[d] 5			1	3	
Wyoming		1		7		15	1	1	1		1	1		
Colorado	1		7	69		14	2	7	4		1	1	8	
New Mexico	1			30		17	2		1			1	1	
Arizona			22	52	1	4			1				4	
Utah [a]	1			97			2						31	
Nevada														
PACIFIC														
Washington	2		1	173		2	1		13				15	
Oregon	2		3	101	2	7	3	1	5				26	
California	6		5	877	5	18	23		56			6	80	5
Total	94	13	562	14,073	55	1,003	278	25	880	0	28	66	1,294	
Median, 1944–48	162	9	590	11,217	97		96	22	1,922	6	23	82	2,106	
Year to dates 24 weeks	3,534	246	73,102	550,187	[1] 1,897	48,155	[1] 2,309	[1] [2] 180	55,471	[2] 39	591	1,148	24,986	
Median, 1944–48	5,871	208	187,067	489,214	3,798		1,049	124	79,409	235	423	1,350	47,752	
	(27th)		(30th)	(35th)	(37th)		(11th)		(32nd)	(35th)		(11th)	(39th)	
Seasonal low week ends	July 10		July 31	Sept. 4	Sept. 18		Mar. 19		Aug. 14	Sept. 4		Mar. 19	Oct. 2	
Since seasonal low week	8,648		109,372	602,580	[1] 2,741		[1] 1,385		78,169	[2] 49		688	35,019	
Median, 1943–48 [b]	13,437		331,196	524,160	5,302		602		117,980	318		875	79,018	

[a] Period ended earlier than Saturday.
[b] The median of the 5 preceding corresponding periods; for poliomyelitis and typhoid fever the corresponding periods are 1944–45 to 1948–49, inclusive.
[c] New York City and Philadelphia only, respectively.
[d] Including cases reported as streptococcal infection and septic sore throat.
• Including paratyphoid fever; currently reported separately, as follows: Maine 1, Virginia 1, Georgia 3, Tennessee 1, Louisiana 1, California 5. Cases reported as salmonella infection, not included, were as follows: Massachusetts 2.
[1] Delayed reports (included in cumulative totals only): Maryland, May onsets, meningococcal meningitis 1, poliomyelitis 1, Rocky Mountain spotted fever 1; Texas, poliomyelitis, week ended May 28, 10 cases, week ended June 4, 17 cases.
[2] Corrections: Smallpox, South Dakota, week ended Feb. 12, 0 (instead of 1 case); Rocky Mountain spotted fever, Georgia, week ended May 28, 1 (instead of 2 cases).

Anthrax: New York 1; New Jersey 1.
Psittacosis: Michigan 1; North Carolina 1.

Alaska: Measles 3; pneumonia 2.
Hawaii Territory: Measles 88; poliomyelitis 1.

TERRITORIES AND POSSESSIONS

Panama Canal Zone

Notifiable diseases—April 1949.—During the month of April 1949, certain notifiable diseases were reported in the Panama Canal Zone and terminal cities as follows:

Disease	Residence [1]									
	Panama City		Colon		Canal Zone		Outside the zone and terminal cities		Total	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Chagas disease							[2] 1		1	
Chickenpox	31		8		9		12		60	
Diphtheria	1								1	
Dysentery, amebic	3						3		3	
German measles	1								1	
Hepatitis, infectious							1		1	
Malaria [3]		1	1				43		44	1
Measles			1		4		1		6	
Meningitis		2								2
Pneumonia		9		1	8	2		4	[4] 8	16
Poliomyelitis					1				1	
Tuberculosis		17		10	1	1		10	[4] 1	38
Typhus fever (endemic)	2		1						3	
Yaws							1		1	

[1] If place of infection is known, cases are so listed instead of by residence.
[2] The Chief Health Officer of the Canal Zone states that although in the past few years 3 or 4 cases of Chagas disease have been diagnosed on the autopsy table following death, this is the first human case in which clinical diagnosis during life has been made in this area.
[3] 4 recurrent cases.
[4] Reported in the Canal Zone only.

DEATHS DURING WEEK ENDED JUNE 11, 1949

[From the Weekly Mortality Index, issued by the National Office of Vital Statistics]

	Week ended June 11, 1949	Corresponding week, 1948
Data for 94 large cities of the United States:		
Total deaths	9,025	8,952
Median for 3 prior years	8,917	
Total deaths, first 23 weeks of year	220,069	223,973
Deaths under 1 year of age	590	612
Median for 3 prior years	681	
Deaths under 1 year of age, first 23 weeks of year	14,932	15,710
Data from industrial insurance companies:		
Policies in force	70,406,105	71,058,014
Number of death claims	12,470	13,048
Death claims per 1,000 policies in force, annual rate	9.2	9.6
Death claims per 1,000 policies, first 23 weeks of year, annual rate	9.6	10.1

FOREIGN REPORTS

CANADA

Provinces—Notifiable diseases—Week ended May 28, 1949.—During the week ended May 28, 1949, cases of certain notifiable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		38		172	312	25	86	41	171	845
Diphtheria				2						2
Dysentery, bacillary					1					1
Encephalitis, infectious					1					1
German measles		12		144	35	4	60	36	11	302
Influenza		68			6	9	1			84
Measles		104	10	250	226	253	252	449	395	1,939
Meningitis, meningococcal					3					3
Mumps		26		57	207	26	2	19	176	513
Poliomyelitis					1					1
Scarlet fever		4		75	50	2	3	17	8	159
Tuberculosis (all forms)		7	11	50	31	21	7		52	179
Typhoid and paratyphoid fever				1		1			3	5
Undulant fever					1					1
Venereal diseases:										
Gonorrhea		8	14	114	57	13	8	27	63	304
Syphilis		6	8	86	28	3	3	8	20	162
Whooping cough			1	47	28	5	2		1	84

NORWAY

Notifiable diseases—February 1949.—During the month of February 1949, cases of certain notifiable diseases were reported in Norway as follows:

Disease	Cases	Disease	Cases
Anthrax	1	Malaria	1
Cerebrospinal meningitis	5	Measles	4,491
Diphtheria	23	Mumps	817
Dysentery, unspecified	2	Pneumonia (all forms)	3,098
Erysipelas	346	Poliomyelitis	2
Gastroenteritis	1,833	Rheumatic fever	113
Gonorrhea	292	Scabies	2,043
Hepatitis, epidemic	131	Scarlet fever	327
Impetigo contagiosa	2,156	Syphilis	91
Influenza	7,937	Tuberculosis (all forms)	292
Laryngitis	13,352	Typhoid fever	1
Lymphogranuloma inguinale	1	Whooping cough	2,640

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual incidence, only those places are included which had not previously reported any of the above-mentioned diseases, except yellow fever, during recent months. All reports of yellow fever are published currently.

A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday in each month.

Cholera

Burma—Rangoon.—During the week ended June 4, 1949, one case of cholera was reported in Rangoon, Burma.

Ceylon—Trincomalee.—During the week ended May 28, 1949, one fatal suspected case of cholera was reported near Trincomalee, Ceylon, and one fatal suspected case was also reported week ended June 4, in the same area.

India—Calcutta.—For the week ended May 28, 1949, 102 cases of cholera, with 17 deaths, were reported in Calcutta, India.

Plague

India—Calcutta.—For the week ended May 28, 1949, 44 cases of plague, with 5 deaths, were reported in Calcutta, India.

Portugal—Azores.—During the week ended May 28, 1949, one case of plague was reported at Ribeirinha, Ribeira Grande, in the Azores.

Smallpox

Belgium.—During the week ended June 4, 1949, one suspected case of smallpox was reported at Eupen in Leige Province, Belgium.

Colombia.—During the period April 1–30, 1949, 265 cases of smallpox were reported in Colombia.

Great Britain—England and Wales.—In the recent outbreak of smallpox in England, 20 confirmed cases (including 14 imported cases) were reported during the period April 2–May 21. The onset of the last case was stated to have been on May 16.

Italy—Rome.—During the period May 28–June 10, 1949, 5 cases of smallpox (varioloid) were reported in Rome, in addition to the 90 cases previously reported for the period January 1–May 27, 1949.

Java—Batavia.—During the week ended June 4, 1949, 244 cases of smallpox, with 29 deaths, were reported in Batavia, Java.

Nigeria.—Smallpox has been reported in Nigeria as follows: Week ended April 9, 1949, 504 cases, 41 deaths; week ended April 16, 253 cases, 43 deaths; week ended April 23, 392 cases, 55 deaths; week ended April 30, 345 cases, 48 deaths.

Typhus Fever

Colombia.—During the month of April 1949, 202 cases of typhus fever were reported in Colombia.

Yellow Fever

No reports of yellow fever were received during the current week.

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