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Effects of DDT Mosquito Larviciding on Wildlife

IV. The Effects on Terrestrial Insect Populations of Routine Larviciding by Airplane

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This report is the fourth in a series dealing with the effects on various forms of wildlife of routine DDT larviciding for mosquito control. It is based on studies made during 1946 and 1947 in the Savannah Migratory Waterfowl Refuge, Jasper County, Ga. The purpose of this investigation was to determine whether routine airplane larviciding would show any effect on the insect populations of terrestrial areas, situated adjacent to routinely larvicided bodies of water and over-lapped by the application and drifting of the larvicide.

Procedure

The Savannah Migratory Waterfowl Refuge lies within the lower Savannah River tidal bottoms, which are generally brackish; however, the areas studied were protected from tidal fluctuation and brackish water by a system of dikes. The dikes, islands, and vegetation of the area studied have been described by Erickson (*1*). During the latter part of 1945, ecological investigations of the dikes and islands were made and the species of vegetation identified and compared in order that stations might be selected in check and treated areas which would be comparable and so have similar insect faunas. Four similar islands and three dikes were selected for intensive study and for the erection of light traps for the sampling of insect populations before and after the routine airplane treatments.

The area selected for treatment included about 815 acres in four ponds, their adjoining islands and dikes, and a narrow zone around them. In the untreated portion of the refuge, two islands and the dikes around a large 850-acre pond were selected as check areas. Two

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of the treated ponds, 6 and 2, were routinely sprayed; the other two, 3 and 3A, received a thermal aerosol. Treatments were applied at weekly intervals and at a dosage of 0.1 pound of DDT per acre. The formulation used was a 20 percent solution (by weight) of technical grade DDT in a methylated naphthalene, Velsicol NR–70.[1] The sprays and aerosol treatments were applied with a Stearman PT–17 plane having a 220-horsepower Continental engine. The plane was equipped with a Venturi exhaust generator, similar to the one described by Krusé and Metcalf (*2*) for the distribution of thermal aerosols, and five nozzles for the application of sprays. During 1946, the pond 6 area received 17 applications; the pond 2 area, 16; and ponds 3 and 3A and their surrounding zone, 15 applications each. In the 1947 season, all treated areas received 20 applications. In applying the larvicide, the plane was flown along parallel flight lines at 100-foot intervals and at an elevation of about 30 feet.

In order to determine the actual amount of DDT reaching the ground in areas where the insect populations were being studied, 3x12-inch glass sampling slides for the collection of the DDT sprays and aerosols were put out before treatment. These slides were collected after treatment and taken to the laboratory where the amount of DDT deposited on them was determined. The DDT recoverable from these slides was quantitatively determined by the Schechter-Haller colorimetric method. Six slides were placed at fixed stations on each of the dike and island areas studied. The average amount recovered from these slides after each treatment was considered as the actual amount reaching the ground. In the sprayed area, this amount varied from 13 to 88 percent of the amount discharged by the plane. According to the determinations made, the average calculated amount reaching the ground per spraying was 0.046 ± 0.021 pound per acre. In the areas receiving the thermal aerosols, the amount recovered varied from 1.3 to 18 percent, and the calculated average amount reaching the ground surface per application was 0.008 ± 0.002 pound of DDT per acre. It is thus apparent that the sprayed areas received almost six times as much DDT as the areas which received the aerosol. The total calculated deposit of DDT was 0.78 pound for the sprayed areas and 0.12 pound for the aerosoled areas during 1946.

Although the primary purpose of the study was to determine the effects of routine airplane mosquito larviciding with DDT on insects in bordering terrestrial areas into which the larvicide may have drifted, it was deemed desirable in the 1946 study to test the maximum likely effect by including direct treatment of these marginal study areas.

Several independent series of observations were made for the

[1] This does not represent an endorsemen the product by the Public Health Service.

detection of the possible effects on terrestrial insects of these routine airplane applications of DDT sprays and aerosols for mosquito control. General field observations were made of the abundance of several species of insects in check and treated areas; post-treatment inspections of water areas were made for the detection of insects killed; aphid colonies were studied to determine any increase in their numbers or decrease in their predators; several hives of bees located within the treated area were observed and their honey production recorded; and light traps were set up in selected areas for sampling the night-flying insect populations before and after treatment.

To determine whether or not the night-flying insect population was reduced in the marginal terrestrial areas included in the larviciding operations, seven light traps were operated at selected stations—three in check areas and four in treated areas. These traps were run the night before and the night after routine larvicidal treatment.

In 1946, the routine larvicidal treatments were made from May 28 to September 5. During this period insect collections were made before and after 12 routine treatments on the following dates: May 28 and 29; June 4, 5, 18, 19, 25, and 26; July 2, 3, 9, 10, 16, 17, 23, 24, 30, and 31; August 20, 21, 27, and 28; and September 4 and 5. Due to occasional mechanical failures, all seven traps were not operated on each of the above nights, but a total of 142 complete trap-night collections was obtained.

In 1947 the light traps were set up at the same stations used in 1946, but collections were made before and after only the last three routine larvicidal treatments. Collection dates were August 20, 21, 26, and 27, and September 3 and 4. The dates of these collections are practically the same as those made before and after the last three treatments of the 1946 season. Mechanical failure and other causes prevented full trap operation; however, a total of 26 trap-night collections was obtained.

The insects caught in each trap each night were classified according to order, counted, and weighed so certain comparisons could be made between check and treated areas after individual treatments and throughout the season.

The light trap used in this study (figs. 1 and 2) was a battery-operated trap designed by the senior author. This trap provides a means for obtaining good insect collections in areas where electric current is not available. The light source for the trap is a neon-style gas tube activated by a Model-T Ford coil and an automobile storage battery. The light trap consists of three tightly fitting but removable parts: a protecting hatch cover, a trap body having four glass-louvered windows, and a battery-box base.

Four feet of mercury-argon tubing make up the lighting element, suspended by three wires from the ceiling of the trap body. This is connected by insulated ignition wire to the Model-T Ford coil and switch which is attached on top of the trap body. Wires are strung down through one corner of the trap body and attached by clips to the battery in the battery box.

The trap body is protected from the weather by a hatch cover which

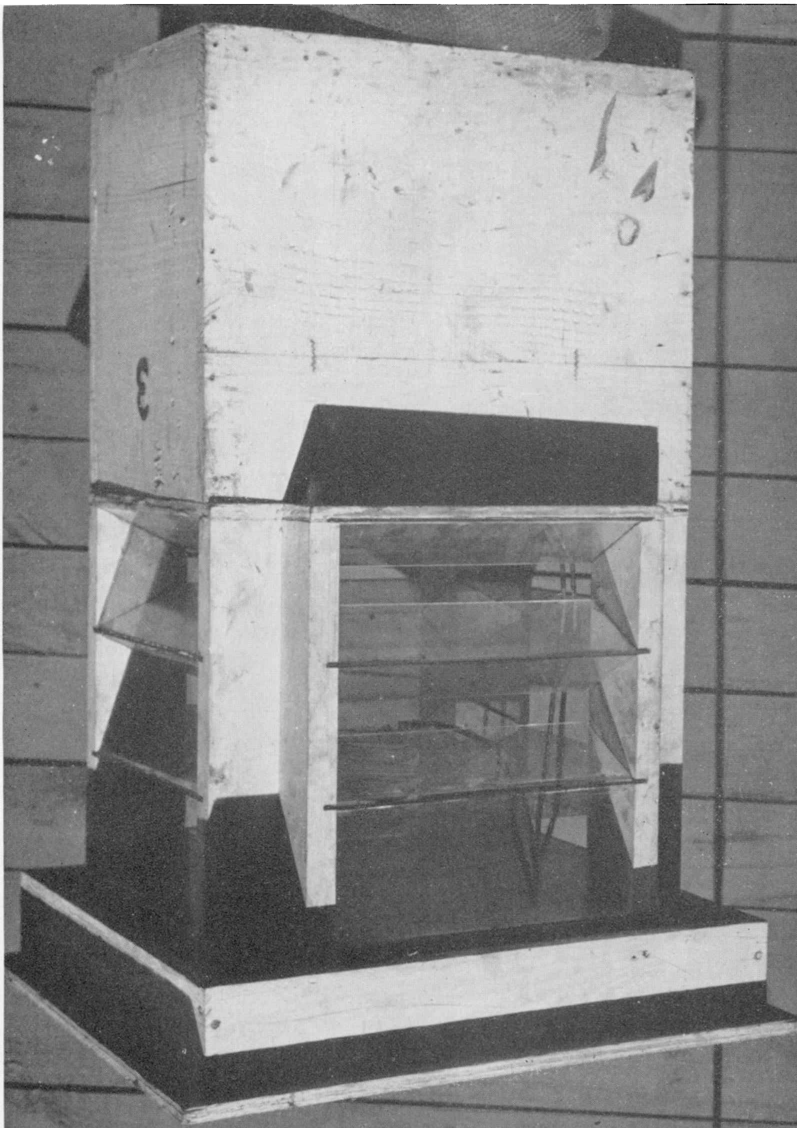

Figure 1. A weatherproof mercury-argon light trap with glass louvers operated by an automobile storage battery and used for quantitative sampling of night-flying insect populations.

is supported on upward prolongations of the four corner posts of the trap body, thus allowing ventilation for the coil beneath.

On each of the four sides of the trap, glass louvers afford two ingress openings, each 1½ inches wide, sufficient for large moths to pass, so a great variety of insects can be collected. A large funnel located directly beneath the light and fitted to the floor of the trap body leads

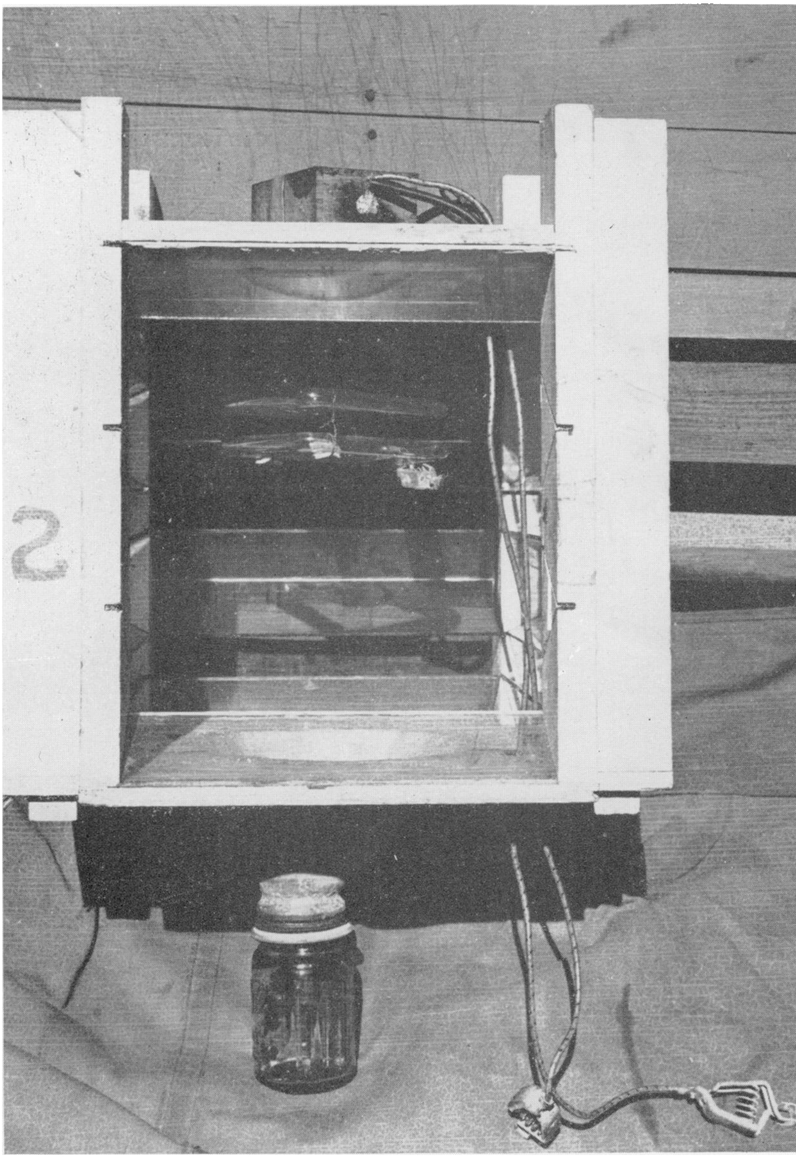

Figure 2. The light trap with protective hatch cover removed.

down to a 2-quart screw-topped killing jar, which is charged regularly with carbon tetrachloride. The collecting funnel with its attached jar extends downward beside the battery in the battery box.

The battery box is provided with only a partial bottom, sufficient for the battery, while the rest is open below to permit changing the poison jars, which can be reached easily through the bottom of the box and unscrewed from a ring lid soldered to the funnel.

The entire trap has proved to be weatherproof and difficult to upset because of the weight of the included battery. Each trap was mounted on four posts in a fairly open place whether in woods or dike areas.

The traps were operated all night each night of operation. Because the batteries supplied energy sufficient for only two nights' operation, they had to be recharged for each week's run.

A special effort was made to obtain similar locations for the traps in both check and treated areas. Traps 1 and 2 were check traps placed on small islands in locations closely similar to those for traps 3 and 4, which were established on small islands in the sprayed area. Traps 5, 6, and 7 were located on the dikes in more open areas. Trap 5 was placed on the dike of pond 2 which was sprayed; trap 6 was set on the dike of pond 4 which was a check area, and trap 7 was located on the dike of pond 3 which received the thermal aerosol treatments. Data on each of the trap situations are summarized in table 1.

Table 1. *Light-trap situations*

Trap No.	Area treatment	Location	Situation	Local flora
1	None	Island 1	Partly wooded, well-drained.	*Quercus, Melia, Solidago. Morus.*
2	None	Island 2	Wooded, well-drained	*Liquidambar, Quercus, Ilex.*
3	DDT spray	Island 5	Open woods, low	*Liquidambar, Quercus Mocus, Sapium.*
4	DDT spray	(Pond 6) Island 6	Open woods, low	*Mocus, Quercus, Liquidambar.*
5	DDT spray	(Pond 2) Dike I	Water edge, open dike area.	*Salix, Baccharis, Sapium, Rubus.*
6	None	(Pond 4) Dike H	Water edge, open dike area.	*Salix, Rubus.*
7	DDT thermal aerosol.	(Pond 3) Dike G	Water edge, open dike area.	*Baccharis, Sapium, Rubus.*

Results

General Field Observations

During the spray season rather constant observation of both check and treated areas showed only those differences in general insect numbers and activity which could be considered due to differences in the respective ecological situations. No over-all effect of the treatments was observed.

Field observations on certain individual groups of insects did indicate reductions in their populations. Mosquitoes, deer flies, and sand flies were definitely reduced in numbers as attested by both those people living in the area and the scientific personnel who had worked there during the previous year (1945). The untreated area during the spraying seasons showed high deer fly and mosquito populations as expected from the previous year. In addition, the great numbers of midges (Diptera: Chironomidae) observed were moderate in the treated areas.

Deer Flies. Although deer flies (Tabanidae: *Chrysops* spp.) were observed to be common in the treated areas in late May and through June, they were distinctly more numerous just outside the treated area. The difference was so noticeable that it was attributed to the DDT treatment, since in the previous year (1945) the deer flies had been plentiful in all areas.

Aside from these insect groups, no other effects were noticeable, since grasshoppers, ants, dragonflies, damsel flies, wasps, bees, and other common forms appeared in usual abundance.

By diligent inspection a very few affected insects could be found crawling about after each spraying. Examination of the sprayed area (pond 6) showed only the following affected or dead specimens in 2 hours of inspection of the ground cover and of special 3-foot square traps placed out for the purpose:

Four soldier beetles (Coleoptera: *Chauliognathus* sp.).
One leaf beetle (Coleoptera: Chrysomelidae).
One flesh fly (Diptera: *Sarcophaga* sp.).
One parasitic fly (Diptera: Tachinidae).
Three midges (Diptera: Chironomidae).
Three ants (Hymenoptera: Formicidae).
One spider (Arachnida: Araneae).

This type of observation was discontinued because its value was not believed to justify the time required.

Horse-Guard Wasps. As indirect evidence of the normal abundance of aerial insects, it was noted that a colonial population of a few thousand highly predaceous horse-guard wasps (Hymenoptera: Sphecidae—*Stictia carolina*) seemed to thrive successfully on the open sandy high ground of an island marginal to the DDT-spray-treated area (pond 6), which received an average DDT deposit of 0.03 pound per acre as recorded from a glass panel in the area. The horse-guard wasps exhibited extreme activity over a 3-week period, May 25 to June 14, during which they policed a large well-defined area like a group of fighter planes, each jealously guarding the air over a fixed plot of ground having a radius of about 3 feet, and assailing any flying

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insect that ventured near. As this species of wasp is known to provision its solitary nests with horseflies and deer flies (Diptera: Tabanidae), these observations indicated that even on the tabanids, generally considered to be fewer in number in the treated areas, the treatment did not exercise an effect great enough to starve their natural predators, the horse guards. In addition, in spite of the treatment, no dead or affected specimens of the horse guards were found.

It is realized that searching the terrain for dead insects is difficult and uncertain, and that scavenging forms undoubtedly destroy many specimens before they would be found; but it is believed that any general decimation would have been observable. Consequently, aside from the few forms discussed, it was considered that no general effect of significant nature was produced by the treatment.

Insects Found Dead or Affected Shortly After Treatment. Seven post-treatment inspections were made of a selected area of sprayed water surface (pond 6), and the affected and dead insects were roughly classified (table 2). These inspections were made from a boat within 8 hours after treatment.

The section studied was a strip of water area partly covered with floating vegetation and extending between 10 feet and 30 feet from a cutgrass, *Zizaniopsis miliacea,* margined shore line. The aquatic vegetation present was principally white waterlily in fairly dense stands with a scattering of emergent vegetation.

The ecological factors varied greatly within the area sampled, and distances from shore strongly affected the distribution of the insects found. For these reasons, no quantitative data collecting was attempted, but the data given may serve to show the relative mortalities of groups of aerial insects common at that location.

It can be noted from table 2 that the insects most commonly found dead or dying after the DDT treatment were may flies (Ephemeroptera), damsel flies (Odonata: Zygoptera), *Donacia* (Coleoptera: Chrysomelidae), long-legged flies (Diptera: Dolichopodidae), and miscellaneous acalyptrate muscid flies (Diptera: Acalyptratae). Undoubtedly, a great many more were overlooked, and many were eaten by fish or other predators before the inspections were made, but these partial data are of interest in considering the very light dosage used in the tests.

In spite of the insects killed, there was no evidence of any general diminution of damsel flies and dragonflies on the wing, or of aquatic insects in general, all of which were abundant throughout the spray season.

Aphid Studies. Since higher DDT dosages have been shown to favor the aphid population by killing off their parasites and predators (*3*), a series of field observations was made in the early summer of

1946 to see if the low anopheline-larviciding dosage used in the current experiments would be enough to produce the same effect.

The aphid colonies chosen for study were those of the common goldenrod aphid, probably *Macrosiphum rudbeckiae* (Fitch), which abounds in the Savannah area and is conspicuous for its bright red colonies along the goldenrod stems. The active length or extent of the colony along the stem (roughly indicative of its vigor) and the

Table 2. *Insects and spiders dead*[1] *or affected by DDT, found on the surface of pond 6 within 8 hours after airplane treatment of the area with 0.1 pound DDT per acre as a spray*

Insect groups found dead or affected on water surface	Date of collection, 1946							Total number insects collected
	June		July		August		Sept.	
	11	18	16	23	13	27	4	
Orthoptera	0	0	0	0	0	0	0	0
Neuroptera: Chrysopidae	0	0	0	0	0	0	1	1
Ephemeroptera	11	2	4	2	1	0	1	21
Odonata:								
Anisoptera	1	-------	1	1	1	-------	1	5
Zygoptera	4	9	7	12	8	5	4	49
Hemiptera:								
Corixidae	0	0	0	0	1	0	1	2
Nepidae	1	0	0	0	0	0	0	1
Belostomatidae	0	0	0	1	1	0	0	2
Naucoridae	1	0	0	0	0	0	0	1
Homoptera:								
Cercopidae	0	0	0	1	0	0	0	1
Cicadidae	0	0	0	0	0	1	0	1
Coleoptera:								
Carabidae	1	0	0	0	0	0	0	1
Dytiscidae	0	0	2	1	1	1	1	6
Hydrophilidae	0	0	0	0	0	0	1	1
Coccinellidae	7	0	0	0	0	0	0	7
Chrysomelidae[2]	8	8	27	10	5	2	12	72
Curculionidae	0	0	0	1	0	0	1	2
Trichoptera	0	0	0	0	0	0	0	0
Lepidoptera:								
(Microlepidoptera)	0	0	0	0	0	2	0	2
Pyralididae	3	0	0	0	0	2	6	11
Geometridae	0	0	0	1	1	2	0	4
Noctuidae	0	0	0	0	0	0	4	4
Pieridae	0	1	0	0	0	0	0	1
Nymphalidae	0	0	0	0	1	0	0	1
Lycaenidae	0	0	0	0	0	0	1	1
Diptera:								
Tipulidae	0	0	0	0	1	0	0	1
Chironomidae	2	0	0	0	0	0	0	2
Bibionidae	0	0	0	0	1	0	0	1
Dolichopodidae	32	54	35	17	77	12	29	256
Empididae	0	0	0	0	0	2	1	3
Syrphidae	0	1	1	0	0	0	0	2
(Acalyptratae)	11	26	8	8	6	5	5	69
Hymenoptera:								
Formicidae	0	2	0	0	0	0	0	2
Andrenidae	0	0	0	0	0	0	1	1
Arachnida: *Araneae* (Spiders)	1	0	0	0	2	0	1	4

[1] Not necessarily killed by the DDT.
[2] All but one of these were *Donacia*.

identity and numbers of parasites and predators were noted in both an untreated and treated area (pond 6). No colony differences were observable either with respect to treatment or to location in either open or shaded areas (table 3).

The predators found in the colonies were larvae of coccinellids and chrysopids, while braconids were the chief aphid parasites.

Honeybee Studies. Five 10-frame hives of Italian honeybees, each hive weighing over 100 pounds, were kept under observation in the sprayed area (pond 6) to determine whether or not the treatment would affect them. These colonies had been placed in position the previous autumn (1945), at which time they were studied and determined to be vigorous and free from disease. The five colonies passed the winter in good condition in the mild Savannah climate.

Table 3. ***Colonies of the goldenrod aphid,*** **Macrosiphum rudbeckiae (Fitch),** ***compared to show effects of several routine DDT spray treatments at 0.1 pound per acre***

Study area	Total number colonies examined	Colony locations		Colony length along stem in cm.		Colonies w/parasites and/or predators
		In sun	In shade	Average	Variation	
DDT treated	24	14	10	12.3	2.2–26.0	20
Untreated	30	10	20	11.9	3.2–25.8	20

The beehives were located in an open live oak grove, *Quercus virginiana*, on well-drained ground about 200 feet from the treated water area (pond 6). They were subjected to routine DDT surface deposits averaging 0.03 pound per acre with an upper extreme of 0.07 pound for one treatment as indicated by the chemical determination of DDT deposited on glass slides placed in the center of the bee yard. This dosage was about two-thirds of that determined for the adjacent open-water pond area. The points near the bee yard where the bees took water were also within the treated zone, but only about a quarter of their theoretical honey-flow area was estimated to be under treatment, since their range from the hive locations included a 250° sector of untreated swamp bordering the experimental area. Nevertheless, the treated area was the only impoundage in their range, and its richer flora must have been far more attractive than the surrounding tidal swamp.

During the period of treatment the bees showed no abnormalities in their activity which could be assigned to DDT. The number of dead bees about the colony entrances was never great and was considered normal for the colonies. Occasionally a few bees were seen to be in some kind of distress, but it could not definitely be determined as due to DDT.

During the spray season the colonies each produced several extract-

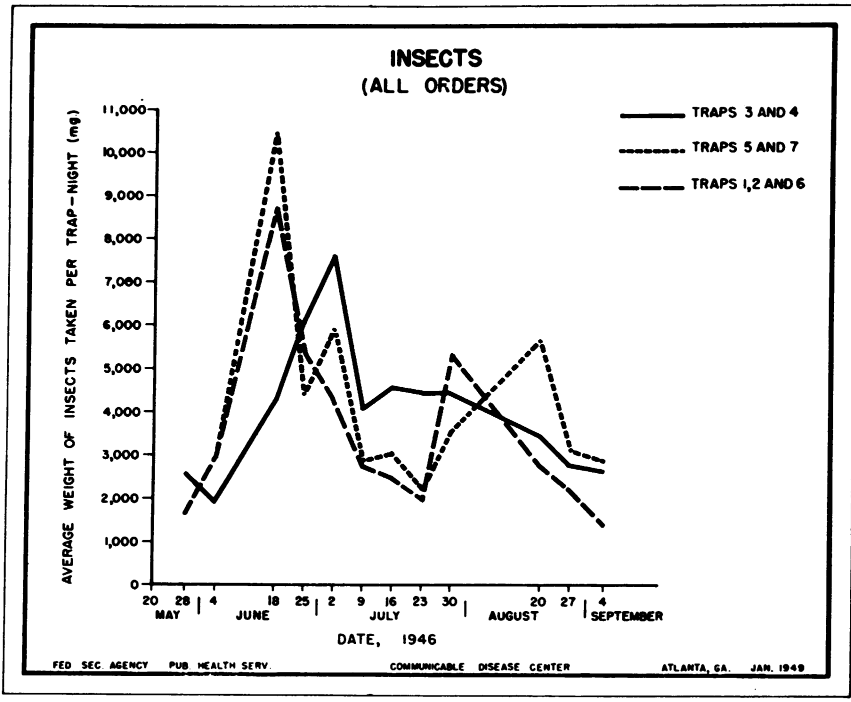

Figure 3. The average weight, in milligrams, of all insects taken per trap night in wooded island areas sprayed at the rate of 0.1 pound of DDT per acre (traps 3 and 4), in open-dike areas receiving 0.1 pound of DDT as a spray or aerosol (traps 5 and 7), and in check or untreated areas (traps 1, 2, and 6) during the period of study. Each point is the average of four or six trap-night catches.

ing frame supers with the exception of one colony which became weakened by an invasion of wax moths (probably the lesser wax moth, *Achroia grisella*). As the yard had a previous history of wax moth infestations, it was considered of no significance in estimating the effects of DDT. An experienced beekeeper examined the colonies during and at the close of the spray season (September 1946) and stated that the colonies had had a very successful year, regardless of the DDT treatment, and showed better honey production than expected for the season on the basis of other colonies in the Savannah area.

From these studies it was concluded that the routine airplane spraying at the rate of 0.1 pound of DDT per acre did not significantly affect the colony strength or honey production of honeybee colonies maintained adjacent to the treated water area. During the second and third years of routine larvicidal treatment in the refuge area, the beekeepers moved many additional colonies back into the sprayed areas. They obtained good honey production and reported no unusual killing of bees, which indicated that DDT mosquito larvicid-

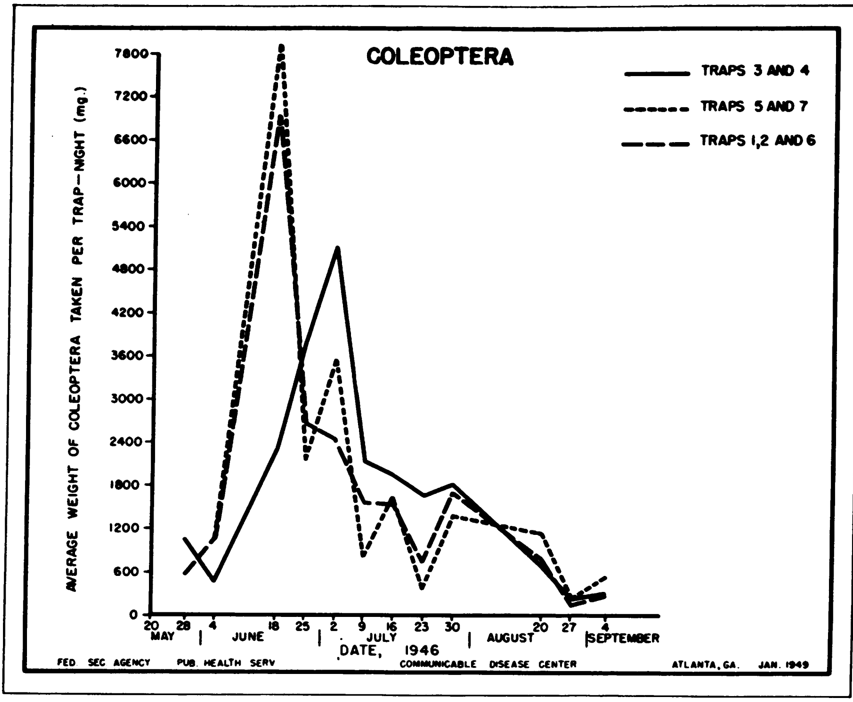

Figure 4. The average weight, in milligrams, of Coleoptera taken per trap night in wooded island areas sprayed at the rate of 0.1 pound of DDT per acre (traps 3 and 4), in open-dike areas receiving 0.1 pound of DDT as a spray or aerosol (traps 5 and 7), and in check or untreated areas (traps 1, 2, and 6) during the period of study. Each point is the average of four or six trap-night catches.

ing apparently is not significantly harmful to the honey industry.

Field studies carried out by Eide (*4*) have indicated that DDT when used as a 5-percent dust is much less toxic to bees than calcium arsenate or cryolite.

Light-trap Studies. Complete data from the seven light traps were obtained for a total of 142 trap nights in 1946. Of the total trap nights, 62 were in check areas, 61 in sprayed areas, and 19 in an area receiving a thermal aerosol. The average catch per trap night in the treated areas was 1,908 insects weighing 4.314 grams, while in the check areas it was 1,520 insects weighing 3.407 grams. In the sprayed areas, the average catch per trap night was 1,144 insects weighing 3.968 grams; in the area receiving the thermal aerosol, it was 4,361 insects weighing 5.414 grams. The average catch per trap night for all traps was 1,739 insects weighing 3.917 grams. Average catches in check and treated areas did not differ drastically, indicating that the treatments had little effect on the total population of insects. Total catches varied from night to night in the various traps princi-

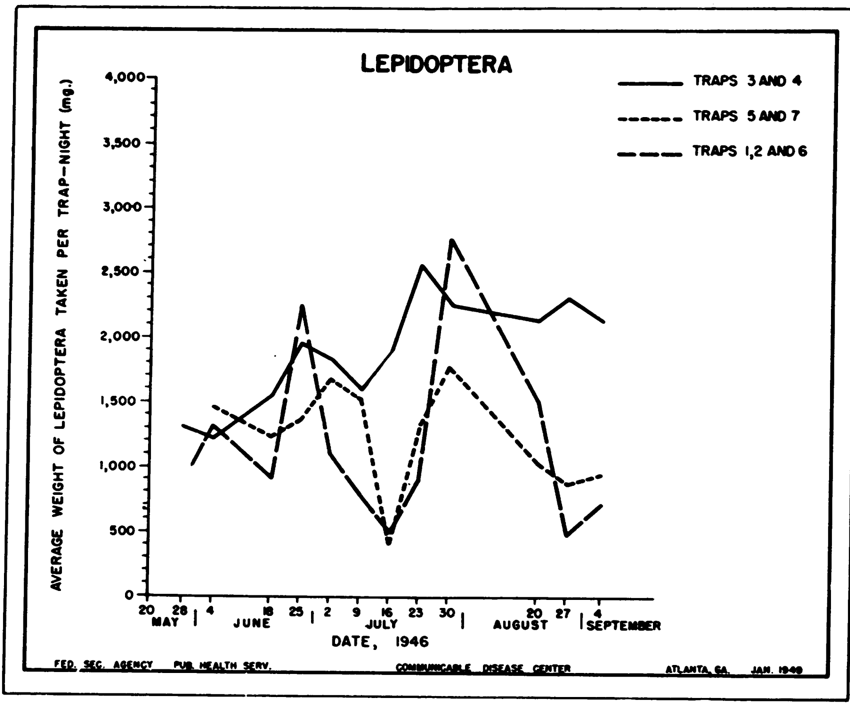

Figure 5. The average weight, in milligrams, of Lepidoptera taken per trap night in wooded island areas sprayed at the rate of 0.1 pound of DDT per acre (traps 3 and 4), in open-dike areas receiving 0.1 pound of DDT as a spray or aerosol (traps 5 and 7), and in check or untreated areas (traps 1, 2, and 6) during the period of study. Each point is the average of four or six trap-night catches.

pally because of differences in weather and the heavy emergence flights of may flies and staphylinid beetles.

The Coleoptera, Lepidoptera, Diptera, and Trichoptera accounted for the majority of insects taken and ranked in numbers in the order named. The composition of the catch also varied as did the average size of the insects taken. Because of the variable and often great numbers of very small insects, principally Staphylinidae, Ephemeroptera, Helodidae, and Chironomidae, taken in the light traps, it was deemed that the dry weight of the total catch and of each of the four dominant orders provided the best basis for a comparison of changes in check and treated areas throughout the period of treatment. The weights of the average catch per trap night for all insects and for the Coleoptera, Lepidoptera, Diptera, and Trichoptera taken in the traps during the period of study are shown in figures 3 through 7.

For purposes of comparison the catches from the seven traps are divided into three groups, namely, catches in the check areas, traps 1, 2, and 6; catches in island areas which were sprayed, traps 3 and 4;

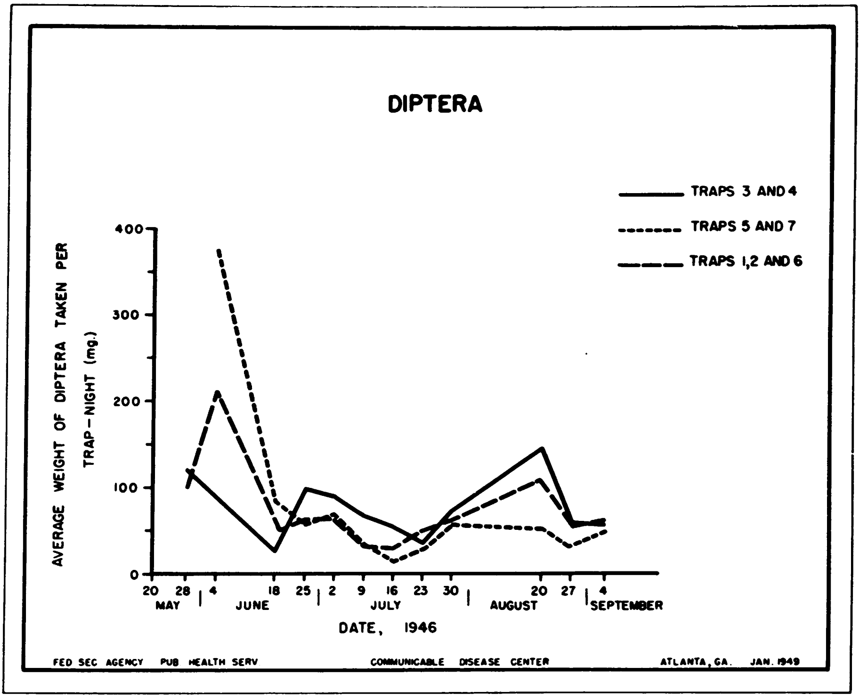

Figure 6. The average weight in milligrams, of Diptera taken per trap-night in wooded island areas sprayed at the rate of 0.1 pound of DDT per acre (traps 3 and 4), in open-dike areas receiving 0.1 pound of DDT as a spray or aerosol (traps 5 and 7), and in check or untreated areas (traps 1, 2, and 6) during the period of study. Each point is the average of four or six trap-night catches.

and catches from open dike areas which were treated, traps 5 and 7. In showing the average catch per trap night for these traps throughout the season, the weights of the catches taken just before and just after each treatment were combined and averaged so that each point on the graph represents the average weight of insects taken during four to six trap nights. A comparison of the weights of all insects taken in the three groups of traps throughout the period of study indicates that the trap catches had a fairly high degree of correlation with each other and that there was no great reduction in the insect population due to the treatments. The four dominant orders with the possible exception of the Trichoptera show no effects that can be definitely attributed to the treatments. The weight of Trichoptera taken in the traps on the islands in the sprayed area was considerably less than that taken in traps of the check areas or the area receiving the thermal aerosol (fig. 7). It is believed that the differences between the curves for the other groups and possibly also for the Trichoptera are due to differences in the ecological situation around the various traps. It

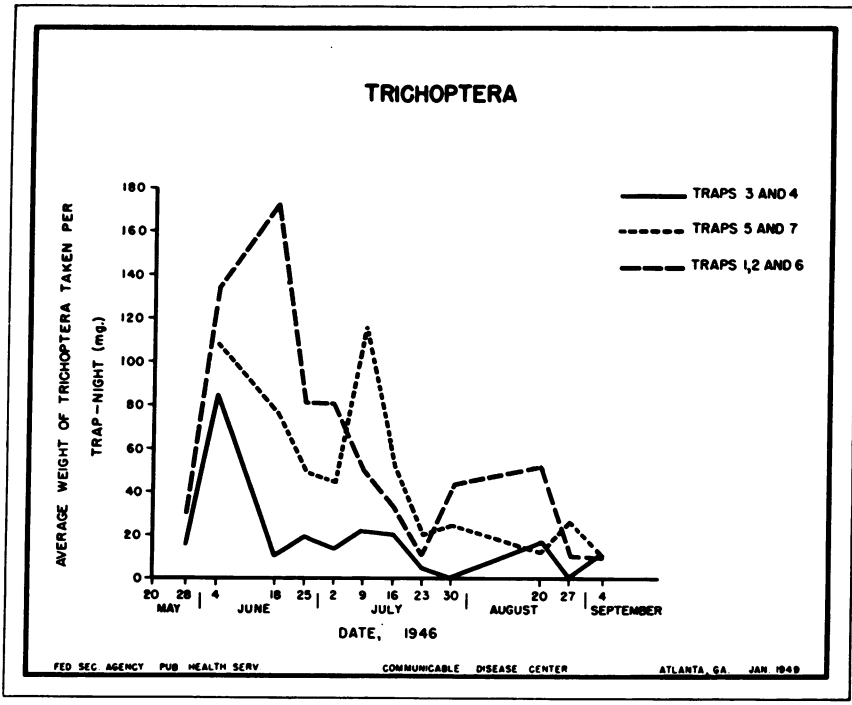

Figure 7. The average weight, in milligrams, of Trichoptera taken per trap-night in wooded island areas sprayed at the rate of 0.1 pound of DDT per acre (traps 3 and 4), in open-dike areas receiving 0.1 pound of DDT as a spray or aerosol (traps 5 and 7), and in check or untreated areas (traps 1, 2, and 6) during the period of study. Each point is the average of four or six trap-night catches.

appears that the major curve variations are due to weather, lunar phases, and emergence of aquatic forms.

Differences in the catches before and after individual treatments were not consistent for the various traps and were not significantly different in check and treated areas.

Collections were made during the latter part of the second year of treatment to determine if 2 years of application had drastically changed the insect fauna. Collections were made in the same locations and at the same times as in 1946; however, because ponds 2 and 3 were not treated in 1947, light traps 5 and 7 for that year were in an untreated instead of a treated area. The average number of insects taken in the various light traps before and after the last three applications in 1946 and 1947 are compared in table 4. It will be noted that variations are considerable. From this limited period of study, the only conclusion which can be drawn is that there was not a catastrophic kill of terrestrial insects in adjoining areas due to routine DDT larviciding over a 2-year period.

Table 4. *A comparison of the average numbers of the various orders of insects taken per trap night in light traps in check and treated areas during the last 3 weeks of treatment in 1946 and 1947—traps 1, 2, and 6 were in check areas and the others in treated areas*

Various orders of insects	Average catch—individual traps											
	Trap 1		Trap 2		Trap 3		Trap 4		Trap 5,[1] 1946	Trap 6		Trap 7,[1] 1946
	1946	1947	1946	1947	1946	1947	1946	1947		1946	1947	
Lepidoptera	192	178	168	206	383	200	331	226	129	136	194	230
Coleoptera	1,623	680	740	271	1,045	310	424	384	1,778	178	363	382
Diptera	73	97	132	413	135	616	146	294	108	52	85	84
Trichoptera	3	3	16	9	7	7	8	8	8	37	6	11
Ephemeroptera	9	3	15	------	7	1	2	------	209	4,230	289	7,209
Homoptera	85	77	21	48	18	32	10	46	256	131	295	67
Hemiptera	25	15	3	6	4	4	3	11	6	9	22	10
Hymenoptera	5	9	8	15	2	31	6	10	3	3	34	1
Neuroptera	------	2	1	1	4	1	2	1	3	1	2	1
Odonata	------	------	1	------	2	2	4	2	6	------	------	1
Orthoptera	------	------	------	------	1	1	1	1	1	------	1	------
Total	2,067	1,063	1,104	970	1,609	1,003	935	982	2,505	4,777	1,290	7,996

Various orders of insects	Average catch—all traps			
	1946		1947	
	Check	Treated	Check	Treated [2]
Lepidoptera	165	357	193	213
Coleoptera	864	735	438	347
Diptera	86	141	198	455
Trichoptera	19	8	6	8
Ephemeroptera	1,418	5	97	----------
Homoptera	79	14	140	39
Hemiptera	12	4	14	8
Hymenoptera	5	4	19	20
Neuroptera	1	3	2	1
Odonata	----------	3	----------	2
Orthoptera	----------	1	----------	1
Total	2,649	1,272	1,108	993

[1] The area surrounding these traps was not treated in 1947.
[2] These averages are for traps 3 and 4 only.

Conclusions

Mosquitoes, deer flies, and sand flies were reduced in numbers by the routine larvicidal treatments; however, for other than these forms, no over-all effect of the treatments was observed. Observations in check and treated areas showed only those differences in general insect numbers and activity which could be considered to be due to differences in the respective ecological situations. Grasshoppers, ants, dragonflies, wasps, bees, and other common forms appeared in usual abundance during the first season of treatment.

Examination of water areas shortly after treatment disclosed considerable numbers of dead insects, especially may flies, damsel flies, certain beetles (*Donacia*), and dolichopodid and acalyptrate flies;

however, during the first season there was no evidence of any general diminution of damsel flies and dragonflies on the wing or of aquatic insects in general.

Aphid colonies in treated and check areas showed no significant differences in vigor or in the occurrence and number of parasites and predators.

Experimental beehives kept under observation during the first season of treatment showed no over-all adverse effects and produced a crop of honey normal for the year. During the two succeeding years of treatment, beekeepers kept many colonies in treated areas with no reported adverse effect, indicating that routine DDT mosquito larviciding is not detrimental to honey production.

Light-trap catches in treated and check areas during two seasons' treatment showed no significant over-all reduction in the insect population of areas adjoining those routinely larvicided with DDT at 0.1 pound per acre with the possible exception of the Trichoptera.

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Q Fever—An Epidemiological Note

By EDWARD A. BEEMAN, M. D.*

Q fever occurs endemically in Western Europe (*1*), the Mediterranean Area (*2, 3*), the Balkans (*4, 5, 6, 7*), the Near East (*8, 9*), Australia (*10*), Panama (*11, 12*), and in the United States in southern California (*13, 14, 15*), Texas (*16*), Chicago (*17*). It has also been recognized in Arizona (*18*), and Montana (*19*). Q fever occurring in the eastern United States has usually been the result of direct association with laboratory sources of infection (*20, 21*), and one case (*22*) not associated with a laboratory epidemic was probably the result of an infection contracted while the patient was visiting in a Mediterranean endemic area. The present report deals with two cases of Q fever in which the usual epidemiological factors were absent and in which the only contact with the causative organism presumably came through an intermediate source.

Patient A, a housewife aged 39, wife of Patient B, became ill November 14, 1948, and was hospitalized at Walter Reed General Hospital from November 17 to December 15, 1948. She had a severe illness, and the clinical course was consistent with Q fever (*23, 24*). She developed X-ray evidence of a right pneumonitis which persisted, but with considerable diminution, up to the time of discharge. The diagnosis was established by the appearance of a rising titer of complement-fixing antibodies against the Henzerling strain of *Coxiella burnetii*. Serum collected at the Army Medical Department Research and Graduate School on November 26 showed a titer of 1:160, and another specimen on December 8 showed a positive reaction in a dilution of 1:640 or greater. Serum examined at the National Institutes of Health Microbiological Institute gave a titer of 1:256.

Patient B, an Army officer, 44 years old, husband of Patient A, became ill December 15, 1948, and was hospitalized at Walter Reed General Hospital from December 16, 1948, to January 6, 1949. His illness was rather mild. X-ray evidence of a right pneumonitis was present on admission and showed almost complete resolution at the time of discharge. Serum examined at the Army Medical Department Research and Graduate School showed a rising titer of complement-fixing antibodies against the Henzerling strain of *C. burnetii*: December 17, negative, 1:10; December 27, 1+, 1:10; December 30, positive, 1:40; January 3, 1949, positive, 1:160. Serum examined at the National Institutes of Health showed no titer on December 17 and was positive 1:256 on January 3 against Henzerling antigen.

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* Laboratory of Infectious Diseases, National Institutes of Health. The author is indebted to Dr. Ross L. Gauld of the Army Medical Department Research and Graduate School for access to records on the patients reported.

Epidemiological Data

The patients resided in a suburban Maryland community near Washington, D. C. They lived with A's mother in a brick, single-family, six-room, two-story house. The basement of the house contained a finished room with a bathroom and shower stall. This room was rented for permanent occupancy. It had no direct connection with the main living quarters of the house, and access was gained by two entrances, one through the basement and the other through the outside of the house.

No cattle, sheep, or goats were located in the immediate vicinity and there were no dairies within several miles of this residence. The patients had no contact with animals at any time and had not traveled recently to any endemic areas where *C. burnetii* was prevalent. There was no history of visits to meat packing or rendering plants. The incubation period and onset of their illnesses were beyond the season of peak incidence for ticks in Maryland, and neither reported contact with ticks. Neither patient worked with wool in the raw state. The household used pasteurized milk and obtained meat from one of the Army commissaries.

On August 1, 1948, the basement room of the house was rented to a research worker assigned to the Rickettsial Unit, Laboratory of Infectious Diseases, National Institutes of Health. Patient A had direct and indirect contact with this worker. She did the housework in the room, including a thorough cleaning once a week. She laundered the sheets, pillow cases, and towels used by the occupant in an automatic washing machine but did not do any of his personal linen. The worker frequently paid the family brief visits and occasionally dined with them. On October 31, 1948, about 2 weeks prior to onset of Patient A's illness, the family had a social gathering at which the research worker sat next to the patient. While she was in the hospital, her husband and mother did the cleaning and laundering in the basement apartment. The worker who had been vaccinated against Q fever never showed any evidence of illness during this period, and examination of his serum revealed the absence of antibodies against *C. burnetii*.

About the time of the onset of A's illness, a minor epidemic of Q fever occurred among some of the laboratory and maintenance personnel at the National Institutes of Health. The first case occurred October 10, 1948, the second and third November 11, the fourth November 13, the fifth November 16, the sixth November 18, and the seventh November 22. All these cases (except the case of one patient who denied ever having been in the infectious disease building) had exposure within 2 to 4 weeks of onset of illness inside the Rickettsial Unit. Two patients were maintenance personnel who had been inside the Rickettsial Unit laboratory every day for at least 4 to 5 months. It seems likely then that during the month of October 1948 there was a high concentration of *C. burnetii* in the environment of the laboratory. During that time and for the previous 8 to 9 months antigens were being prepared regularly in large quantities from the Henzerling strain of *C. burnetii* for use in large scale serological tests. One other routine laboratory procedure during this period was the inoculation of large numbers of guinea pigs with milk specimens collected from dairies in southern California; many of these specimens contained *C. burnetii*. The only departure from the routine work prior to the onset of illness in the cases at the National Institutes of Health were several experiments on the thermal death point of some strains of *C. burnetii*. Some of the experiments involved the injection of many guinea pigs with heavily infected yolk sac suspensions of the organism. In connection with this work guinea pigs were infected September 1, September 20, October 1, October 14, and November 10, 1948. Animals infected with this type of inoculum usually have a severe illness and a high mortality. Normal control guinea pigs placed in the cages with these animals showed a high incidence of spontaneous infection (*25*). The exact mode of infection of controls is not known; however, urine specimens from guinea pigs injected with less virulent suspensions have been shown to contain *C. burnetii* (*30*). The new worker in the laboratory (who resided in the home of Patients A and B) at this time was employed primarily in egg inoculation and yolk sac harvesting work. About October 27, 1948, he began participating in the preparation of antigens. He did not begin working with guinea pigs until November 15, 1948.

All workers in the Rickettsial Unit were required to change their laboratory uniforms (coveralls) when working with infected materials; however, protective, discardable outer gowns were not worn and it was not customary to wear protective head coverings. Changing of shoes between infected and clean areas was not customary at that time and frequently many of the laboratory personnel, including the new worker, wore the same shoes both at work and at home.

This gives a general picture of the conditions prevailing within the Rickettsial Unit during the period of probable infection and incubation of the patients discussed in this report.

Discussion

In other studies on the epidemiology of Q fever, certain situations were present in which patients had an opportunity to come into direct contact with the organism possibly by means of infected dust, droplets of infected material, or other particulate matter. The disease occasionally becomes an occupational hazard in certain groups, e. g., laboratory workers (*20, 21, 26, 27*), abattoir and packing house personnel (*10, 16, 17*), dairy workers (*15*), rendering plant, and hide workers. Among military personnel, epidemiological evidence (*3, 28*) points to common sources of exposure for large groups of individuals. Exposure of certain populations (*15*) by reason of proximity to dairies or household use of raw milk seems to be a factor in the incidence of the disease, although the exact role of infected milk in the transmission of the disease is not yet established. Recently Oliphant et al. (*29*) described cases of Q fever occurring in laundry workers who handled unsterilized laboratory apparel used by persons working with the organism. In a sense these cases are comparable to the two described here in that they were indirectly exposed to *C. burnetii*.

None of these factors seem to have been present in the patients of this report. The most feasible explanation for their contact with *C. burnetii* is through the medium of their tenant, but the method by which this was accomplished is not readily apparent. The most reasonable theory is that of passive carriage of the organism from the laboratory either on the clothing, shoes, hands, or hair. It is not surprising that *C. burnetii* would survive the period of transportation from one location to another since it is resistant to physical and chemical agents (*21, 25*). The onset of illness in Patient A falls within the period when other cases at the National Institutes of Health were occurring. The onset in Patient B came one month later. The latter visited his wife frequently while she was in the hospital. However, previous epidemiological work indicates that person-to-person transmission of Q fever is unlikely. The tenant never showed signs, symptoms, or laboratory proof of Q fever. Patient B assumed many of the household duties of his wife and, therefore, was more intimately exposed to the same environmental conditions of the latter. Although the mother of Patient B had the same contacts, she did not develop clinical or serological evidence of infection.

The set of factors involved in the acquisition of the disease by the patients of this report suggests that laboratory personnel working with *C. burnetii* or any other infectious agent should take scrupulous pains to keep the organism within the confines of the laboratory. Adequate coverings completely protecting all parts of the body not only should be worn but should be completely changed before leaving the laboratory, and all exposed body surfaces should be thoroughly cleansed.

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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 DECEMBER 31, 1949

For the last week of the year, reported cases of poliomyelitis increased from 154 for the preceding week to 195 and interrupted a consecutive weekly decline for the 18 weeks since August 20. The cumulative total for the year is 42,375 as compared with 27,676 for 1948. The 5-year median (1944–48) is 19,272.

For the week, reported cases of typhoid and paratyphoid fever decreased from the preceding week. One case of anthrax was reported in New York. No cases of smallpox or Rocky Mountain spotted fever were reported. Hawaii reported 528 cases of influenza. Total reported cases of the more important notifiable diseases for the current week, the preceding week, the corresponding week last year, and the cumulative totals for the current and preceding years are shown below.

Disease	*Total for week ended*			*Cumulative total*		*Median*
	12-31-49	*12-24-49*	*1-1-49*	*1949*	*1948*	*1944-48*
Diphtheria	158	118	202	8, 039	9, 725	14, 126
Influenza	2, 620	2, 289	2, 821	106, 397	175, 085	338, 209
Measles	2, 778	2, 008	7, 161	607, 648	604, 027	602, 397
Meningitis, meningococcal	69	57	80	3, 429	3, 280	5, 638
Scarlet fever	1, 214	1, 083	1, 913	74, 105	77, 924	112, 981
Typhoid and paratyphoid fever	25	52	35	3, 617	3, 592	4, 003
Whooping cough	1, 470	1, 394	619	68, 138	72, 956	100, 212
Encephalitis, infectious	11	12	3	761	564	620

Of 41 States and the District of Columbia reporting on rabies in animals, 24 States and the District of Columbia reported no cases. The remaining 17 States reported 125 cases with the largest numbers in Texas (23), New York (17), and Kentucky (14). The total number of rabies in animals reported for the year is 5,678.

A total of 9,828 deaths was recorded during the week in 91 large cities in the United States as compared with 9,192 last week; 10,384 and 10,238, respectively, for the corresponding weeks of 1948 and 1947; and 10,238 for the 3-year (1946–48) median. For the year to date the total is 466,572 as compared with 466,968 for the same period last year. Infant deaths for the current week totaled 637; for last week, 626; for the corresponding week last year, 644; and for the 3-year median, 712. The cumulative figure is 32,992 as compared with 33,697 for the corresponding period last year.

Telegraphic case reports from State health officers for week ended Dec. 31, 1949

[Leaders indicate that no cases were reported]

Division and State	Diphtheria	Encephalitis, infectious	Influenza	Measles	Meningitis, meningococcal	Pneumonia	Poliomyelitis	Rocky Mt. spotted fever	Scarlet fever	Smallpox	Tularemia	Typhoid and paratyphoid fever [1]	Whooping cough	Rabies in animals
NEW ENGLAND														
Maine	----	----	----	60	----	27	2	----	9	----	----	----	6	----
New Hampshire	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Vermont	----	----	----	----	----	----	6	----	4	----	----	----	6	----
Massachusetts	6	1	----	29	3	----	4	----	74	----	----	----	117	----
Rhode Island	----	----	1	1	----	----	1	----	9	----	----	----	5	----
Connecticut	----	----	----	4	----	83	3	----	16	----	----	----	66	----
MIDDLE ATLANTIC														
New York	12	2	(2)	196	3	256	17	----	[3] 77	----	----	----	173	17
New Jersey	1	1	3	317	----	96	7	----	438	----	----	1	173	1
Pennsylvania	3	----	----	59	3	70	5	----	59	----	----	1	114	----
EAST NORTH CENTRAL														
Ohio	11	----	7	43	5	84	4	----	186	----	6	----	112	3
Indiana	----	2	20	20	2	19	4	----	49	----	1	----	15	11
Illinois	2	----	2	54	----	75	5	----	43	----	5	----	57	----
Michigan [4]	3	----	3	798	3	43	14	----	98	----	----	----	136	6
Wisconsin	----	----	40	100	----	10	8	----	39	----	----	----	74	2
WEST NORTH CENTRAL														
Minnesota	2	1	----	35	2	9	5	----	17	----	----	----	16	----
Iowa	3	----	----	129	----	----	----	----	13	----	----	----	10	2
Missouri	1	----	1	----	----	19	2	----	12	----	----	----	17	----
North Dakota	----	----	1	35	----	----	----	----	1	----	----	----	3	----
South Dakota	----	----	----	1	----	1	3	----	----	----	----	----	----	----
Nebraska	----	1	22	32	----	6	3	----	23	----	----	----	13	----
Kansas	1	----	----	4	----	16	----	----	18	----	----	----	16	----
SOUTH ATLANTIC														
Delaware	----	----	----	3	1	----	----	----	----	----	----	----	3	----
Maryland [4]	3	----	----	11	1	42	4	----	20	----	----	----	51	----
District of Columbia	1	----	1	32	----	16	----	----	2	----	----	----	----	----
Virginia	4	----	288	13	----	58	1	----	20	----	1	1	23	1
West Virginia	9	----	55	16	5	11	----	----	6	----	----	----	21	9
North Carolina	20	----	----	97	1	----	3	----	75	----	2	1	11	----
South Carolina	3	----	8	53	1	8	1	----	4	----	----	1	1	3
Georgia	9	----	166	7	1	21	5	----	20	----	1	----	6	12
Florida	1	----	2	8	1	15	5	----	4	----	----	1	1	----

EAST SOUTH CENTRAL														
Kentucky	5	...	3	10	6	32	4	...	64	...	...	1	15	14
Tennessee	5	1	43	63	6	49	1	...	16	...	3	...	21	7
Alabama	2	...	39	4	1	37	2	...	11	...	...	...	3	11
Mississippi [4]	7	...	10	49	3	33	1	...	9	...	...	3	6	...
WEST SOUTH CENTRAL														
Arkansas	1	...	143	33	3	67	4	...	1	...	2	1	12	2
Louisiana	5	...	1	...	1	39	2	...	...	...	3	1	6	...
Oklahoma	3	1	121	3	2	40	4	...	14	...	...	1	2	1
Texas	17	1	1,473	46	3	323	14	...	18	...	...	3	55	23
MOUNTAIN														
Montana	...	...	2	22	...	1	...	...	4	...	8	...	...	...
Idaho	...	...	17	2	...	12	4	...	16	...	...	...	...	...
Wyoming	...	...	...	2	...	...	5	...	2	...	...	...	...	...
Colorado	...	...	9	18	3	21	5	...	7	...	...	...	...	...
New Mexico	2	...	...	12	...	13	...	...	3	...	...	...	1	...
Arizona	10	...	123	36	...	14	1	...	7	...	...	3	11	...
Utah [4]	1	...	...	151	...	1	1	...	4	...	...	...	20	...
Nevada	...	...	...	...	...	1	2	...	...	...	...	...	...	...
PACIFIC														
Washington	...	...	1	49	2	...	4	...	47	...	...	...	13	...
Oregon	1	...	13	21	...	15	2	...	8	...	...	...	10	...
California	4	...	2	100	7	21	27	...	47	...	...	6	49	...
Total	158	11	2,620	2,778	69	1,704	195	...	1,214	...	32	25	1,470	...
Median, 1944–48	118	5	3,466	2,723	80	...	86	1	1,913	3	45	43	1,570	...
Year to date, 52 weeks	[5] 8,039	761	106,397	607,648	3,429	77,691	[6] 42,375	560	74,105	48	1,138	3,617	68,138	...
Median, 1944–48	14,126	620	338,209	602,397	5,638	...	19,272	523	112,981	333	1,049	4,003	100,212	...
Seasonal low week ends	(27th) July 9	...	(30th) July 30	(35th) Sept. 3	(37th) Sept. 17	...	(11th) Mar. 19	...	(32nd) Aug. 13	(35th) Sept. 3	...	(11th) Mar. 19	(39th) Oct. 1	...
Since seasonal low week	[5] 4,271	...	30,530	19,130	913	...	[6] 41,460	...	15,845	7	...	3,157	21,536	...
Median, 1944–45 to 1948–49 [7]	7,566	...	36,270	26,124	972	...	19,009	...	26,686	54	...	3,528	24,337	...

[1] Including paratyphoid fever currently reported separately as follows: Florida 1, Arizona 2, California 4. Cases reported as salmonella infection not included in the table were as follows: New York 2, Pennsylvania 2.
[2] New York City only.
[3] Including cases reported as streptococcal sore throat.
[4] Period ended earlier than Saturday.
[5] Virginia—Diphtheria, delayed report, 13 cases not assignable to specific weeks.
[6] Deductions—Michigan, weeks ended Aug. 20 and 27, Sept. 17, 1 case each. Arkansas, week ended Aug. 13, 1 case.
[7] The median of the 5 preceding corresponding periods (1944–45 to 1948–49).

Anthrax: New York 1 case.
Alaska: Influenza 1, measles 14.
Hawaii: Influenza 528, whooping cough 1.

TERRITORIES AND POSSESSIONS

Hawaii Territory

Influenza.—During the week ended November 12, 1949, a sharp increase in the incidence of influenza was noted in Hawaii Territory. From November 6 to December 24, 1949, 2,289 cases were reported. Report for week ended December 31, recorded 528 cases.

DEATHS DURING WEEK ENDED DECEMBER 31, 1949

	Week ended Dec. 31, 1949	Corresponding week, 1948
Data for 91 large cities of the United States:		
Total deaths	9,828	10,384
Median for 3 prior years	10,238	
Total deaths, first 52 weeks of year	466,532	466,968
Deaths under 1 year of age	637	644
Median for 3 prior years	712	
Deaths under 1 year of age, first 52 weeks of year	32,992	33,697
Data from industrial insurance companies:		
Policies in force	69,878,197	70,695,788
Number of death claims	9,543	11,777
Death claims per 1,000 policies in force, annual rate	7.1	8.7
Death claims per 1,000 policies, first 52 weeks of year, annual rate	9.1	9.2

FOREIGN REPORTS

CANADA

Provinces—Notifiable diseases—Week ended December 10, 1949.—During the week ended December 10, 1949, cases of certain notifiable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	New found-land	Prince Edward Island	Nova Scotia	New Bruns-wick	Que-bec	On-tario	Mani-toba	Sas-katch-ewan	Al-berta	British Colum-bia	Total
Chickenpox	1		49	1	187	196	61	52	75	116	738
Diphtheria					13	2					15
Dysentery, bacillary					1						1
Encephalitis, infectious						1					1
German measles			1		15	27		3	72	4	122
Influenza			17				10				27
Measles			16	1	250	109	74	70	87	108	715
Meningitis, meningococcal					1	1				2	4
Mumps			88		193	229	4	13	62	56	645
Poliomyelitis							1			1	2
Scarlet fever	6		4	4	73	69	16	1	65	6	244
Tuberculosis (all forms)	41		4	12	115	24	37	8	4	47	292
Typhoid and paratyphoid fever					9			1		1	11
Undulant fever					1	1	1		2		5
Venereal diseases:											
Gonorrhea	5	1	10	7	87	70	22	15	47	81	345
Syphilis	3		3	5	48	26	5	20	2	10	122
Other forms								1			1
Whooping cough	1				128	60	2		1	15	207

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

Note.—The following reports include only items of unusual incidence or of special interest and the occurrence of these diseases, except yellow fever, in localities which had not recently reported cases. 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—Moulmein.—During the week ended December 3, 1949, 1 case of cholera was reported in the town of Moulmein, Burma.

Plague

Indonesia—Java.—For the week ended December 17, 1949, 16 fatal cases of plague were reported in Jogjakarta City, Java.

Union of South Africa—Southwest Africa.—During the week ended December 3, 1949, 3 suspected cases of plague, with 2 deaths, were reported in Gobabis District, Southwest Africa.

Smallpox

Pakistan—Chittagong.—During the week ended December 17, 1949, 12 cases of smallpox with 2 deaths were reported in Chittagong, Pakistan.

Information from Dacca, Pakistan, dated December 23, 1949, states that 11 fatal cases of smallpox occurred among passengers on a pilgrim ship due to arrive at Chittagong from Jedda on December 16, and that 70 additional cases were reported aboard the ship.

Palestine.—During the month of November 1949, 101 cases of smallpox were reported in Palestine, including 58 cases in Hebron and 5 cases in Jerusalem.

Peru—Pacasmayo.—Information dated January 3, 1950, states that in the recent outbreak of smallpox in the port of Pacasmayo, Peru, 90 cases with 20 deaths were reported during the period beginning in the month of September, ending December 6, 1949.

PLAGUE INOCULATION FOR JORDAN AIR TRAVELERS

Quarantine restrictions for plague have been imposed on air travelers arriving in Jordan from the Cape of Good Hope Province, South Africa. The restrictions, put into effect Dec. 14, 1949, by the Public Health Department at Amman, Hasemite Kingdom of the Jordan, require air travelers to have an international inoculation certificate.

Regular Corps Examinations

Examinations for psychologists, bacteriologists, and nurses will be held March 20, 21, and 22 for appointments in the Regular Commissioned Corps of the Public Health Service. Completed applications must be in the Washington Office by February 20.

Psychologist and bacteriologist appointments will be made in the grades of assistant and senior assistant, equivalent to Army ranks of first lieutenant and captain, respectively. The nurse appointments will also include the junior assistant grade (second lieutenant).

Psychologist applicants must have at least 7 years training and experience after high school, including a doctor's degree in psychology from a university of recognized standing. Bacteriologist applicants must have at least 7 years of training and experience after high school, including a doctor's degree in bacteriology. Nurse applicants must be graduates of an approved school of nursing, have a bachelor's degree from a recognized college, and be currently registered as a graduate professional nurse. Additional nurses' training and experience are required for assistant and senior assistant grades.

For application forms and additional information write to: Surgeon General, Public Health Service, Federal Security Agency, Washington 25, D. C. Attention: Division of Commissioned Officers.