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AN ANALYSIS OF THE DESIGN AND PERFORMANCE OF AIRPLANE EXHAUST GENERATORS FOR THE PRODUCTION OF DDT AEROSOLS FOR THE CONTROL OF *ANOPHELES QUADRIMACULATUS*

By C. W. KRUSÉ and R. L. METCALF, *Health and Safety Department, Tennessee Valley Authority, Wilson Dam, Ala.*

Introduction

The use of the airplane exhaust generator for the production of DDT aerosols employed in the control of *Anopheles quadrimaculatus* larvae has been extensively studied during the past 2 years. This type of equipment is ideally suited for larvicidal operations on the impounded waters of the Tennessee Valley Authority as it provides a relatively uniform coverage over wide swaths at exceedingly low rates of discharge. The particle size of the larvicide generated may be controlled to meet field requirements. The use of particles of aerosol size will result in the effective penetration of heavy vegetative cover. The visible smoke cloud produced serves as a marker to guide the pilot. The equipment is simple, inexpensive, and easily installed on the 450-hp. 4–DX and 220-hp. PT-17 Stearman biplanes which were available for study. Comparative cost records of the DDT larviciding operation and paris green dusting indicate an approximate cost per acre of $0.26 for DDT and $0.79 for paris green, and the DDT treatments resulted in more effective anopheline larvae control. A preliminary account of the development and field testing of this equipment has previously appeared (*1*), and it is the purpose of this paper to present basic information on the design and performance of the airplane exhaust generator, especially as applied to anopheline larvae control.

Equipment

Preliminary experiments indicated that the injection of oil solutions of insecticides into the exhaust gas stream of an aircraft engine resulted in the atomization of the solutions and that the drop spectrum obtained was dependent on the controllable factors of: (1) Volume and velocity of exhaust gases, and (2) the rate of liquid injection and the physical properties of the liquid used. Therefore, it follows that accurate measurements of these variables are essential in the design of the equipment.

The volume and velocity of exhaust gases are directly related to the fuel consumption of the engine and to the cross-section area of the exhaust stack at the point of liquid injection. The gas flow can be measured by means of Pitot tube readings provided the exhaust gas temperature and consequent density are known. In order to calculate the velocity, the assumption was made that the exhaust gas consisted largely of nitrogen.[1] In actual practice reliable pitometer readings are difficult to make since investigations should be made in flight. Satisfactory estimates of gas volume have therefore been made from the fuel consumption of the engine, assuming stoichiometric oxidation of octane into carbon dioxide and water vapor which are eliminated in the exhaust with the unburned nitrogen from the air utilized. These volumes were totaled and corrected to the temperature of the exhaust. The equation used was

$$2\ C_8H_{18}+25\ O_2 \longrightarrow 16\ CO_2+18\ H_2O$$

The amount of nitrogen exhausted was computed from the oxygen required, assuming air to be by weight 23 percent oxygen. A comparison of the results obtained by Pitot measurements and from fuel consumption on the two engines studied is given below.

Aircraft engine	Volume [1] of exhaust gas (cubic feet per second)	
	Computed from fuel consumption	Pitometer readings
450-hp. Pratt & Whitney	24	20.5–26.4
220-hp. Continental	13	10.8–12.0

[1] Engine operating at cruising r.p.m.

The velocity of the exhaust stream may be regulated by varying the cross-sectional area of the exhaust stack. In most instances it is necessary to introduce a venturi constriction to provide the high

[1] At the temperature of the gas measured (1,000° F.), the density of nitrogen is 0.0267 lb. per cubic foot. The Pitot equation, therefore, reduces to: velocity in feet per second = 112 × velocity head in inches H_2O.

velocities required to break up the desired amount of liquid. The quantity of liquid to be atomized is determined by the required rate of treatment, cruising speed of the aircraft, and the effective swath width obtained.

By plotting the data from a number of experiments where the relative rates of liquid flow and gas flow were correlated with the

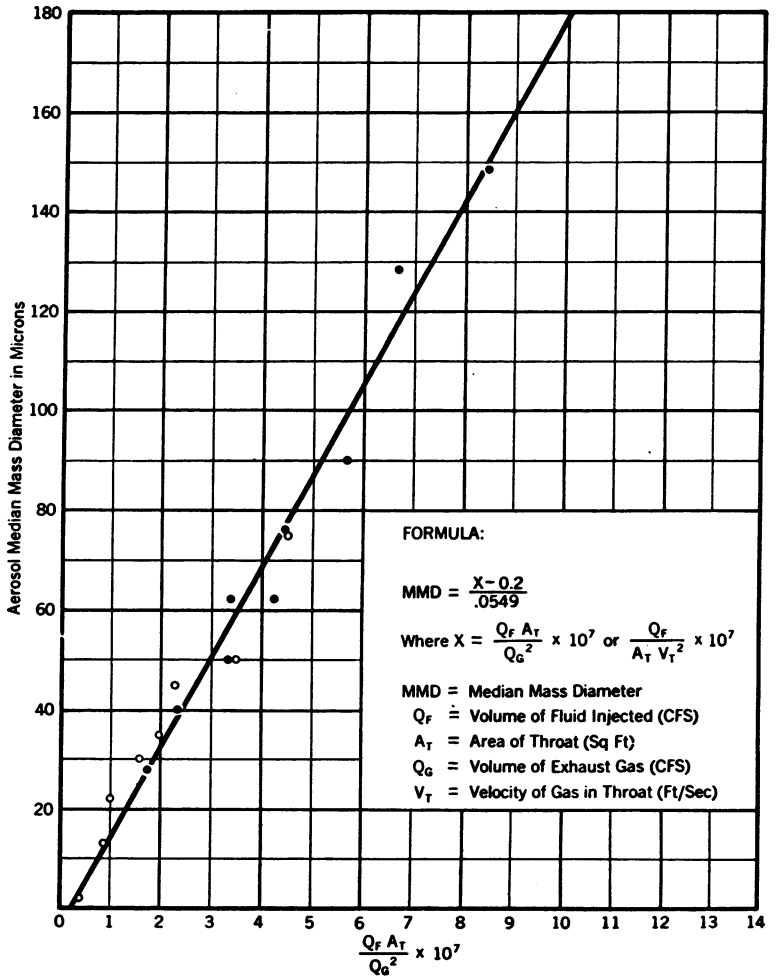


FIGURE 1.—Relationship of mass median diameter to liquid gas flow rates.

mass median diameters of the aerosols produced, it became apparent that a linear relationship existed between these factors. In order to formulate this relationship for purposes of designing exhaust generating equipment, the graph shown in figure 1 was plotted. Thus, with a given volume of fluid injection and a known volume of exhaust gas produced by the engine, the required cross-sectional area of a

venturi throat to produce an aerosol of any desired mass median diameter may be calculated. The empirical equation resulting from this plot is:

$$MMD=\frac{Q_f A_t \times 10^7}{0.0549\ (Q_g)^2}-3.66$$

Where MMD=Mass median diameter in microns
Q_f=Fluid flow rate in cubic feet per second
A_t=Area of venturi throat in square feet
Q_g=Exhaust gas flow rate in cubic feet per second

This equation was developed from values obtained by the use of a 20 percent solution of technical DDT in Velsicol NR-70 (see Insecticide Formulation, page 1177), and therefore the factors of liquid density, viscosity, and surface tension remain constant under the conditions of the experiment and do not appear in the equation.

Since the completion of this work, Dr. H. F. Johnstone of the University of Illinois kindly called our attention to the fundamental equations of Nukiyama and Tanasawa (*2*) for the atomization of liquids by gas streams. Using methods of calculation developed by Dr. Johnstone and staff (*3*), we have made an analysis of our data employing the equations of Nukiyama and Tanasawa which is shown in table 1.

TABLE 1.—*Comparison of observed and computed drop sizes obtained with exhaust generators under a variety of operating conditions*

Gas flow Q_g	Gas velocity V_g	Liquid flow Q_f	Liquid velocity V_f	Observed		Calculated	
				MMD in microns	D_o in microns	MMD (equation 1)	D_o from Japanese equation
21.3	694	0.0029	68.5	40	37	32	21
13.0	596	.00268	63.5	50	44	59	28
33.0	1,075	.00268	63.5	15	16	16	12
21.3	235	.00223	3.8	75	67	84	55

MMD=Mass median diameter in microns.
D_o=Diameter in microns of a single drop with the same ratio of surface area to volume as a representative sample of spray. From the data above, it appears that MMD=1.1 D_o.

From the data in table 1 it appears that the agreement between the observed D_o values and those predicted by the equation of Nukiyama and Tanasawa is relatively good over the entire range of operation of the exhaust generator. In all the plots made of D_o the value of q was 1.[2] This confirms the evidence of Lewis et al. (*3*) who found good

[2] q represents the relative scattering of drop distribution and a value of 1 indicates a relatively narrow drop spectrum as compared with most atomizing devices.

agreement between observed and calculated D_o and a value of $q=1$ for the performance of an exhaust generator on a large military aircraft engine. Thus, it would appear that the large-scale exhaust generator represents a nearly ideal application of the principles of liquid atomization by gases.

Back pressures in exhaust generation equipment should be kept to a minimum to insure adequate power output from the aircraft engine. Generally, the back pressure created is of small consequence and any loss of power is greatly offset by the fact that a lighter load is carried by using DDT insecticide. For example, the Stearman 4-DX, as a duster, carried 1,200 pounds of dust mixture and covered an average of 160 acres per load. With a 20-percent DDT solution only 440 pounds of insecticide is carried with a treatment range of 880 acres which, on the impounded water type of breeding situation, is the limit a pilot can treat without rest. The criteria regarding back pressure are reflected in the cylinder head temperatures of the aircraft engine. The exhaust generator may be considered safe if a 10-minute, full throttle climb during insecticide injection does not produce head temperature beyond the limit set by the engine manufacturers.

Back pressures may be minimized by the proper selection of stack and throat diameters and venturi design. The following design features are desirable:

1. Included angle of entrance cone 20° to 30°
2. Included angle of exit cone 7°
3. Ratio of throat diameter to exhaust stack diameter 0.25 to 0.50
4. Machined throat surface to insure a smooth union with the entrance and exit cone
5. Length of throat section to be kept at minimum

If the exit cone of the venturi is not shortened, there will be interspersed within the aerosol a few black tarry droplets of very large diameters. It is believed that these droplets are formed by accumulations of aerosol along the walls of the downstream venturi section. Shortening the downstream section to a length equal to five or six times the throat diameter usually eliminates the black droplets without appreciably increasing the back pressure.

Figure 2 shows a typical flow diagram of an airplane equipped with the venturi exhaust generator. The sketch also shows the wing spray equipment which was studied with the aerosol generator. It may be observed that a simple wind-driven pumping unit mounted on the wing discharges the insecticide into the venturi throat by means of two fan-type nozzles.

The rate of discharge is controlled by maintaining a constant pressure on the nozzles by the use of a relief valve and bypass located on

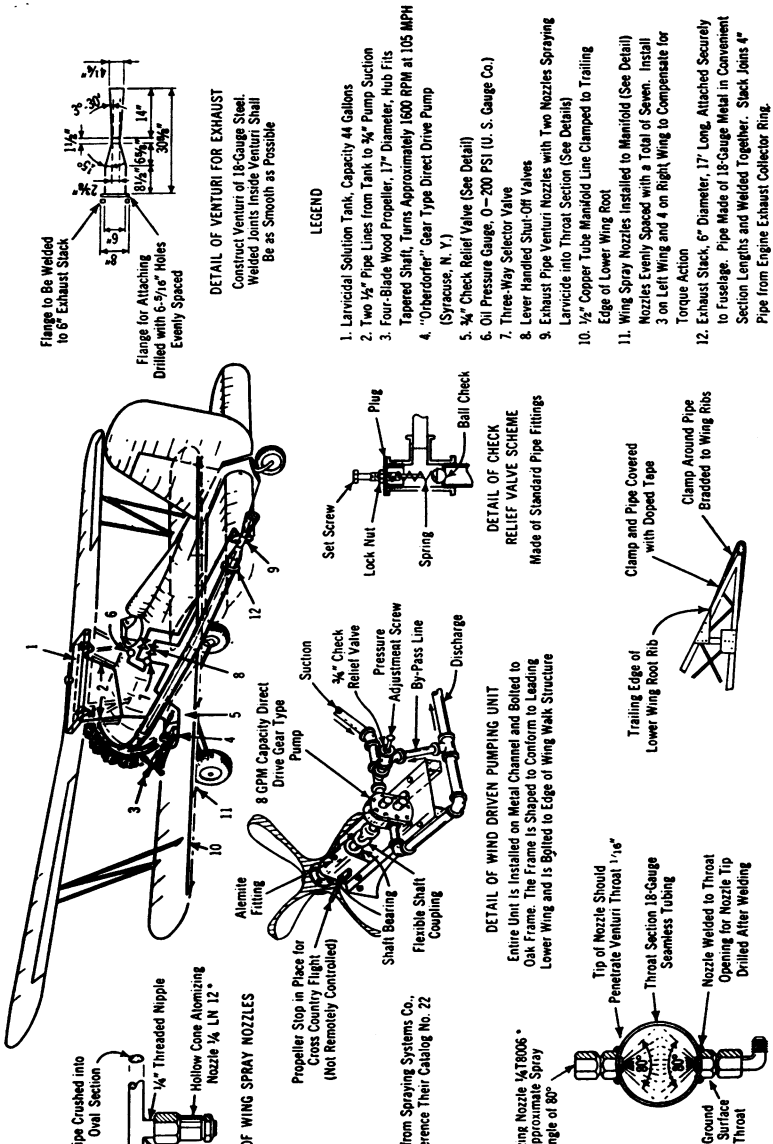


FIGURE 2.—Diagram of an airplane equipped for distribution of liquid larvicides as sprays or as hermal aerosols.

the pumping unit. The nozzles are calibrated for various pressures, and the discharge rate may be varied by simply adjusting the relief valve to the desired pressure.

On the operation of the exhaust generator, some screening smoke is formed by the evaporation of the polymethyl naphthalene solvent. Chemical analysis of the recovered aerosol has shown a DDT content of 25 percent as compared with 20 percent in the original solution. This is equivalent to the evaporation of about one-fourth of the solvent. No crystals of DDT are formed in the screening smoke, indicating further that the concentration of the DDT in the aerosol remained under the saturation point of DDT. The absence of the characteristic odor of volatilized DDT substantiated this conclusion.

Table 2 presents performance data for two field units developed for anopheline larvae control.

Insecticide Formulation

The desirable factors in a DDT solvent for airplane application are: (1) High solvent power to permit the use of concentrated solutions which greatly increase "payload"; (2) low volatility which increases safety factors is desirable for the persistence of the solution on the water surface and decreases solvent evaporation from the hot exhaust gases; and (3) noncorrosive and nonpoisonous chemical properties. After an investigation of commercially available solvents, the methylated naphthalenes were chosen as the most suitable DDT solvents for this purpose. A fraction Velsicol NR-70 [3] was readily available which dissolved and maintained stable solutions of 30 to 35 percent technical DDT by weight at room temperature, had a boiling point of 500° to 700° F., and a flash point of 175° F. The vapor pressure of this material ranges from 0.02 cm. mercury at 20° C. to 60 cm. mercury at 300° C. The specific gravity is approximately 1.05 to 1.06 or about 2.3° A. P. I. The technical product consists of at least 70 percent tri-, tetra-, and penta-methylnaphthalenes. The specific heat ranges from 0.31 at 0° F. to 0.68 at 800° F. A 20-percent solution of technical DDT in Velsicol NR-70 was used in all the experiments to be reported. This solution weighed 9.35 pounds per gallon.

Field Investigations

In order to determine the most suitable operating conditions, rates of discharge, and particle-size ranges to be employed in anopheline larvicidal operations with the exhaust generator, it was necessary to consider the following factors: (1) Occurrence of narrow, sharply defined breeding areas which necessitated low flight of 20 to 30 feet to insure proper coverage; (2) presence of woody and herbaceous cover through which the larvicide must penetrate to be effective; and (3) presence of many desirable forms of wildlife which must not be injured by the mosquito larvicide. A large number of field tests were carried out to determine the optimum size of aerosol to satisfy these conditions.

[3] Velsicol Corporation, Chicago, Ill.

TABLE 2.—*Performance data of airplane exhaust generator for application of DDT Aerosol*

Aircraft	Engine	Cruising speed	Acres per minute, 100-ft. swath	Gallons per minute=0.1 lb. DDT per acre [1]	Exhaust velocity		Engine back pressure, inches water		Mass median diameter, microns	
					Stack	Venturi throat	Dry	Fluid injected	Computed	Observed
	Hp.	*Miles per hour*					*Inches*	*Inches*		
Stearman 4 DX	450	107	22	1.2	107'/sec. (6" diam.)	690'/sec. (2⅜" diam.)	6	11	30	37
Stearman PT-17	220	85	17	0.9	105'/sec. (4.5" diam.)	525'/sec. (2" diam.)	9		40	50

[1] 20 percent DDT=80 percent Velsicol NR-70.

Methods

The basic consideration in the airplane distribution of any particulate material is the swath cross section. The investigations of swath characteristics were made by measuring the ground deposition at sampling points arranged at 20-foot intervals at right angles to the line of flight. Flights were made at a height of 20 to 30 feet, and all the studies were made during the inversion conditions existing just after dawn. When wind drift existed, the aircraft was flown directly into the breeze in order to minimize the effect of this factor on the swath characteristics.

The discharge characteristics of the dispersal equipment were measured by microscopic analysis of the droplets impacted upon clean microscope slides waved in the descending cloud, following the passage of the aircraft, and by the deposition of droplets collected upon slides placed horizontally upon cardboards on the ground or water surface. The former admittedly may not give an entirely satisfactory picture of the composition of the discharge cloud, as very small particles tend to flow around the slide rather than to impact upon it, but in the particle-size range studied, i. e., from 5 to 200 microns diameter, consistent results were obtained. The deposit on the horizontal slides represents precisely the amount of material which will be larvicidally effective.

The quantitative rate of surface recovery was measured by microscopic counting of the drops on a given slide, recording the apparent diameters of the lenses formed; correcting for the spread factor of the 25-percent DDT-Velsicol solution on clean glass, which is 3.3, to convert the lenses to spherical droplets of equivalent volume; and computing from the total weight of DDT collected per slide to the recovery of DDT in pounds per acre. This method is quite precise as it serves to indicate the presence of as small an amount as 2×10^{-5} micrograms of DDT in an area of 3 square inches. It will be noted that all recovery values of DDT solution should be corrected for the increase in DDT content to 25 percent due to volatilization of a portion of the solvent.

The correlation of larvicidal effectiveness with insecticidal deposit was made by using insectary-reared fourth instar *A. quadrimaculatus* larvae in 10-inch paper plates filled with approximately 1 inch of water. Twenty larvae were used in each plate. These plates were shaded after treatment, and mortality data were taken 24 hours after exposure to the insecticide. To avoid contamination, the plates were discarded after each test.

Properties of Aerosols

An aerosol is defined as a stable suspension of matter in air. Even the smallest liquid particles, however, have a settling velocity in still

air. This velocity can be calculated from Stokes' law which is applicable to the settling rates of spherical particles under 200 microns in diameter in a fluid medium (*4*). The application of Stokes' law to droplets of DDT-Velsicol NR–70 solution of density 1.12 gm. per cubic centimeter reduces to the expression:

$$\text{Velocity of settling in feet per minute} = 0.027\ (\text{radius in microns})^2$$

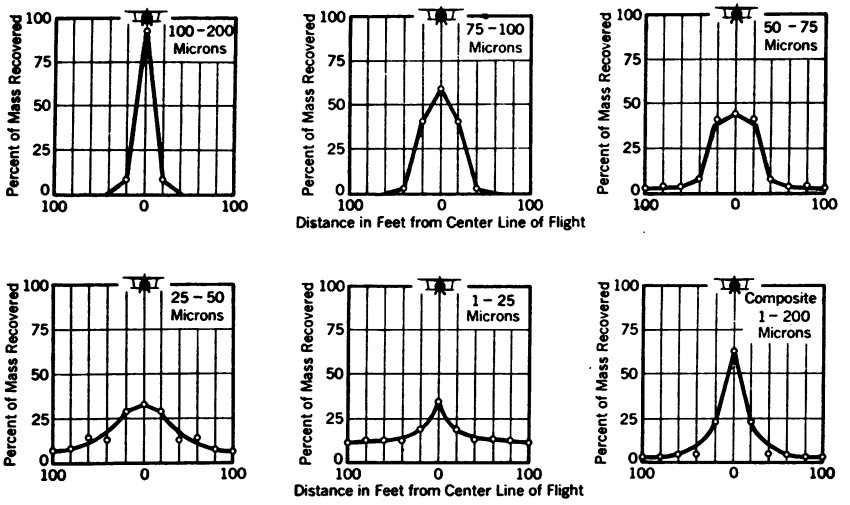
According to these rates of settling, larger particles would be more effective as larvicides as they would be less susceptible to wind drift. However, the air in the wake of an airplane is turbulent and there exists in this region a downdraft which measured for the Stearman 4–DX biplane is approximately 600 feet per minute. This downdraft imparts a settling velocity to the small aerosol droplets which is far in excess of their settling rates in still air, and it is this factor that makes possible the successful larvicidal deposition of fine droplets.

A decided advantage in the use of aerosols for larviciding is the large number of particles formed from the break-up of a given amount of material which results in more even coverage of the water surface. The following tabulation indicates the approximate number of droplets formed from 0.1 lb. of DDT per acre as a 20-percent solution in Velsicol NR–70.

Particle diameter (microns)	Particle weight (micrograms)	Number of particles formed	
		Per acre	Per square centimeter
5	0.07×10^{-3}	$2,900\times10^{9}$	72,000
25	9×10^{-3}	23×10^{9}	580
50	70×10^{-3}	2.9×10^{9}	72
100	600×10^{-3}	$.37\times10^{9}$	9

Relation of Particle Size to Aerosol Spread

Preliminary observations on swath widths obtained with sprays and aerosols from low-flying planes indicated that the smaller the particle size, the wider the swath width. This would be expected owing to the slower subsidence rates of smaller particles which would expose them to the lateral drifting air currents due to the propeller torque for longer periods. This effect has been studied by determining the mass median diameters of particles deposited on microscope slides at 20-foot intervals from the line of flight. The mass median diameter of the aerosol employed was approximately 85 microns. Figure 3 represents the average results of five such tests. The results confirm the theory by showing that the mass median diameter decreases with the distance from the center of flight and indicate the desirability of utilizing particles under 50 microns diameter to obtain satisfactory swath widths and to prevent undue peaking at the center of the swath.



RELATION OF PARTICLE SIZE OF AEROSOL TO SWATH DISTRIBUTION

FIGURE 3.—Swath cross section curves showing the effect of aerosol particle size on the distribution of recovered material.

Relation of Particle Size to Penetration of Plant Cover

The relative efficiency of aerosol penetration through plant cover was studied under conditions of still air shortly after dawn. Vegetative cover was arbitrarily classed by visual estimation as low, 0 to 33 percent; medium, 33 to 66 percent; and high, 66 to 100 percent. Flights were made over numbers of slides placed in varying degrees of cover and the rate of recovery and mass median diameters were compared. The results of typical tests are given in table 3.

TABLE 3.—*Penetration of DDT aerosols through plant cover*

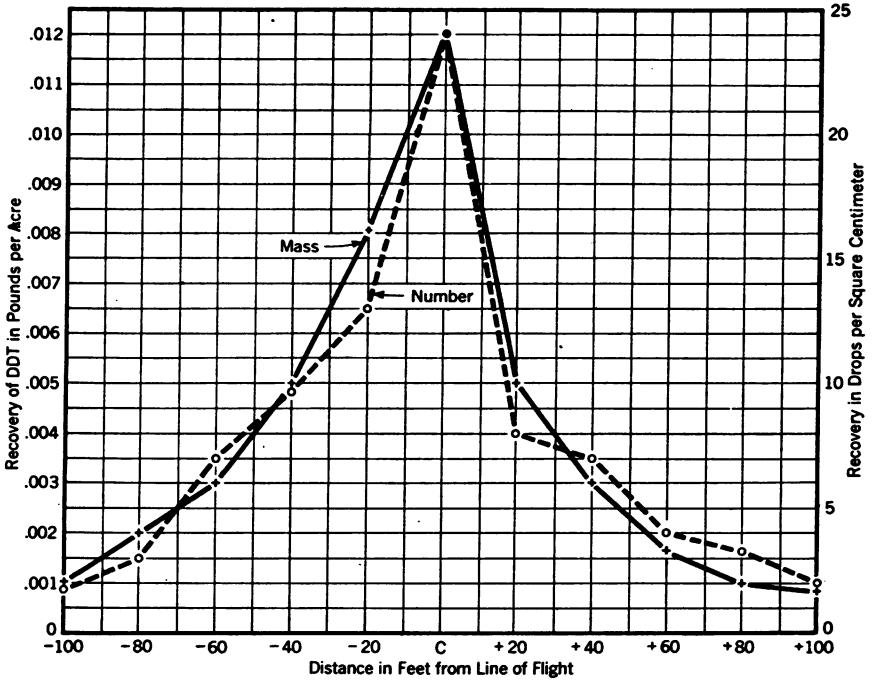
Plant cover	Recovery of aerosol		Mass median diameter of recovery (microns)
	DDT (lbs. per acre)	Drops per cm.²	
Herbaceous cover: Rate of discharge 0.1 lb. DDT per acre; height of flight, 30 feet			
Low (open)	0.0057	12.6	60
Medium	.0014	8.3	40
High	.0005	5.7	25
Woody cover: Rate of discharge 0.1 lb. DDT per acre; height of flight, 100 feet			
Low (open)	0.0074	6.7	110
Medium	.0044	3.7	90
High	.0010	4.0	50

These data offer conclusive evidence that droplets over 50 microns are more readily screened out by vegetation than are smaller droplets. Therefore, it is essential to utilize a discharge of droplets under

50 microns in order to obtain adequate penetration of heavy vegetative cover. This has been repeatedly proved under field test conditions.

Analysis of Swath Cross Section

The swath cross section is the basic unit in the airplane application of insecticides, and its dimensions under field conditions should be accurately measured. This was done by the use of settling slides as described under "Methods" (page 1179). Ther ates of aerosol recovery were determined from the slides in pounds of DDT per acre



DISTRIBUTION CURVE OF AEROSOL HAVING A MASS MEDIAN DIAMETER 35–40 MICRONS

FIGURE 4.—Rates of airplane aerosol recovery in pounds DDT per acre and number of drops per square centimeter at a discharge rate of approximately 0.1 pound DDT per acre.

and in number of drops per square centimeter. The average results of seven such tests are given in figure 4. The aerosol studied had a mass median diameter of 35 microns. With such an aerosol having a high degree of homogeneity, the correlation between number of drops and mass deposited is striking as is shown in the figure. The average percent recovery of the aerosol on open-water surface over the 200-foot swath width was 9 percent of the amount discharged. The remainder is impinged on vegetation or drifts away from the treatment area.

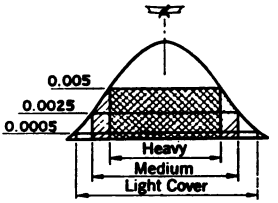
Toxicity of Aerosol to A. quadrimaculatus *Larvae*

The relation of aerosol deposit to larvicidal action was determined by placing pans of larvae at intervals along the swath cross section and correlating larval kill with DDT dosage determined from slides placed by the pans. The results of seven such tests with the 35-micron mass median diameter aerosol indicated that a deposit of 0.0001 lb. of DDT per acre gives at least 90 percent larval kill in the open. The equivalent of 0.0001 lb. DDT per acre is approximately 1 microgram of DDT per square foot. As this amount of aerosol will kill 90 to 100 percent of 20 fourth-instar larvae in a pan 10 inches in diameter, the LD_{90} is about 0.025 microgram of DDT per larva. This amount of DDT is represented by an aerosol droplet about 55 microns in diameter. Expressed in terms of body weight, this dose would be equivalent to about 10 micrograms per gram of larval body weight.

Application of Data to Field Control Work

To apply the analytical data of recovery rates to actual field larviciding practice, the minimum required recovery of 0.0001 lb.

Data Based on Distribution of 20% DDT - 80% Velsicol Aerosol with Mean Mass Diameter of 35-40 Microns



Required Recovery of DDT on Open Water Surface in Pounds per Acre To Give 90% Anopheles Larval Kill		
Plant Cover		
Light	Medium	Heavy
0.0005	0.0025	0.005

Swath Treatment	Rate of Discharge of DDT in Pounds per Acre for 100' Swath								
	Light Cover			Medium Cover			Heavy Cover		
	0.05	0.1	0.2	0.05	0.1	0.2	0.05	0.1	0.2
	Width of 90% Larval Kill in Feet								
	180	200	240	65	120	170	10	60	115
200'	380	410	450	130	240	370	20	120	230
100'	270	300	335	160	225	270	30	160	215
50'	230	250	290	110	170	220	55	110	170

FIGURE 5.—Effective swath widths of *Anopheles* larval control with varying rates of treatment and vegetative cover.

DDT per acre was increased by a factor of 5 to allow a margin of safety, giving a required deposit of 0.0005 lb. DDT per acre to insure 90 percent anopheline larval kill in the open. Using the data obtained on aerosol penetration of plant cover, it was determined that five times this amount would be required in the open above medium plant cover to insure 0.0005 lb. per acre on the water surface and that 10 times the minimum amount would be required in heavy plant cover. Thus, the limiting rates of surface recovery necessary per acre to give

90 percent larval kill are: open, 0.0005 lb. DDT; medium cover, 0.0025 lb. DDT; and high cover, 0.005 lb. DDT.

Using these figures in conjunction with the swath cross-sectional recovery curve, figure 5 has been constructed showing the widths of 90 percent larval kill which will be obtained under varying rates of plant cover, aerosol discharge, and flight pattern. This figure represents a practical guide for the field use of the airplane exhaust generator for the control of anopheline larvae.

Summary and Conclusions

1. A practical airplane unit for the production of DDT aerosols for anopheline larval control has been developed which is simple and inexpensive and can readily be adapted to certain types of available aircraft.

2. The factors determining the particle size of the DDT aerosol produced have been analyzed and formulated for the practical application to the design of equipment. This analysis appears to conform closely to the basic theory of liquid atomization by gas streams.

3. The characteristics of aerosol distribution with regard to swath width, penetration of vegetation, and minimum dosage for larvicidal effectiveness have been analyzed and formulated for field use. These results indicate that aerosols having a mass median diameter between 25 and 50 microns are best suited for the control of *A. quadrimaculatus* larvae under conditions encountered on impounded waters.

Acknowledgements

The authors are particularly indebted to Dr. H. F. Johnstone and staff of the Department of Chemical Engineering, University of Illinois, for assistance and advice in the development of the exhaust generator and in the analysis of the results obtained. Dr. C. W. Kearns, Department of Entomology, University of Illinois, was also very helpful. Mr. C. C. Kiker and Dr. A. D. Hess and staffs of the engineering and biology sections of the Health and Safety Department, Tennessee Valley Authority, have provided advice and assistance in the course of this study.

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(*2*) Nukiyama, S., and Tanasawa, Y.: Trans. Soc. Mech. Eng. (Japan), **4**: 86 (1938); **4**: 138 (1939); **5**: 63 (1939); **5**: 68 (1939); **6**: (II): 7, 18 (1940).

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DDT IN PARADICHLOROBENZENE AS A LARVICIDE [1]

By H. A. JOHNSON, *Senior Sanitary Engineer*, and J. L. EASON, JR., *Chemist*, *United States Public Health Service*

During the mosquito-producing season of 1945, a series of continuous tests was run to determine whether DDT incorporated in paradichlorobenzene pellets with or without solvents and submerged in a stream would be lethal to *Anopheles* larvae over a period of time.

The stream selected was one with a slow but continuous dry-weather flow; it ranged from 6 to 9 feet in width. The stream itself was free of vegetation, but the banks were overgrown with grass, which offered excellent protection for *Anopheles* larvae. The water surface frequently was covered entirely, or in part, with a thin to moderately thick organic scum, which shifted with the wind. The stream was under observation for many years, and has been consistently a prolific breeding place of *Anopheles* mosquitoes, the larvae being protected by the grassy edges of the stream.

For this study, a portion of the stream was divided into seven connected areas, the length of each section being determined roughly by the configuration of the stream. No. 1, at the upstream end, was 57 feet long by 6 feet average width; No. 2 was 291 feet long by 8 feet average width; No. 3 was 121 feet long by 8 feet average width; No. 4 was 84 feet long by 6 feet average width; No. 5 was 100 feet long by 9 feet average width; No. 6 was 215 feet long by 7 feet average width; No. 7 was 164 feet long by 6 feet average width.

The pellets were prepared by melting the paradichlorobenzene in a Griffin beaker and adding solvents containing DDT and emulsifiers and DDT in crystalline form. To insure even distribution of the DDT, the hot paradichlorobenzene was stirred until the congealing point was reached. Wires were added to the congealing mass for handling purposes. By means of these wires, the pellets were fastened in the water at the upper end of the respective areas close to the banks. Table 1 gives the data pertaining to each pellet.

With two exceptions, all pellets were placed in the stream on June 26, 1945, and were left in place until October 9, 1945. The pellet in area No. 1 was removed on August 28 in order to utilize this area as an additional check on effectiveness, and the pellet in area No. 5 was lost at an undetermined date.

To compare *Anopheles* larvae production in treated and untreated waters, an area was selected upstream, above the treated section, and, after August 28, area No. 1 was also utilized as an untreated comparison area.

[1] From the Office of Malaria Investigations of the National Institute of Health, Memphis, Tenn.; and Office of Malaria Control in War Areas, States Relations Division, Atlanta, Ga.

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TABLE 1.—*Data on treated pellets*

Area No.	Pellet as prepared	Weight when placed, in grams	Weight when removed, in grams	Percent disinte-grated
1	475 cc. paradichlorobenzene 25 cc. of a 7-percent solution DDT in No. 10 motor oil 20 gm. DDT 12 cc. Triton X-100	478	[1]	----------
2	475 cc. paradichlorobenzene 25 cc. of 50-percent solution DDT in Velsicol 70 plus 1.5 percent Triton X-100 20 gm. DDT	555	395	30.0
3	475 cc. paradichlorobenzene 25 cc. of 50-percent solution DDT in Velsicol 70 plus 0.5 percent Triton X-100 20 gm. DDT	545	322	41.0
4	475 cc. paradichlorobenzene 25 cc. of a 7-percent solution of DDT in No. 10 motor oil 20 gm. DDT	408	281	31.0
5	550 cc. paradichlorobenzene 50 cc. of a 7-percent solution of DDT in No. 10 motor oil 20 gm. DDT	557	Lost	----------
6	475 cc. paradichlorobenzene 25 cc. of a 7-percent solution of DDT in No. 10 motor oil 20 gm. DDT	421	322	23.5
7	575 cc. paradichlorobenzene 25 cc. of a 7-percent solution of DDT in No. 10 motor oil 10 cc. Triton X-100 20 gm. DDT	565	287	49.0

[1] Damaged at removal Aug. 28.

Examination of the study areas for *Anopheles* production was made at intervals during the season. Table 2 gives the record of dippings made for this purpose.

TABLE 2.—*Dipping records*

Date	Average number of *Anopheles* larvae per dip										Remarks
	Number dips per area	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Average, areas 1–7	Untreated areas	
1945											
June 25	15	3.00	1.20	1.20	3.50	2.20	2.10	2.40	2.23	0.60	Untreated
June 29	25	1.30	.45	.08	0	0	.50	.50	.40	7.30	Treated 1–7
July 16	13	.43	.13	.25	.25	.90	[2]	0	.33	.64	Treated 1–7
July 20	15	.04	.85	.80	1.50	.13	.75	0	.52	3.20	Treated 1–7
Aug. 6	14	1.10	.65	1.00	2.00	.10	.50	.30	.81	3.50	Treated 1–7
Aug. 10	11	1.50	.60	1.20	1.90	.75	.60	.42	.97	4.00	Treated 1–7
Aug. 18	12	.38	1.10	.60	.75	.26	.43	[2]	.50	1.40	Treated 1–7
Sept. 4	13	[1] 3.30	.85	1.50	2.20	2.20	.80	.60	1.36	[2]	Treated 2–7
Sept. 21	20	[1] 1.70	.90	.80	.30	.25	.30	[2]	.51	[2]	Treated 2–7

[1] Treatment pellet removed from area No. 1 on August 28. This area used thereafter as a comparison or untreated area. Prompt resumption of *Anopheles* production should be noted.

[2] Lack of a record in certain areas due to conditions beyond control, usually development of rainy weather.

Figure 1 is included to show the *Anopheles* larvae rates in treated and untreated areas. The curves show the average number of larvae per dip for the treated and untreated areas.

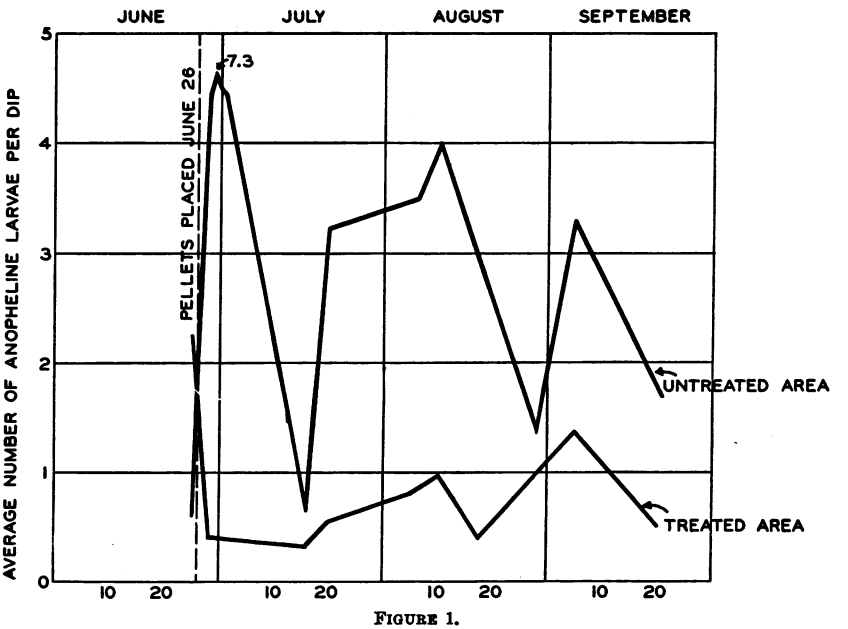

FIGURE 1.

The experiments were purely qualitative rather than quantitative. Consequently, definite figures are not quoted to indicate results achieved. It is apparent from the data presented that notwithstanding the unusual and frequent summer rains, a material reduction in *Anopheles* larvae was noted in the treated areas during the entire season, following the introduction of the pellets.

There is a notable rise in the number of *Anopheles* larvae present during the period August 6 to 10 in the treated areas, whereas the number of larvae in the untreated area did not show this rise to the same degree. The increase is attributable in part at least to rains.

Undoubtedly, the quantity of DDT dispensed by the pellets per unit of water area was very small, as evidenced by the fact that the pellets disintegrated less than 50 percent of their volume after a period of 3½ months. While the reduction in larvae was marked, up to a period of at least 6 weeks, changes caused by rains or scum growth materially influenced the results secured. In some instances, grass growing out into the stream completely buried the pellets in a mass of turf. They had to be freed in order to make them more effective.

As in previous experiments, it was noted repeatedly that where the surface scum had been blown away by the wind and the water surface left clean, the DDT was much more effective in preventing *Anopheles* production along the adjacent grass-lined banks.

It is probable that the amount of DDT dispensed was insufficient to secure the most effective control. The results obtained, however, indicate the practicability of liberating DDT continuously as a means of preventing the development of *Anopheles* larvae. By increasing the rate of disintegration of the pellets, a higher degree of *Anopheles* control might be expected.

PREVALENCE OF COMMUNICABLE DISEASES IN THE UNITED STATES

June 16–July 13, 1946

The accompanying table summarizes the prevalence of nine important communicable diseases, based on weekly telegraphic reports from State health departments. The reports from each State for each week are published in the PUBLIC HEALTH REPORTS under the section "Prevalence of disease." The table gives the number of cases of these diseases for the 4 weeks ended July 13, 1946, the number reported for the corresponding period in 1945, and the median number for the years 1941–45.

DISEASES ABOVE MEDIAN PREVALENCE

Poliomyelitis.—The number of cases of poliomyelitis rose from 568 during the 4 weeks ended June 15 to 1,214 during the 4 weeks ended July 13. The number of cases was 1.8 times the 1941–45 median which was represented by the 1945 incidence (678 cases). The current incidence was higher than in 1945 in all but 2 of the 9 geographic regions and higher than the 1941–45 median in all sections. Of the total cases Texas reported 195, Florida 111, Colorado 89, California 82, Minnesota 71, Illinois 66, Alabama 61, Louisiana 53, Arkansas and Oklahoma 40 cases each—two-thirds of the cases occurred in these 9 States. While there has been a sharp rise in the number of cases of this disease in a few States in other sections, the current epidemic has been confined largely to Southern and Western States. Since the preceding 5-year medians in many sections fell within an epidemic year, it is significant that the current incidence in each section was considerably higher than the median. Since the beginning of the year there have been 2,587 cases reported as compared with 1,674, 1,796, and 1,626 cases for the same period in 1945, 1944, and 1943, respectively, 3 successive years of above normal expectancy. In Florida where the disease first appeared in epidemic form, the number of cases (111) for the current 4 weeks was the same as in the preceding 4-week period, while in Texas and Colorado the largest numbers of weekly cases were reported during the current 4-week

Number of reported cases of 9 communicable diseases in the United States during the 4-week period June 16–July 13, 1946, the number for the corresponding period in 1945, and the median number of cases reported for the corresponding period, 1941–45

Division	Current period	1945	5-year median	Current period	1945	5-year median	Current period	1945	5-year median
	Diphtheria			Influenza [1]			Measles [2]		
United States	845	770	623	2,171	2,545	2,545	39,747	12,009	23,046
New England	30	25	15	5	75	5	7,244	1,440	3,160
Middle Atlantic	133	70	75	21	18	18	12,332	2,303	4,581
East North Central	100	108	100	57	62	101	7,734	2,475	4,007
West North Central	85	72	57	15	37	37	1,102	479	1,263
South Atlantic	189	109	93	706	573	581	4,057	283	1,719
East South Central	68	58	46	83	58	70	707	172	238
West South Central	120	161	112	1,156	1,468	1,118	1,956	943	943
Mountain	47	46	42	88	194	199	1,172	723	978
Pacific	73	121	100	40	60	109	3,443	3,191	3,191
	Meningococcus meningitis			Poliomyelitis			Scarlet fever		
United States	311	502	502	1,214	678	678	4,602	6,494	5,053
New England	11	25	41	15	25	10	398	622	622
Middle Atlantic	76	98	98	67	128	33	1,578	1,755	1,237
East North Central	48	114	114	126	50	35	1,182	1,710	1,412
West North Central	31	34	34	186	21	21	263	514	345
South Atlantic	35	60	60	171	105	105	296	476	279
East South Central	31	51	48	107	87	87	101	169	162
West South Central	33	52	50	328	187	73	119	232	152
Mountain	7	10	10	114	6	12	222	183	183
Pacific	39	58	58	100	69	50	443	833	502
	Smallpox			Typhoid and paratyphoid fever			Whooping cough [2]		
United States	20	18	24	470	498	618	7,995	10,251	13,933
New England	0	0	0	46	12	21	784	937	937
Middle Atlantic	1	0	0	40	40	56	1,316	2,614	2,640
East North Central	7	6	10	63	53	67	1,789	1,398	3,182
West North Central	2	6	8	35	12	24	387	285	665
South Atlantic	0	0	1	88	140	140	1,537	1,987	1,987
East South Central	3	1	6	43	74	99	311	398	581
West South Central	6	4	4	124	127	149	1,072	1,079	1,096
Mountain	1	1	1	15	28	28	344	398	525
Pacific	0	0	2	16	12	19	455	1,155	1,155

[1] Mississippi and New York excluded; New York City included.
[2] Mississippi excluded.

period; in Texas the cases rose from 123 for the preceding 4-week period to 195 for the 4 weeks ended July 13, and in Colorado there were 89 cases as compared with 23 during the preceding 4-week period. The 1945 epidemic first appeared in Texas and spread rapidly into all sections of the country; in 1944 the first rise occurred in North Carolina and later appeared in the northeastern section of the country, approximately one-third of the cases occurring in New York City. In 1943 the disease was most prevalent in the Pacific States and the southwestern part of the country.

Diphtheria.—For the 4 weeks ended July 13 there were 845 cases of diphtheria reported, the number being about 10 percent above that reported for the corresponding period in 1945 and about 35 percent

above the 1941–45 median. In the East North Central and Mountain sections the incidence was about normal and in the Pacific section the number of cases was only about 70 percent of the median expectancy, but in the other 6 sections the increases ranged from 1.1 times the median in the West South Central section to twice the median in both the New England and South Atlantic sections.

Measles.—For the country as a whole the incidence of measles was the highest reported for this season of the year since 1941 when approximately 45,000 cases were reported for the corresponding 4 weeks. The number of cases (39,747) reported for the current 4 weeks was 3.3 times the incidence in 1945 and 1.7 times the 1941–45 median for the corresponding 4 weeks. While each section of the country except the West North Central reported a relatively high incidence, the largest increases over the normal seasonal expectancy were reported from the Atlantic Coast and East South Central sections.

DISEASES BELOW MEDIAN PREVALENCE

Influenza.—For the 4 weeks ended July 13 there were 2,171 cases of influenza reported. The number was about 85 percent of the 1941–45 median, which was represented by the 1945 incidence (2,545 cases). The number of cases in the South Atlantic section was about 20 percent above the 5-year median, but in other sections the incidence either closely approximated the median or fell considerably below it.

Meningococcus meningitis.—During the 4 weeks ended July 13 there were 311 cases of meningococcus meningitis reported. The preceding 5-year median for these same weeks was 502 cases. Each section shared in the decline of this disease. For the country as a whole the current incidence was the lowest since 1942. While this disease is experiencing a gradual decline since the 1942–44 epidemics, the number of cases is still high compared with the incidence in normal and minor epidemic years.

Scarlet fever.—The number of cases (4,602) of scarlet fever was about 70 percent of the 1945 incidence for the corresponding 4 weeks and 90 percent of the 1941–45 median. The Middle Atlantic, South Atlantic, and Mountain sections reported excesses over the median, but all other sections reported a relatively low incidence.

Smallpox.—The smallpox incidence was about normal, 20 cases being reported for the current 4-week period as compared with 18 for the corresponding period in 1945 and a 1941–45 median of 24 cases. One case was reported from New York, which is the first case reported from the North Atlantic section during the corresponding period since 1939, when 6 cases occurred in Connecticut.

Typhoid and paratyphoid fever.—The number of cases (470) of these

diseases was lower than the number reported for the corresponding period in 1945 and only about 75 percent of the 1941–45 median. The numbers of cases in the New England and West North Central sections were higher than the normal seasonal expectancy, but in other sections the incidence either closely approximated the median or fell considerably below it.

Whooping cough.—For the current 4-week period there were 7,995 cases of whooping cough reported, as compared with 10,251 for the corresponding period in 1945 and a 1941–45 median of 13,933 cases. For the country as a whole the current incidence was the lowest for this period in the 9 years for which these data are available. The incidence was considerably below the median expectancy in all sections of the country.

MORTALITY, ALL CAUSES

For the 4 weeks ended July 13 there were 33,840 deaths from all causes reported to the Bureau of the Census by 93 large cities. The preceding 3-year average for the corresponding weeks was 34,322 deaths. The number of deaths was lower than the preceding 3-year average in each of the first 3 weeks of the 4-week period but during the fourth week the number was about 4.5 percent higher than the 1943–45 average.

INCIDENCE OF HOSPITALIZATION, JUNE 1946

Through the cooperation of the Hospital Service Plan Commission of the American Hospital Association, data on hospital admissions among members of Blue Cross Hospital Service Plans are presented monthly. These plans provide prepaid hospital service. The data cover hospital service plans scattered throughout the country, mostly in large cities.

Item	June	
	1946	1945
1. Number of plans supplying data	81	81
2. Number of persons eligible for hospital care	20,475,364	18,151,008
3. Number of persons admitted for hospital care	202,351	182,128
4. Incidence per 1,000 persons, annual rate during current month (daily rate × 365)	120.3	122.1
5. Incidence per 1,000 persons, annual rate for the 12 months ended June 30, 1946	108.7	104.7
6. Number of plans reporting on hospital days	29	31
7. Days of hospital care per case discharged during month [1]	8.08	8.05

[1] Days include entire stay of patient in hospital whether at full pay or at a discount.

PREVALENCE 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 JULY 20, 1946

Summary

Increases in the incidence of poliomyelitis occurred in all of the 9 geographic divisions, but were slight in the South Atlantic, West South Central, and Pacific areas, and in the New England area, with the exception of New Hampshire. A total of 668 cases was reported for the week, as compared with 427 last week, a 5-year median of 329, and 568 (the largest number previously recorded for a corresponding week) for the week in 1944. In the 21 States reporting more than 6 cases and showing increases, 561 cases were reported, as compared with 301 for the preceding week. Probably the most significant increases occurred in New Hampshire (4 to 12), Pennsylvania (1 to 9), Illinois (23 to 42), Minnesota (40 to 97), Missouri (14 to 34), South Dakota (5 to 11), Nebraska (12 to 20), Kansas (18 to 35), Alabama (14 to 33), Mississippi (6 to 19), Louisiana (18 to 27), Colorado (31 to 43), New Mexico (1 to 12), Arizona (1 to 9), and California (25 to 38). Decreases were recorded in Michigan (11 to 7), Arkansas (20 to 15), and Oklahoma (15 to 6). Ohio and Florida reported the same numbers as for the preceding week (13 and 24, respectively). The total to date is 3,262, as compared with 2,048 for the period last year, 2,320 in 1944, and 2,923 in 1934, which was the highest number recorded for the corresponding period of any previous year of record (weekly figures not available for 1916).

Of the total of 44 cases of infectious encephalitis, as compared with 17 last week, Texas reported 11 and California 21. The cumulative total is 304, as compared with 205 for the same period last year and an average of 280 for the corresponding periods of the past 4 years.

Deaths recorded during the week in 93 large cities of the United States totaled 8,093, as compared with 8,770 last week, 7,698 and 7,783, respectively, for the same weeks in 1945 and 1944, and a 3-year (1943–45) average of 7,924. The total for the year to date is 273,272, as compared with 267,820 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended July 20, 1946, and comparison with corresponding week of 1945 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none was reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median 1941–45	Week ended—		Median 1941–45	Week ended—		Median 1941–45	Week ended—		Median 1941–45
	July 20, 1946	July 21, 1945		July 20, 1946	July 21, 1945		July 20, 1946	July 21, 1945		July 20, 1946	July 21, 1945	
NEW ENGLAND												
Maine	2	0	0	------	------	------	28	1	26	0	0	0
New Hampshire	0	0	0	------	------	------	4	1	5	0	0	0
Vermont	0	0	0	------	------	------	62	5	25	0	0	0
Massachusetts	14	0	2	------	------	------	405	142	185	0	2	2
Rhode Island	1	0	0	------	------	------	20	3	13	0	2	2
Connecticut	1	0	0	------	------	------	122	22	69	3	2	2
MIDDLE ATLANTIC												
New York	14	7	7	[1] 4	[1] 2	[1] 2	589	70	184	12	13	13
New Jersey	5	3	2	3	1	2	275	34	122	3	3	3
Pennsylvania	1	3	5	2	------	------	223	111	111	1	4	4
EAST NORTH CENTRAL												
Ohio	1	5	5	------	3	5	340	12	73	2	2	2
Indiana	0	4	4	------	2	3	16	3	14	0	3	2
Illinois	2	3	9	2	4	4	86	178	106	6	5	5
Michigan [2]	13	15	3	6	1	1	205	100	105	3	4	4
Wisconsin	4	4	1	9	19	9	300	45	280	0	4	1
WEST NORTH CENTRAL												
Minnesota	3	6	3	------	------	------	21	2	33	3	3	0
Iowa	4	1	1	------	------	------	29	12	30	1	0	0
Missouri	2	4	4	1	1	------	14	17	17	2	9	3
North Dakota	0	1	1	------	11	------	4	3	8	0	0	0
South Dakota	0	1	1	------	------	------	3	8	7	0	1	1
Nebraska	0	3	1	------	1	3	11	3	7	0	0	0
Kansas	4	3	1	1	1	1	11	9	23	0	1	0
SOUTH ATLANTIC												
Delaware	0	0	0	------	------	------	4	3	2	0	0	0
Maryland [2]	3	0	0	3	4	1	158	8	15	2	4	5
District of Columbia	0	0	0	------	------	------	24	------	9	0	0	0
Virginia	15	4	4	65	68	38	122	4	30	0	1	7
West Virginia	2	3	3	------	19	1	9	2	14	1	0	0
North Carolina	1	6	6	------	------	------	35	5	37	3	4	4
South Carolina	7	9	5	73	58	87	34	4	16	0	1	1
Georgia	3	6	4	3	6	8	21	3	10	0	1	1
Florida	14	5	4	2	------	4	14	------	10	2	2	1
EAST SOUTH CENTRAL												
Kentucky	4	2	2	1	------	------	102	7	13	2	5	2
Tennessee	2	4	3	3	5	8	23	6	16	2	8	3
Alabama	4	3	3	7	14	12	24	4	12	1	4	4
Mississippi [2]	1	5	3	------	------	------	------	------	------	1	1	0
WEST SOUTH CENTRAL												
Arkansas	1	3	3	2	4	5	10	8	21	2	2	2
Louisiana	17	10	5	5	2	2	13	5	5	7	3	2
Oklahoma	2	1	2	1	19	4	10	3	9	2	1	1
Texas	29	35	23	246	330	231	176	81	101	12	1	3
MOUNTAIN												
Montana	2	1	0	------	------	------	22	7	7	0	1	0
Idaho	1	1	0	4	10	------	5	12	4	1	0	0
Wyoming	0	2	0	------	------	------	10	8	8	0	0	0
Colorado	8	2	3	1	3	3	24	9	9	1	0	0
New Mexico	2	3	1	------	3	1	22	3	8	0	0	0
Arizona	13	1	0	8	19	19	40	1	12	0	0	0
Utah [2]	0	0	0	------	------	------	50	100	33	0	0	0
Nevada	0	0	0	------	------	------	1	1	5	0	1	0
PACIFIC												
Washington	5	1	1	------	1	------	28	93	61	2	2	2
Oregon	3	7	1	------	2	5	59	26	32	0	1	1
California	33	21	13	4	2	3	246	352	352	12	13	11
Total	243	198	154	456	615	584	4,054	1,536	2,739	89	114	114
29 weeks	9,068	7,318	6,765	189,694	68,307	79,477	630,726	97,111	528,294	4,199	5,770	5,770

[1] New York City only.

[2] Period ended earlier than Saturday.

Telegraphic morbidity reports from State health officers for the week ended July 20, 1946, and comparison with corresponding week of 1945 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever [3]		
	Week ended—		Median, 1941–45	Week ended—		Median, 1941–45	Week ended—		Median, 1941–45	Week ended—		Median, 1941–45
	July 20 1946	July 21 1945		July 20 1946	July 21 1945		July 20 1946	July 21 1945		July 20 1946	July 21 1945	
NEW ENGLAND												
Maine	1	3	0	2	2	6	0	0	0	1	2	0
New Hampshire	12	4	0	0	0	0	0	0	0	0	0	0
Vermont	2	2	0	0	7	2	0	0	0	1	0	0
Massachusetts	1	14	3	30	62	62	0	0	0	2	2	2
Rhode Island	0	0	0	4	1	1	0	0	0	0	0	0
Connecticut	4	3	0	9	15	12	0	0	0	0	1	1
MIDDLE ATLANTIC												
New York	22	46	10	72	98	79	0	0	0	6	5	8
New Jersey	8	37	5	32	28	19	0	0	0	1	2	2
Pennsylvania	9	12	6	45	67	43	0	0	0	2	10	6
EAST NORTH CENTRAL												
Ohio	13	8	2	55	54	51	0	0	0	5	1	8
Indiana	5	2	2	5	14	10	1	0	0	4	2	2
Illinois	42	6	7	33	69	43	0	0	0	3	2	4
Michigan [2]	7	3	6	46	64	48	0	0	1	0	7	7
Wisconsin	4	0	0	22	40	37	0	0	0	0	0	0
WEST NORTH CENTRAL												
Minnesota	97	0	0	10	23	27	0	0	0	0	0	0
Iowa	13	1	1	3	14	8	1	0	0	0	0	0
Missouri	34	4	3	5	17	12	0	0	0	0	8	5
North Dakota	3	0	1	1	3	2	0	0	0	0	0	0
South Dakota	11	0	0	3	3	5	0	0	0	0	0	0
Nebraska	20	1	1	4	11	4	0	0	0	0	0	0
Kansas	35	8	5	16	37	10	0	1	0	1	0	1
SOUTH ATLANTIC												
Delaware	0	2	0	0	1	1	0	0	0	1	0	0
Maryland [2]	3	6	4	5	19	19	0	0	0	0	0	3
District of Columbia	0	9	1	1	4	3	0	0	0	0	0	0
Virginia	4	28	3	23	16	4	0	0	0	11	5	5
West Virginia	4	1	1	29	19	19	0	0	0	4	1	8
North Carolina	3	3	3	10	14	10	0	0	0	3	2	6
South Carolina	0	12	4	2	2	2	0	0	0	5	2	8
Georgia	3	5	5	3	7	11	0	0	0	1	11	14
Florida	24	2	2	5	2	2	0	0	0	1	1	1
EAST SOUTH CENTRAL												
Kentucky	7	3	4	2	21	15	0	0	0	2	8	9
Tennessee	0	20	11	6	12	14	0	0	0	3	6	9
Alabama	33	3	3	16	5	8	0	0	0	3	3	8
Mississippi [2]	19	0	5	0	5	3	0	0	0	2	4	5
WEST SOUTH CENTRAL												
Arkansas	15	3	3	3	4	4	0	0	0	12	2	9
Louisiana	27	4	4	10	3	3	0	0	0	13	12	13
Oklahoma	6	9	4	3	9	9	0	0	0	1	4	4
Texas	61	62	9	24	34	18	0	0	0	13	20	25
MOUNTAIN												
Montana	2	0	0	2	2	4	0	0	0	0	0	1
Idaho	1	0	0	2	8	4	0	0	0	2	0	0
Wyoming	8	0	0	3	1	2	0	0	0	0	0	0
Colorado	43	2	0	14	11	9	0	0	0	0	1	1
New Mexico	12	0	1	5	13	1	0	0	0	1	2	3
Arizona	9	0	0	3	2	2	0	0	0	2	0	0
Utah [2]	0	11	0	11	11	7	0	0	0	0	1	1
Nevada	0	0	0	0	0	0	0	0	0	0	0	0
PACIFIC												
Washington	2	4	1	18	12	12	0	0	0	0	0	1
Oregon	1	1	3	19	9	4	0	0	0	0	0	1
California	38	25	11	70	121	87	0	0	0	3	2	4
Total	668	369	329	686	996	807	2	1	5	109	129	264
29 weeks	3,262	2,048	1,955	84,478	131,152	94,785	266	255	596	1,930	2,133	2,584

[2] Period ended earlier than Saturday.

[3] Including paratyphoid fever reported separately, as follows: Massachusetts 2; New York 1; New Jersey 1; Indiana 1; Illinois 1; Virginia 1; Arkansas 4; Louisiana 2; California 2.

Telegraphic morbidity reports from State health officers for the week ended July 20, 1946, and comparison with corresponding week of 1945 and 5-year median—Con.

Division and State	Whooping cough			Week ended July 20, 1946							
	Week ended—		Median 1941–45	Dysentery			Encephalitis, infectious	Rocky Mt. spotted fever	Tularemia	Typhus fever, endemic	Undulant fever
	July 20, 1946	July 21, 1945		Amebic	Bacillary	Unspecified					
NEW ENGLAND											
Maine	1	67	28								
New Hampshire	2	9	4								
Vermont	29	15	15								1
Massachusetts	156	141	141		2						1
Rhode Island	9	4	22								
Connecticut	36	25	38		2						3
MIDDLE ATLANTIC											
New York	121	302	291	3	6		1	1		1	7
New Jersey	148	253	184			2		4			3
Pennsylvania	104	196	255					2			2
EAST NORTH CENTRAL											
Ohio	96	186	186								3
Indiana	21	29	29	1					1		7
Illinois	145	91	158	3			3	5			9
Michigan [3]	214	165	170		1		1				5
Wisconsin	180	50	161						1		6
WEST NORTH CENTRAL											
Minnesota	11	11	43	2							2
Iowa	21	8	30				1		1		8
Missouri	11	40	40								3
North Dakota		2	6								
South Dakota	1		4								1
Nebraska	2	2	9								
Kansas	31	39	58								18
SOUTH ATLANTIC											
Delaware	6		1								
Maryland [3]	14	83	103			1		3			
District of Columbia	4	10	10								
Virginia	79	89	89			134		6		2	2
West Virginia	17	79	32					1			
North Carolina	118	206	206					7		7	1
South Carolina	35	82	106	5	17					1	2
Georgia	7	14	28					3		24	3
Florida	41	20	19				2			7	
EAST SOUTH CENTRAL											
Kentucky	71	61	61				1	3			
Tennessee	17	15	34	8	1	1		2			2
Alabama	26	29	29	1				2		22	2
Mississippi [3]									1	3	
WEST SOUTH CENTRAL											
Arkansas	1	15	23	7	3		2		8	3	6
Louisiana	8	6	7	2						20	2
Oklahoma	11	11	11					1			
Texas	221	147	190	27	428	28	11			43	30
MOUNTAIN											
Montana	3	7	27								
Idaho	21	14	6	1		2					1
Wyoming	3	2	4						1		
Colorado	15	45	21		1						
New Mexico	33	7	7								
Arizona	5	15	19			29	1				
Utah [3]	16	37	66			1			1		5
Nevada			1								
PACIFIC											
Washington	36	36	49								
Oregon	25	19	19								1
California	73	240	240	3	1		21		1	1	4
Total	2,245	2,924	3,439	63	467	198	44	40	15	134	140
Same week, 1945	3,439			111	615	333	11	27	16	164	123
Average, 1943–45	3,166			91	645	389	13	[4] 27	15	[4] 141	
29 weeks: 1946	55,284			1,634	10,018	3,722	304	260	546	1,669	2,777
1945	73,290			1,045	13,607	3,876	205	231	456	1,986	2,729
Average, 1943–45	81,873		[4]109,174	1,035	11,023	3,642	288	[4] 262	445	[4] 1,638	

[3] Period ended earlier than Saturday.

[4] 5-year median, 1941–45.

Leprosy: Illinois 1 case.

WEEKLY REPORTS FROM CITIES

City reports for week ended July 13, 1946

This table lists the reports from 88 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	0	0	------	0	36	0	3	0	0	0	0	------
New Hampshire:												
Concord	0	0	------	0	-------	0	0	0	0	0	0	------
Vermont:												
Barre	0	0	------	0	-------	0	0	0	0	0	0	------
Massachusetts:												
Boston	1	0	------	0	84	2	3	0	6	0	0	23
Fall River	0	0	------	0	12	0	0	0	0	0	0	------
Springfield	0	0	------	0	30	0	0	0	3	0	1	1
Worcester	0	0	------	0	98	0	3	0	0	0	0	38
Rhode Island:												
Providence	0	0	------	0	43	0	1	0	6	0	0	16
Connecticut:												
Bridgeport	0	0	------	0	-------	0	1	0	0	0	0	1
Hartford	0	0	------	0	7	0	1	0	0	0	0	2
New Haven	0	0	------	0	17	1	0	0	1	0	0	------
MIDDLE ATLANTIC												
New York:												
Buffalo	1	0	------	0	6	0	3	0	1	0	0	3
New York	7	1	------	1	193	3	42	7	41	0	3	34
Rochester	0	0	------	0	4	0	2	1	2	0	0	2
Syracuse	0	0	------	0	1	0	0	1	8	0	0	2
New Jersey:												
Camden	0	0	------	0	1	0	0	1	0	0	0	1
Newark	0	0	------	0	25	2	2	0	3	0	0	21
Trenton	0	0	------	0	19	0	1	0	2	0	0	1
Pennsylvania:												
Philadelphia	2	0	1	0	15	3	16	0	12	0	1	24
Pittsburgh	0	0	------	0	15	0	1	1	3	0	0	6
Reading	0	0	------	0	2	0	1	0	0	0	0	3
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	0	0	------	1	3	2	3	0	5	0	0	10
Cleveland	1	0	------	0	189	0	5	5	7	0	0	19
Columbus	0	0	------	0	3	0	1	0	1	0	0	2
Indiana:												
Fort Wayne	0	0	------	0	1	0	0	0	1	0	1	------
Indianapolis	1	0	------	0	3	0	5	0	4	0	0	14
South Bend	0	0	------	0	1	0	0	0	0	0	0	------
Terre Haute	0	0	------	0	3	0	0	0	0	0	0	------
Illinois:												
Chicago	2	0	------	0	31	2	22	9	19	0	1	50
Springfield	0	0	------	0	-------	0	2	0	1	0	0	------
Michigan:												
Detroit	2	0	------	0	13	1	7	3	17	0	0	74
Flint	0	0	------	0	1	0	1	0	1	0	0	------
Grand Rapids	1	0	------	0	6	0	0	0	1	0	0	5
Wisconsin:												
Kenosha	0	0	------	0	18	0	0	2	2	0	0	------
Milwaukee	2	0	------	0	25	0	4	0	1	0	0	70
Racine	0	0	------	0	87	0	0	0	0	0	0	------
Superior	0	0	------	0	1	0	0	0	0	0	0	18
WEST NORTH CENTRAL												
Minnesota:												
Duluth	0	0	------	0	-------	1	0	0	1	0	0	1
Minneapolis	1	0	------	0	6	0	7	23	5	0	0	------
Missouri:												
Kansas City	0	0	------	0	-------	0	1	2	2	0	0	5
St. Joseph	0	0	------	0	-------	0	0	0	0	0	0	------
St. Louis	0	0	1	0	17	1	6	4	1	0	0	5

City reports for week ended July 13, 1946—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
Nebraska:												
Omaha	0	0	------	0	1	0	1	*10	1	0	0	------
Kansas:												
Topeka	0	0	------	0	2	0	2	2	2	0	0	8
Wichita	0	0	------	0	3	1	3	3	0	0	0	5
SOUTH ATLANTIC												
Delaware:												
Wilmington	0	0	------	0	1	0	0	0	0	0	0	1
Maryland:												
Baltimore	6	0	------	1	164	0	4	0	3	0	0	24
Cumberland	0	0	------	0	------	0	0	0	1	0	0	------
Frederick	0	0	------	0	------	0	0	0	0	0	0	------
District of Columbia:												
Washington	1	0	------	0	24	1	3	1	2	0	0	21
Virginia:												
Lynchburg	0	0	------	0	7	0	0	0	1	0	0	------
Richmond	0	0	------	0	6	0	1	1	1	0	0	5
Roanoke	0	0	------	0	1	0	0	0	1	0	0	1
West Virginia:												
Charleston	0	0	------	0	------	0	0	0	1	0	0	------
Wheeling	0	0	------	0	------	0	0	0	0	0	0	8
North Carolina:												
Raleigh	0	0	------	0	2	0	0	0	0	0	1	6
Wilmington	0	0	------	0	3	0	2	0	0	0	0	------
Winston-Salem	0	0	------	0	4	0	0	0	0	0	0	23
South Carolina:												
Charleston	0	0	------	0	1	0	1	0	0	0	0	1
Georgia:												
Atlanta	0	0	------	0	8	0	2	1	0	0	0	------
Brunswick	0	0	------	0	------	0	0	0	1	0	0	------
Savannah	0	0	1	0	2	0	0	0	1	0	0	------
Florida:												
Tampa	4	0	------	0	2	0	2	4	1	0	0	3
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	1	1	4	1	3	0	5	2	1	0	2	5
Nashville	0	0	------	0	1	0	1	0	0	0	1	------
Alabama:												
Birmingham	1	0	------	0	1	0	1	3	0	0	0	------
Mobile	1	0	------	0	------	1	0	2	0	0	0	------
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0	------	0	------	0	0	5	1	0	0	------
Louisiana:												
New Orleans	0	0	2	1	2	1	6	20	2	0	0	------
Shreveport	0	0	------	0	------	0	0	3	0	0	1	------
Texas:												
Dallas	0	0	------	0	1	0	1	6	1	0	1	------
Galveston	4	0	------	1	------	0	0	1	0	0	0	------
Houston	1	0	------	0	1	1	2	0	2	0	0	------
San Antonio	0	0	------	0	------	0	9	5	0	0	1	3
MOUNTAIN												
Montana:												
Billings	0	0	------	0	10	0	2	0	0	0	0	------
Great Falls	0	0	------	0	9	0	1	0	0	0	0	------
Helena	0	0	------	0	1	0	0	0	0	0	0	------
Missoula	2	0	------	0	1	0	0	1	0	0	0	------
Idaho:												
Boise	0	0	------	0	------	0	2	0	0	0	0	------
Colorado:												
Denver	1	0	------	0	13	0	2	14	3	0	0	14
Pueblo	0	0	------	0	16	0	0	0	2	0	0	------
Utah:												
Salt Lake City	0	0	------	0	12	0	3	0	3	0	0	

*Including 7 nonresident cases.

City reports for week ended July 13, 1946—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle	0	0	------	0	13	0	3	3	1	0	0	8
Spokane	0	0	------	0	------	0	1	0	1	0	0	------
Tacoma	0	0	------	0	5	0	0	0	2	0	0	6
California:												
Los Angeles	1	0	3	0	75	2	6	8	8	0	0	3
Sacramento	1	0	------	0	1	1	0	1	0	0	0	3
San Francisco	0	0	1	0	32	1	7	0	4	0	0	3
Total	45	2	13	6	1,444	27	217	155	204	0	14	604
Corresponding week, 1945	63	------	10	6	827	------	242	------	301	0	12	888
Average, 1941–45	43	------	22	[1] 7	[2] 1,117	------	[1] 240	------	314	0	22	1,060

[1] 3-year average, 1943–45.
[2] 5-year median, 1941–45.

Dysentery, amebic.—Cases: New York 2; Chicago 1; St. Louis 1; San Francisco 1.
Dysentery, bacillary.—Cases: Worcester 3; New York 1; Rochester 1; Chicago 1; Charleston, S. C., 2; San Antonio 1; Los Angeles 1.
Dysentery, unspecified.—Cases: San Antonio 13.
Leprosy.—Cases: New Orleans 1.
Rocky Mountain spotted fever.—Cases: Philadelphia 2.
Tularemia.—Cases: Great Falls 1.
Typhus fever, endemic.—Cases: Chicago 1; Winston-Salem 1; Tampa 3; Birmingham 2; Mobile 2; New Orleans 2; Houston 2; Los Angeles 1.

Rates (annual basis) per 100,000 population, by geographic groups, for the 88 cities in the preceding table (estimated population, 1943, 34,086,800)

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
			Case rates	Death rates								
New England	2.6	0.0	0.0	0.0	855	7.8	31.4	0.0	42	0.0	2.6	212
Middle Atlantic	4.6	0.5	0.5	0.5	130	3.7	31.5	5.1	33	0.0	1.9	45
East North Central	5.5	0.0	0.0	0.6	234	3.0	30.4	11.6	36	0.0	1.2	159
West North Central	2.3	0.0	2.3	0.0	65	6.8	45.1	99.2	27	0.0	0.0	54
South Atlantic	18.0	0.0	1.6	1.6	368	1.6	24.5	11.4	21	0.0	1.6	152
East South Central	17.7	5.9	23.6	5.9	30	5.9	41.3	41.3	6	0.0	17.7	30
West South Central	14.3	0.0	5.7	5.7	11	5.7	51.7	114.8	17	0.0	8.6	9
Mountain	23.8	0.0	0.0	0.0	492	0.0	79.4	119.1	64	0.0	0.0	127
Pacific	3.2	0.0	6.3	0.0	199	6.3	26.9	19.0	25	0.0	0.0	36
Total	6.9	0.3	2.0	0.9	221	4.1	33.3	23.8	31	0.0	2.1	93

PLAGUE INFECTION IN SAN LUIS OBISPO COUNTY, CALIF., AND KLAMATH COUNTY, OREG.

CALIFORNIA

Under date of July 11, plague infection was reported in San Luis Obispo County, Calif., as follows: In a pool of 136 fleas from burrows in the Salinas Dam Area, 7½ miles east of Santa Margarita (Pozo Road). Specimens were received at the laboratory on May 29 and proved positive on July 9.

OREGON

Under date of July 12, plague infection was reported in Klamath County, Oregon, as follows: In a pool of 4 fleas from 8 ground squirrels, *C. oregonus*, collected on June 27, in a locality 5 to 10 miles southwest of Klamath Falls, and proved positive on July 12. This locality borders on Siskiyou County, Calif., where 4 human cases of plague, with 3 deaths, occurred during the years 1941–43, and plague infection was subsequently found in ground squirrels taken in several scattered localities of the county.

TERRITORIES AND POSSESSIONS

Hawaii Territory

Plague (in ectoparasites).—Plague infection in ectoparasites has been reported on the Island of Maui, T. H., under date of July 17, 1946, as follows: One lot of 48 fleas recovered from 22 rats trapped May 24, 1946, in Kailua Gulch, District 16, Makawao District; one lot of 56 fleas recovered from 33 rats trapped May 24, 1946, District 14, Kahului, Makawao District.

* * *

DEATHS DURING WEEK ENDED JULY 13, 1946

[From the Weekly Mortality Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended July 13, 1946	Corresponding week, 1945
Data for 93 large cities of the United States:		
Total deaths	8,770	8,174
Average for 3 prior years	8,392	
Total deaths, first 28 weeks of year	265,179	260,122
Deaths under 1 year of age	750	612
Average for 3 prior years	612	
Deaths under 1 year of age, first 28 weeks of year	17,445	17,088
Data from industrial insurance companies:		
Policies in force	67,231,494	67,323,083
Number of death claims	11,331	12,746
Death claims per 1,000 policies in force, annual rate	8.8	9.9
Death claims per 1,000 policies, first 28 weeks of year, annual rate	10.1	10.7

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended June 22, 1946.—During the week ended June 22, 1946, cases of certain communicable 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		53		54	357	27	43	32	117	683
Diphtheria		2	2	32	8	2			2	48
Encephalitis, infectious						1				1
German measles		1		25	21	1	1	6	5	60
Measles		40	5	283	504	216	16	326	33	1,423
Meningitis, meningococcus				1	1					2
Mumps		2	1	16	264	55	30	27	142	537
Poliomyelitis					2				1	3
Scarlet fever	2	8	2	66	36	11		13	7	145
Tuberculosis (all forms)		16	2	144	83	12	15	19		291
Typhoid and paratyphoid fever				7	3				3	13
Undulant fever		1			1			1		3
Venereal diseases:										
Gonorrhea	4	18	11	92	162	46	44	45	96	518
Syphilis	1	10	5	54	90	11	11	13	39	234
Other forms				1					2	3
Whooping cough				107	72	1		17		197

NEW ZEALAND

Notifiable diseases—4 weeks ended May 18, 1946.—During the 4 weeks ended May 18, 1946, certain notifiable diseases were reported in New Zealand as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Cerebrospinal meningitis	16	3	Poliomyelitis	15	2
Diphtheria	257	11	Puerperal fever	8	
Dysentery:			Scarlet fever	137	
Amebic	7		Tetanus	7	6
Bacillary	14		Trachoma	1	
Erysipelas	26	1	Tuberculosis (all forms)	196	50
Food poisoning	13		Typhoid fever	23	
Malaria	11		Undulant fever	2	

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

China.—Cholera has been reported in China as follows: Kwangsi Province—May 11–31, 1946, 189 cases, 27 deaths; Kwangtung Province—Canton—June 11–20, 1946, 317 cases, 105 deaths; Shanghai—June 21–30, 1946, 488 cases, 29 deaths.

Indochina (French)—Cambodia.—For the month of June 1946, 162 cases of cholera were reported in Cambodia, French Indochina. For the week ended June 29, 1946, 2 cases of cholera were reported in Pnom-Penh, Cambodia.

Japan—Formosa.—For the month of April 1946, 15 cases of cholera with 5 deaths were reported in Keelung, and 33 cases of cholera with 23 deaths were reported in Tainan, Formosa, Japan.

Malay States (Unfederated).—Cholera has been reported in the Malay States (Unfederated) as follows: Kelantan, weeks ended—July 6, 1946, 72 cases, 59 deaths; July 13, 1946, 34 cases, 25 deaths; Trengganu, week ended July 6, 1946, 3 cases, 1 death.

Manchuria.—Under date of July 20, 1946, 312 deaths from cholera were reported in various localities in Manchuria, including Mukden, where 27 cases of cholera with 7 deaths were reported up to July 18, 1946.

Plague

Canada—Nova Scotia—Cape Breton Island—Sydney.—On July 9, 1946, 1 imported suspected case of plague was reported in Sydney, Cape Breton Island, Nova Scotia, Canada.

China.—Plague has been reported in China as follows: May 21–31, 1946, Kwangtung Province, 16 cases, 10 deaths; June 1–10, 1946, Chekiang Province, 17 cases, 3 deaths; Fukien Province, 151 cases, 61 deaths, including 131 cases, with 48 deaths in Foochow.

Ecuador—Chimborazo Province—Avinag.—During the month of June 1946, 2 cases of plague with 1 death were reported in Avinag, Chimborazo Province, Ecuador.

Egypt—Matariya.—During the week ended July 6, 1946, 2 cases of plague were reported in Matariya, Egypt.

Indochina (French)—Cochinchina.—For the month of June 1946, 2 cases of plague were reported in Cochinchina, French Indochina.

Smallpox

Indochina (French)–Cambodia.—For the month of June 1946, 467 cases of smallpox were reported in Cambodia, French Indochina.

Typhus Fever

Ecuador.—For the month of June 1946, 133 cases of typhus fever with 8 deaths, were reported in Ecuador. Provinces reporting the highest incidence are: Tungurahua, 40 cases; Chimborazo, 21 cases; Carchi, 20 cases; Bolivar, 16 cases.

Yellow Fever

Ivory Coast—Bobo Diulasso.—On July 17, 1946, 1 case of suspected yellow fever was reported in Bobo Diulasso, Ivory Coast.

Nigeria—Oyo Province.—For the week ended May 25, 1946, 1 fatal case of yellow fever was reported in Oyo Province, the location not specified. On July 1, 1946, 2 cases of suspected yellow fever with 1 death were reported in Oshogbo, Oyo Province, Nigeria.

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