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STUDIES IN DERATIZATION OF SURFACE VESSELS BY MEANS OF 1080 (SODIUM FLUOROACETATE)[1]

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Rat control on surface vessels has long received serious attention, particularly since the incrimination of the rat and flea in plague transmission. It has been given further impetus by the discovery that other rat-borne arthropods are vectors.

Ratproofing provisions have been incorporated into the construction plans of modern vessels with favorable results; but of course there are still many ships that offer rats an abundance of attractive harborage.

The United States Public Health Service has developed and utilized numerous methods of rat control on surface vessels, including fumigation with hydrocyanic acid gas, the use of traps, and the use of stomach poisons. Hydrocyanic acid gas fumigation has given the most satisfactory results.

Some new rodenticides were developed during World War II, and a search for others is being conducted at present. The compound "1080" (sodium fluoroacetate) is the product of an accelerated wartime rodenticide research program sponsored by the National Research Council. This compound has proved to be very effective for general rodent control. "ANTU" (alphanaphthylthiourea), another recently developed compound, reportedly is highly specific to the Norway rat, *Rattus norvegicus*.

In 1945 the Foreign Quarantine Division of the Public Health Service began a study to ascertain the potential effectiveness of new rodenticides in rat control on surface vessels. There follows a report of the developmental nature of the study of the 1080 compound in

[1] From the Foreign Quarantine Division.

deratization and some results obtained, with pertinent information on the compound 1080.

THE QUARANTINE 1080-DERATIZATION PROGRAM

A few quarantine stations were advised of the proposed study. They were subsequently provided with information pertaining to the nature and use of the two rodenticidal compounds, 1080 (sodium fluoroacetate) and ANTU (alphanaphthylthiourea), and were instructed to place initial emphasis on the use of 1080. Because of the known hazards associated with the use of the poisonous compound 1080, it has been necessary to observe precautions in setting up and conducting the study.

Facilities available at quarantine stations lend themselves readily to studies of the nature being reported. Quarantine personnel are well aware of the rat-control problems. Carefully trained inspectors, many of whom have had years of experience in ship inspection and rat-control work, are available. One of the most desirable features is the study unit, the ship. Various activities aboard can be controlled to a large degree during deratization operations. This aids materially in the evaluation of the rat-control method employed. Fluctuation of the rat population during the course of the deratization study on a ship can be largely prevented. It is possible to account for the rats on a particular vessel with a fair degree of accuracy.

PROCEDURE FOR 1080-DERATIZATION STUDIES

Vessels subject to quarantine inspection and treatment for rats are methodically examined by inspection crews for evidence of rats and for the nature and distribution of the infestation. Simultaneously with the inspection for rat evidence, pertinent observations regarding the cargo are made. The latter is very important and may preclude, or necessitate modification of, a particular control method.

When it has been decided to employ the 1080 compound on a certain surface vessel, the ship's personnel and others concerned are notified, through a responsible officer of the vessel, and advised of the hazards involved.

The rat-control crew, usually consisting of two or three of the men who inspected the vessel for rat evidence, then proceeds with the control measures.

The 1080 compound is a powder. It may be used in a water solution or with bait.

When used in water, one-half ounce or 14 gm. of the 1080 concentrate are dissolved in each gallon of water required. For the purpose of this program it was suggested that wax-coated squat paper cups of approximately 1-ounce capacity and chicken-watering fountains of

1-pint capacity be used in making the poisoned water available to the rats. The paper cups have been largely satisfactory, although other types of shallow containers are also being used. The fountain-type dispenser has been utilized to a lesser degree. Approximately three-fourths ounce of the 1080 solution is placed in each of the paper cups. This small quantity may be objectionable, particularly when the evaporation rate is high.

Recommendations for baits are one ounce or 28 grams of 1080 concentrate for each 28 pounds of bait.

The poisoned water may be prepared at the quarantine station prior to the time needed, or on board the vessel to be treated. Some stations prepare measured quantities of the concentrate, sufficient for use in 1 or 2 gallons of water, and store it in vials or other suitable containers.

The use of a large number of poison stations in ship work is usually more effective than the use of a large quantity of poison solution or bait at a few points. The dispensers, plainly labeled as to poisonous content, are securely fastened at strategic points along rat runways and near harborages, preferably in protected places. Care is exercised in determining the areas to be treated and the number and types of dispensers to be used. One quarantine station is utilizing boxlike shelters in which to place some of the poison dispensers.

Ten-eighty poisoned water has been used on all vessels treated in this quarantine program. Poisoned bait has been used on a few of the vessels, but only as a supplemental measure. When baits are used, it is very probable that some will be carried into harborages by the rats and eaten there. This would tend to increase the number of rats which die in places from which their recovery is difficult. Obviously, baits are more costly to prepare than the aqueous solution of 1080.

The 1080-treated ships are carefully searched for poisoned rats, usually within 24 hours following distribution of the poison, and daily until termination of study on a particular ship. It has been noted that poisoned rats frequently die within a few feet of the 1080 dispensers and are easily recovered by inspectors. However, in many instances the poisoned rats have sought harborages from which it has been difficult or impossible for inspectors to recover them. Poisoned rats are destroyed or buried following their identification and study. At the conclusion of the program on a vessel, dispensers and materials containing 1080 are removed. These are labeled and stored for future use, or are destroyed.

SOME RESULTS OBTAINED WITH 1080 ON SHIPS

The initial application of 1080 on a surface vessel during the present study was made in April 1946. During an interval of nearly

1 year 96 vessels have been individually treated with 1080 and observed for results.

A questionnaire furnished the quarantine stations at the beginning of the program has made it possible to obtain reasonably complete and uniformly reported data for each vessel. These reports, one for each vessel treated with 1080, are submitted to headquarters.

A summary of some of the data obtained is given in table 1. Although only four stations have submitted reports to date, 21 others have been advised of the nature of the program and its possible implications. Several of these stations have arranged to participate.

TABLE 1.—*Summary, 1080 studies at Boston, New Orleans, New York, and Seattle*

Port	Number of ships	Dispensers		Solution 1080 (ounces)	Number of rats	
		Cups	Fountains		Estimated	Killed
Boston	16	1,297	57	1,119	231	156
New Orleans	41	2,806	0	1,610	510	673
New York	16	1,839	44	2,202	354	157
Seattle	23	1,951	31	2,585	380	276
Total	96	7,893	132	7,516	1,475	1,262
Average per ship		82.2	1.37	78.29	15.36	13.14

Among other things, it may be noted that a relatively small amount of 1080 solution was used for each vessel. When expressed in terms of 1080 concentrate, the average amount per vessel is approximately three-tenths ounce.

The critical phase of the study, obviously, is the rat mortality resulting directly from the 1080-poisoning program. As may be observed in table 1, 1,262 of the 1,475 rats estimated were found dead following 1080 application. As previously mentioned, a number of rats poisoned during the program could not be recovered from their harborages. Records for these and for many poisoned mice were not incorporated in this report. Three species of rats were recovered from the ships treated: the black rat, *Rattus rattus rattus* (Linnaeus); the Alexander, gray, or roof rat, *Rattus rattus alexandrinus* (Geoffroy); and the Norway, brown, or sewer rat, *Rattus norvegicus* (Berkenhout).

Results obtained through the use of 1080 were compared with some results of hydrocyanic acid gas fumigations. Eight quarantine stations submitted information as requested, for 159 ships fumigated with HCN gas. These reports, most of which were made during 1945 and 1946, were taken at random from the files. A comparison of data from four of these stations, which also participated in the 1080 studies, is made in table 2. The percent of estimated rats killed on 96 ships with 1080 was 85.5, compared with 99.2 percent on 83 vessels fumigated at the same stations.

TABLE 2.—*Comparison of some HCN and 1080 data for Boston, New Orleans, New York, and Seattle*

Deratization method	Number of ships	Number of rats				Percent of estimate killed
		Estimated		Killed		
		Total	Average	Total	Average	
HCN fumigation	83	1,210	14.58	1,200	14.46	99.2
1080 poisoning	96	1,475	15.36	1,262	13.14	85.5

The percent of estimated rats killed by HCN fumigation at all eight stations was 114.7, which is an increase over that for the stations shown in table 2. If the number of rats estimated could be considered the total population, then 1080 would appear 85.5 percent efficient, as applied in the present study. When compared with results obtained through the 159 HCN fumigations previously mentioned, 1080 results exhibit an efficiency of 74.5 percent. Although the compound 1080 has thus far given favorable results, it is fully realized that conclusive data pertaining to its efficacy in the quarantine deratization program have not been obtained. However, the program is being continued and should provide additional pertinent information.

SUITABILITY OF 1080 FOR SHIPBOARD USE

One of the more desirable features of 1080 when used in rat control on ships is the facility with which it may be employed in combination with water or with baits. It is an effective rat-killing agent, is seemingly readily accepted, and is quick-acting following its ingestion by rats. There is a good possibility of easily recovering most of the dead rats, since many rats die within a few feet of the poison stations subsequent to acquiring a lethal dose. Ship crews may remain aboard, and in some cases vessels may be worked after the poison is distributed, depending on the nature of the cargo, location of poison stations, and other factors which vary with the vessel. In addition to lending itself to application to enclosed areas, 1080 may be satisfactorily applied to open deck spaces, in lifeboats, and elsewhere. The reduced number of personnel needed to conduct a deratization program and the simplicity of equipment required are points to be considered. Among other favorable features of 1080 (*1*) is the apparent insignificant degree of tolerance developed to this poison by rats which may ingest sublethal quantities.

One of the less desirable qualities is that in many instances on ships thus far treated only a partial kill of rats was obtained during the first day. This apparent deficiency may be largely due to methods employed, rather than to the poison itself. Also, an aqueous

solution of 1080 freezes when exposed to low temperatures, which necessitates modification of the formula if it is to be used under such conditions.

ADDITIONAL INFORMATION ON TOXICITY OF 1080

The chemical compound 1080 is highly poisonous to rats, and effective when used in accordance with recommendations. The Norway rat, *Rattus norvegicus*, requires only 4 mg. of this poison concentrate per kilogram of body weight to kill 50 percent of the rats so treated. Even this seemingly minute quantity is greater than that required for other species of wild rats tested. This may be seen in table 3, which was compiled from data incorporated in a National Research Council report (*2*) giving the approximate amounts required to kill 50 percent (LD_{50}) and 90 percent (LD_{90}), respectively. The Norway rat, although apparently more resistant to 1080, is far more susceptible to ANTU than other species of wild rats tested.

TABLE 3.—*Toxicity of 1080 to rats*

Species of rat	Milligrams of 1080 per kilogram of body weight required to kill—	
	50 percent	90 percent
Rattus norvegicus	.4	6
Rattus rattus alexandrinus	1	2
Rattus rattus rattus	1	2
Rattus rattus frugivorus	1	2

Ten-eighty is also very poisonous to other animals and presumably to man. Its toxicity to a number of birds and mammals, including certain species of rats, is shown in table 4, which was taken from a National Research Council report (*1*) and modified with respect to requirements for the LD_{50} percent for wild rats, revised data (*2*) being used.

In addition to the fact that 1080 is extremely toxic when taken directly into the body, there are reported deaths to dogs, cats, and other animals (*2*) due to secondary 1080 poisoning, resulting from consumption of dead or dying rats. Dogs and cats are very susceptible to 1080 poisoning, as may be seen from table 4; the amount of 1080 required per kilogram of body weight to kill 50 percent of the dogs and cats is considerably less than that for rats. It is apparent, therefore, that 1080-poisoned rats offer a definite hazard to these animals.

The calculated comparative toxicities to man of seven rodenticides, including 1080, are shown in table 5, which was taken from a National Research Council report (*2*) and slightly modified.

TABLE 4.—*Toxicity of 1080 to various mammals and birds*

Species of animal	Amount of 1080 in milligrams per kilogram of body weight of animal	Percentage killed
Albino rat	5–7	50
Norway rat, wild (*Rattus norvegicus*)	4	50
Roof rat, wild (*R. rattus subsp.*)	1	50
Cat	0.3	50
Dog	0.1–0.2	50
Goat	0.7	50
Pig	0.3	50
Horse	1	50
Monkey (Rhesus)	5–7.5	50
House mouse	8–10	50
Chicken (Rhode Island Red hens)	6–7	50
Mourning dove (*Zenaidura macroura*)	10	33
English sparrow (*Passer domesticus*)	2.7	100

TABLE 5.—*Comparative toxicities to man of 7 rodenticides*

Poison compound	Poison concentration in bait	Estimated LD_{50} in milligrams of poison per kilogram body weight	LD_{50} for 70 kilogram man (milligrams)	Poison in bait—milligrams/ounce	Lethal dose in terms of bait used in the field (ounces)
Sodium fluoroacetate (1080)	1 : 454	5	350	62.4	5.6
	1 : 268 (water)	5	350	105.1	3.3
Thallium sulfate	1 : 65	20	1,400	436.5	3.2
Zinc phosphide	1 : 50	40	2,800	567.0	4.94
Barium carbonate	1 : 5	800	56,000	5,670	9.9
Arsenic	1 : 33	1.5–15	105–1,050	860	0.12–1.22
Strychnine	1 : 320	1	70	88.5	----------
Alphanaphthylthiourea (ANTU)	1 : 20	(1)	----------	----------	(2)

[1] Not determined.
[2] Thought to be high.

The high absorption rate of this compound by the gastrointestinal tract makes treatment for 1080 poisoning difficult. It is highly soluble in water and may be washed out of baits or formulations in the presence of rainfall or other water source and might possibly cause contamination of food or other supplies.

Ten-eighty concentrate is a white powder which could be mistaken for flour, baking powder, or similar food products if not properly labeled and kept under safeguards. The powder form of 1080 is said to be slightly hygroscopic (*2*), and in the presence of excessive moisture this could make accurate weighing and measuring or application of the concentrate to bait difficult.

SUGGESTED PROCEDURE FOR USE IN CASE OF 1080 POISONING

There is no specific treatment known for 1080 poisoning. Instructions given by the National Research Council (*1*), most of which are incorporated in the ensuing paragraphs, should be followed in case of 1080 poisoning. *A physician should be called at once.*

This poison compound acts upon the heart and nervous system of birds and mammals. Death usually results from its effect on the heart.

Ten-eighty is absorbed readily by the gastrointestinal tract and must, therefore, be removed immediately if harmful effects are to be prevented. The patient should be made to vomit at once by sticking a finger in the throat or by other means. Give a dose of magnesium sulfate (Epsom salt) or other cathartic as a purge.

In the event of nervous system excitation the careful use of barbiturates of medium duration of action, such as sodium amytal, intravenously if necessary, is suggested. Other than complete rest and adequate sedation, little can be done to prevent progression of cardiac symptoms. Should ventricular fibrillation occur, intracardiac injection of 5 cc. of 1-percent solution of procaine hydrochloride might be attempted to restore an organized heartbeat. Although symptoms of 1080 intoxication will usually subside within 1 day, the patient should be kept quiet for a period of 3 days if there is any sign of action on the heart.

REFERENCES

(*1*) Anonymous: Instructions for using compound 1080 (sodium fluoroacetate) as a rodent poison. National Research Council, Washington, D. C. Revised July, 1946 (mimeographed).
(*2*) Ormsbee, R. A.: A summary of field reports on 1080 (sodium fluoroacetate). National Research Council, Washington, D. C. December 17, 1945 (mimeographed).

YELLOW FEVER VACCINE INACTIVATION STUDIES[1]

By H. W. Burruss, *Associate Technologist*, and M. V. Hargett, *Senior Surgeon*, *United States Public Health Service*

Yellow fever vaccine is a preparation of living yellow fever virus of an attenuated strain designed to initiate a mild general infection in the nonimmune recipient (*1*, *2*). The immunity resulting from such infection is protective against even the most severe forms of this disease (*3*). To insure the development of immunity subsequent to vaccination requires a vaccine of sufficient living-virus content (*4*, *5*). The failure of immunity to develop subsequent to vaccination with preparations of inadequate virus content has been recorded by Soper and Smith (*6*). Elliott (*7*) has reported the development of severe yellow fever (with two deaths) in three soldiers vaccinated 4 to 16 months previously. On the other hand, Fox, Kossobudzki, and da Cunha (*8*) and Hargett (*9*) report 100-percent immunity following vaccination, and Bugher and Gast-Galvis (*3*) record complete protection of over 600,000 persons vaccinated in Colombia.

[1] From the Rocky Mountain Laboratory of the Division of Infectious Diseases, National Institute of Health.

As yellow fever virus is one of the most labile of viruses (*4*) it is important to know what degree of virus inactivation occurs when the vaccine is maintained in storage for prolonged periods and when it is exposed to various deleterious environments such as are often encountered under field conditions. Such data are of particular value since quantitative determinations of virus content can hardly be done outside of the laboratory, and vaccination with an impotent preparation is quite certain to engender a false sense of security in the vaccinated person. In this paper is presented a series of studies undertaken to gain information relative to vaccine stability under varying conditions.

VACCINE

Forty-nine different lots of vaccine were included in these studies. All were of the 17D serum-free (aqueous-base) type, prepared as described by Hargett, Burruss, and Donovan (*10*) except for some variation in desiccation technique. All were tested as to suitability for human use (*5*, *10*) and all were approved except two (lots AB–133 and AB–320 in study No. 2) which caused paralysis in the test monkeys (*11*). Storage was routinely at −9° C. to −32° C. with the extremes only rarely approached.

The 17D strain of yellow fever seed virus employed in preparing these lots was Colombia No. 88, passed two, three, four, or five times through chick embryos. As Colombia No. 88 virus had been passed through 225 tissue cultures and 3 chick embryos, the seed virus employed in preparing the vaccine lots here considered had passed through a total of 225 tissue cultures and 5, 6, 7, or 8 chick embryos. The origin and development of Colombia No. 88 virus is given by Bauer et al. (*4*).

Selection of vaccine lots for investigation depended on availability, volume content of ampules, consecutive order of preparation, and certification as suitable for human vaccination.

TITRATION

The 50-percent end point method of Reed and Muench (*12*) was employed in all determinations of virus content. This titer, as employed in these studies, indicates the dilution of vaccine in which one volume of 0.03 ml. of diluted material contains one MLD of virus. The number of MLD in 1.00 ml. of undiluted vaccine is thus the titer multiplied by 33⅓.

Rehydration of desiccated vaccine was accomplished with distilled water or 0.85-percent sodium chloride solution. Dilutions were made with similar saline to which had been added nonimmune human serum in the proportion of one part serum to nine parts salt solution.

All mice were of the white Swiss strain raised in this laboratory from a single inbred colony. Daily inspection of all animals was made for a period of 3 weeks subsequent to inoculation.

STUDY NO. 1—THE IMPORTANCE OF TEMPERATURE IN VACCINE DESICCATION

Object.—To determine whether vaccine desiccated at 38° C. to 40° C. is more or less stable than vaccine desiccated at 23° C. to 25° C.

Vaccines.—Eight different lots were studied. Ampules contained 1.00 ml. of vaccine each. All lots were prepared in like manner except for desiccation. The seed virus employed had passed through a total of 225 tissue cultures and 8 chick embryos.

Desiccation.—The desiccator employed was of the lyophile type similar in construction principles to that described by Bauer and Pickels (*13*). It was set up to permit room air to circulate freely about each ampule throughout the desiccation period. Four lots of vaccine were attached at different times to the desiccator in a refrigerated room with a temperature of −19° C to −22.5° C. The vaccine remained in this room throughout the desiccation period of about 20 hours (20 hours to 20 hours and 50 minutes) with the room temperature elevated from the low mentioned to a terminal high of 38° C. to 40° C. Desiccator vacuum at termination of drying registered 1.10 to 1.25 microns. As soon as desiccation was terminated, the ampules were filled with dry nitrogen, sealed, inspected, and stored in the usual manner (*10*). Four other lots were attached at different times to the same desiccator in a room where the temperature was 23° C. to 25° C. This room remained at this temperature throughout the entire desiccation period of about 3 hours (2 hours and 45 minutes to 3 hours and 30 minutes). Vacuum at termination of desiccation registered 0.75 to 0.80 micron. The ampules were cared for as with the preceding lots.

Stability.—To determine stability of the desiccated vaccines, contents of representative ampules from each of the eight lots were titrated for virus content before and after exposure in the dark at 37° C. for 2 and for 28 weeks. It was assumed that the loss of titer which occurred during exposure would indicate the comparative stability of the preparations under study.

Titrations.—Contents of 4 ampules pooled; fourfold dilutions; 7 different dilutions; 18 mice per dilution; mice 37 to 39 days old.

Results and comment.—Results are given in table 1. The percentage inactivation of virus in the two groups of vaccines is almost identical and indicates equal stability of vaccines desiccated at 23° C. to 25° C. compared with those desiccated at −22.5° C. to 40° C. The latter vaccines presented a finer desiccation pattern, a lighter color, a

better appearance, and suspended a little more readily in physiological saline. The factors of convenience and cost of preparation favor desiccation at "room temperature." In the writers' experience, 2 hours is ample to thoroughly dry ampules containing 1.00 ml. of vaccine, and 6 hours is sufficient for ampules containing 5.00 ml. when the air around the ampules is 20° C. to 25° C.

TABLE 1.—*Inactivation of differently desiccated yellow fever vaccines held at 37° C. for 2 and 28 weeks*

Vaccines		Virus content of vaccines				
Lot numbers	Terminal desiccation temperatures	No exposure	2 weeks exposure at 37° C.		28 weeks exposure at 37° C.	
		Titer	Titer	Percentage loss	Titer	Percentage loss
AB-352	38° C. to 40° C.	60,621	9,503	84.3	60	99.9
AB-353	38° C. to 40° C.	126,484	6,881	94.6	23	99.9
AB-354	38° C. to 40° C.	90,440	13,517	85.1	64	99.9
AB-355	38° C. to 40° C.	114,688	9,134	92.0	36	99.9
Composite results		95,027	9,339	90.2	41	99.9
AB-405	24° C. to 25° C.	146,145	30,638	79.0	141	99.9
AB-408	24° C. to 25° C.	194,642	15,606	92.0	56	99.9
AB-415	24° C. to 25° C.	194,642	8,233	95.8	175	99.9
AB-420	24° C. to 25° C.	304,087	44,892	85.2	12	99.9
Composite results		199,885	20,808	89.6	58	99.9

Despite the drop in titer by 90 percent during the 2-week exposure at 37° C., all eight lots remained potent for release in accordance with the standards established by the Biologics Control Laboratory (*5*) requiring a minimum of 150,000 MLD per milliliter.

Investigations (*14*) of the amount of virus inactivated during desiccation by the two methods described showed an average loss of 34 percent at "room temperature" and 40 percent at −22.5° C. to +40° C.

STUDY NO. 2.—VIRUS TITER OF VACCINES AFTER 1, 2, AND 3 YEARS IN COLD STORAGE

Object.—To gain information as to the rate of virus inactivation occurring in vaccines stored in a commercial cold storage plant.

Vaccines.—Twenty different vaccines were studied. Distribution was 0.50, 1.00, 2.50, or 5.00 ml. per ampule. All were prepared in like manner except that the seed virus employed in preparing the "1942 lots" had passed through 225 tissue cultures and 7 chick embryos, whereas that employed in preparing the "1943 lots" had passed through 225 tissue cultures and 8 chick embryos. Vacuum at termination of desiccation registered 0.50 to 1.00 micron.

Titrations.—Contents of 1 or 2 ampules; fourfold or tenfold dilutions; 5 or 7 different dilutions, and 12 or 24 mice per dilution. Mice were 28 to 45 days old.

Storage.—The vaccines were stored in a commercial cold storage plant. The storage temperature varied from −9° C. to −32° C. with the extremes only rarely approached.

Procedure.—Each lot of vaccine was titrated just prior to being placed in storage and after 1, 2, or 3 years in storage.

Results and comment.—Results are given in table 2. The irregularities are probably properly explained on the basis of inadequate titrations, although the possibility of titer elevations resulting from the action of environmental influences, as occurred in studies No. 5 and 7, must be kept in mind.

TABLE 2.—*Virus titer of yellow fever vaccines at time of preparation and following 1, 2, and 3 years storage at −9° C. to −32° C.*

Vaccines	Titers				
		Original	1 year	2 years	3 years
10 lots prepared in 1942	Minimum	16,100	----------	7,550	11,018
	Median	64,650	----------	25,900	17,040
	Maximum	274,000	----------	69,000	65,536
10 lots prepared in 1943	Minimum	28,000	38,600	42,400	36,000
	Median	134,500	169,500	96,000	117,000
	Maximum	369,000	360,000	217,000+	181,000

The results on the whole show a definite diminution in titer. This does not correlate with the experience reported in study No. 3 in which the vaccines stored under the same conditions for 2 years showed a composite increase in titer. It is to be particularly noted that at no time did the titer of any of the 20 vaccines fall below the minimum of 4,500 (equivalent to 150,000 MLD per milliter set by the Biologics Control Laboratory (*5*)). This study demonstrates that a properly prepared vaccine with a titer as low as 16,100 will retain potency for at least 3 years when stored at −9° C. to −32° C.

STUDY NO. 3.—VIRUS TITER OF VACCINES AFTER 1 AND 2 YEARS STORAGE AT DIFFERENT TEMPERATURES

Object.—To determine the best temperature for the storage of vaccine.

Vaccines.—Four different lots were studied. Ampules contained 0.50 or 1.00 ml. of vaccine each. All lots were prepared in like manner except that the seed virus employed in making lots AB–200 and AB–201 had passed through 225 tissue cultures and 7 chick embryos, whereas that used in preparing lots AB–202 and AB–203 had passed through 225 tissue cultures and 5 chick embryos. Vacuum at termination of desiccation registered 2.50 to 3.00 microns.

Titrations.—Contents of one ampule; tenfold dilutions; 6 different dilutions; 12 mice per dilution; mice 34 to 45 days old. The composite

titer was determined for each set of conditions of the three titration periods.

Procedure.—Titer of each vaccine was determined just prior to test exposure and again following storage for 378–379 days and 730 days at the following four temperatures:

+3° C. to +5° C.
−5° C. to −7° C.
−13° C. to −32° C.
−78° C.

Results and comment.—The composite titers recorded in table 3 indicate that considerable virus inactivation occurred during storage at the two higher temperatures and none at the two lower temperatures. In fact, the vaccines appear to have improved in potency during storage at the two lower temperatures. The cause of this increase is a matter for conjecture. Some suggestion is given by study No. 2 that inadequate titrations may be the cause. On the other hand, studies No. 5 and No. 7 demonstrate some very definite titer increases following subjection of vaccines to various environments which cannot be explained by inadequate or faulty titration.

TABLE 3.—*Composite titers of four lots of desiccated yellow fever vaccine before and subsequent to prolonged storage at different temperatures*

Exposure period	Exposure temperature			
	3° C. to 5° C.	−5° C. to −7° C.	−13° C. to −32° C.	−78° C.
0 days (no exposure)	22,800	22,800	22,800	22,800
378–379 days	3,770	12,800	23,300	22,800
730 days	2,740	4,640	30,700	27,400

Examination of individual titration results reveals that at the end of 378–379 days' storage all vaccines except three stored at 3° C. to 5° C. were fully potent according to the standards of the Biologics Control Laboratory (*5*) which stipulate a minimum titer of 4,500. After a 2-year storage all vaccines except those stored at 3° C. to 5° C. and one stored at −5° C. to −7° C. were also found to be potent.

The desirability of storing vaccines at a temperature sufficiently low to insure a high degree of virus preservation is apparent. On the basis of this study, and considerable additional experience, it is our opinion that a temperature of −20° C. to −25° C. is an excellent storage temperature. Electric ice cream storage cabinets and commercial cold storage plants commonly afford such storage. Although lower temperatures may prove to be a little more efficient, the higher refrigeration cost is believed to be unwarranted.

STUDY NO. 4.—INACTIVATING EFFECT OF FLUORESCENT LIGHT ON DESICCATED VACCINES

Object.—To secure information relative to the inactivating effect of light on vaccine.

Vaccines.—Four different vaccines were studied. Distribution was 1.00 ml. per ampule. Ampules were of pyrex glass. All lots were prepared in a similar manner. The seed virus employed had been passed through 225 tissue cultures and 8 chick embryos. Vacuum at termination of desiccation registered 0.50 to 0.75 micron.

Titrations.—Contents of 4 ampules pooled; fourfold dilutions; 7 different dilutions; 24 mice per dilution; mice 40 to 44 days old.

Light.—Two 100 watt "3,500° white" fluorescent lamps of a type in common use constituted the source of light. Spectral distribution of the rays has been determined (*15, 16*) to be almost wholly in the 3,800–7,200 Angstrom band and principally in the 3,950–4,470 and 5,090–6,950 segments. The two lamps were mounted parallel in a horizontal plane in a commercial-type metal fixture having a white enamel reflector. The lamps were suspended 769 mm. directly above a laboratory bench located in a dark corner. Light intensity at point of vaccine exposure was 100 foot-candles as determined with a sight meter.

Procedure.—Ampules of vaccine were taken from cold storage, their labels removed, and promptly exposed. Light exposure was realized by laying the ampules on a white cloth placed on the laboratory bench directly below the described lamps. Dark exposure was made by placing the ampules in a tight black box on the same bench but not under the lamps. Exposure temperatures were determined by placing a thermometer nearby. The ampules remained immobile throughout the exposure period.

The titer of each vaccine was determined promptly following removal from storage and following termination of exposure. Every exposure was for 6 hours at "room temperature" with 0, 3, or 6 hours' exposure to light during this period.

Results and comment.—Results are given in table 4. Exposure in the dark for 6 hours at 22.2° C. to 26.8° C. caused two lots to lose appreciable titer (20 and 27 percent), one to remain essentially unaltered, and one to show a definite increase (51 percent). Exposure to light for 3 or 6 hours resulted in a significant diminution in titer.

It should be kept in mind that these results are applicable only to light of a particular intensity and spectral composition. This light possesses moderate inactivating properties. The results suggest that the vaccine should not be unnecessarily exposed to light.

TABLE 4.—*Titer of four lots of yellow fever vaccine before and after exposure to room temperature and fluorescent light*

Vaccine lot number	Exposure temperature (in degrees centigrade)	Titers			
		Dark 0 hours Light 0 hours	Dark 6 hours Light 0 hours	Dark 3 hours Light 3 hours	Dark 0 hours Light 6 hours
AB–459	22.2° to 26.8°	216,269	158,597	114,688	70,779
AB–460	22.8° to 26.5°	201,851	160,563	186,778	192,020
AB–469	23.0° to 24.0°	160,563	242,483	119,276	162,529
AB–470	22.7° to 24.7°	184,812	181,535	176,292	137,626
Average		190,874	185,795	149,259	140,739
Percentage loss			2.7	21.8	26.3

STUDY NO. 5.—EXPOSURE OF DESICCATED VACCINES FOR 7 OR 8 HOURS TO DIFFERENT TEMPERATURES

Object.—To determine what effect temperatures ranging from 25° C. to 110° C. may exert on desiccated vaccine.

Vaccines.—Eight different lots were studied. Ampules of lots AB–250 and AB–253 contained 0.50 ml. of vaccine each, of lots AB–251 and AB–252 1.00 ml. each, and of lots AB–317, AB–322, AB–326, and AB–331 2.50 ml. each. All were prepared in like manner except for desiccation and the seed virus employed. The virus used in preparing lots AB–251 and AB–252 had passed through 225 tissue cultures and 5 chick embryos, whereas that used in preparing the other lots had passed through 225 tissue cultures and 8 chick embryos. Vacuum at termination of desiccation of lots AB–250–251–252–253 was 1.50 to 1.80 microns and that of lots AB–317–322–326–331 was 0.75 micron. Final desiccation temperature of the "200-series" vaccines was 24.0° C. to 24.8° C., and of the "300-series" vaccines 37.0° C. to 37.75° C.

Titrations.—Contents of 2 ampules pooled; tenfold dilutions; 4 to 6 different dilutions; 12 mice per dilution for the 8-hour exposures and 18 mice per dilution for the 7-hour exposures; mice 36 to 39 days old.

Procedure.—Representative ampules of each lot of vaccine were titrated promptly upon removal from cold storage and after an exposure period of 7 or 8 hours to heat. Promptly following termination of exposure, the test ampules were removed from the test environment and packed in dry ice. Titration was then undertaken at once or within 2 hours.

Results and comment.—Results are shown in chart 1 and table 5. It was surprising to find that every one of the eight vaccines showed an elevation in titer following 7 or 8 hours' exposure at 25° C. to 37° C. The cause for this increase is a matter for conjecture; it certainly is not to be explained on the basis of defective titrations. The same phenomenon was observed with all four vaccines diluted 1:1 in study No. 7.

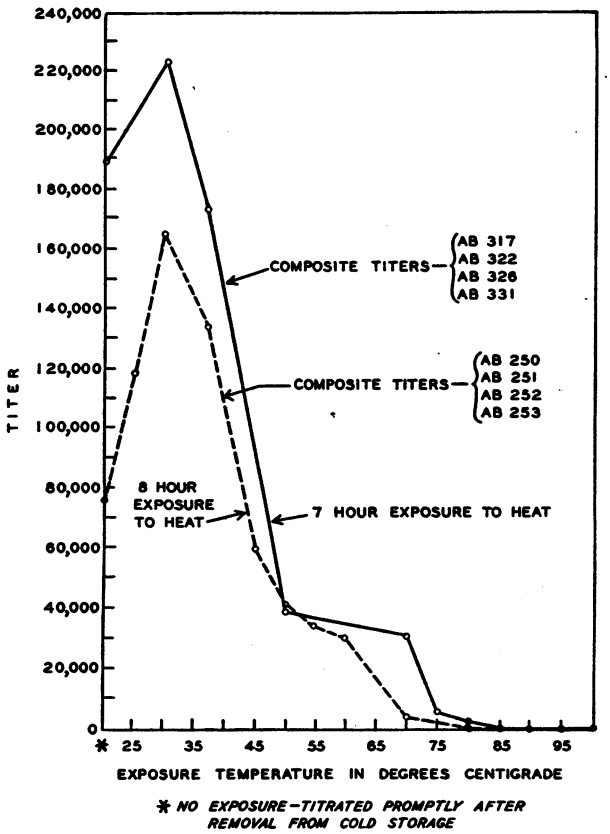

CHART 1.—Composite titers of desiccated vaccines exposed 7 or 8 hours at different temperatures.

TABLE 5.—*Virus titers of desiccated yellow fever vaccines following 7 or 8 hours' exposure to different temperatures*

Exposure temperature in degrees centigrade	Titration results									
	8-hour exposure to heat					7-hour exposure to heat				
	Vaccine lot numbers				Composite averages	Vaccine lot numbers				Composite averages
	AB-250	AB-251	AB-252	AB-253		AB-317	AB-322	AB-326	AB-331	
No exposure	44,300	161,000	35,200	212,000	75,500	203,000	239,000	181,000	150,000	190,000
24.5° to 25.5°	62,700	198,000	36,000	314,000	117,000					
29.5° to 30.5°	154,000	100,000	117,000	280,000	165,000	233,000	274,000	233,000	150,000	223,000
36.5° to 37.5°	203,000	100,000	69,000	173,000	134,000	70,500	287,000	161,000	217,000	173,000
44.5° to 45.5°	40,400	64,400	65,900	72,000	60,000					
49.5° to 50.5°	74,000	60,000	39,400	19,000	41,300	35,200	36,000	54,800	32,900	38,600
53.3° to 57.3°	39,400	65,900	41,300	17,300	34,400					
59.5° to 60.5°	31,400	29,300	16,500	72,000	30,700					
69.5° to 71.0°	2,740	6,000	6,590	3,940	4,430	26,100	77,500	23,300	25,500	31,400
74.0° to 76.0°						2,610	4,970	7,050	12,500	5,480
79.0° to 81.0°	644	600	2,680	464	775	1,610	1,810	4,240	3,210	2,610
84.0° to 86.0°						64	173	344	404	223
88.9° to 91.5°	1	3	2	3	>1	<1	1	2	>1	<1
99.0° to 102.0°	0	0	0	0	0	<1	0	<1	<1	<1
109.0° to 111.0°						0	0	0	0	0

It is to be noted (*a*) that exposure for 7 or 8 hours at 30° C. resulted in a significant elevation of the composite titers, (*b*) that exposure for 7 or 8 hours at 37° C. resulted in either a gain or a slight drop in the composite titers, (*c*) that exposure for 7 hours at 80° C. or 8 hours at 70° C. was required to lower the composite titers below the minimum of 4,500 set by the Biologics Control Laboratory (*5*), (*d*) that every lot exposed 7 or 8 hours at 80° C. still contained adequate virus for immunization (*4, 5*), (*e*) that exposure for 7 hours at 110° C. or 8 hours at 100° C. was necessary to inactivate all virus, and (*f*) that all lots of vaccine reacted in a similar manner.

This study indicates that properly desiccated vaccine of good titer can withstand considerable exposure to heat such as might be encountered in tropical countries and yet possess sufficient active virus for immunization.

STUDY NO. 6.—EXPOSURE OF DESICCATED VACCINES FOR 2 YEARS AT 37°C.

Object.—To determine the rate of virus inactivation of desiccated vaccines held at a tropical temperature.

Vaccines.—Four lots of vaccine prepared in like manner were studied. Each ampule contained 1.00 ml. of vaccine. The seed virus employed had passed through 225 tissue cultures and 8 chick embryos. Vacuum at termination of desiccation registered 1.10 to 1.25 microns.

Titrations.—Contents of 4 ampules pooled; fourfold dilutions; 7 different dilutions; 18 mice per dilution; mice 37 to 39 days old. The composite titers for each titration period were determined.

Procedure.—Ampules of each lot were placed in a bacteriological incubator set at 37° C. The contents of representative ampules were titrated at initiation of exposure and thereafter at varying intervals.

Results and comment.—Selected results of special interest showing the alterations in titer are shown in table 6. It is to be observed (*a*) that all four lots of vaccine reacted in a similar manner, (*b*) that exposure for 2 weeks at 37° C. resulted in a titer decline of 90 percent, (*c*) that every lot still contained adequate virus for successful vaccina-

TABLE 6.—*Virus titer of yellow fever vaccines exposed at 37° C.*

Exposure in weeks at 37° C.	Titers					Percentage titer loss
	Lot AB-352	Lot AB-353	Lot AB-354	Lot AB-355	Composite titer	
0	60,621	126,484	90,440	114,688	95,027	
2	9,503	6,881	13,517	9,134	9,339	90.17
4	1,382	2,888	4,751	2,212	2,437	97.43
6	1,300	1,761	3,123	883	1,587	98.33
8	420	351	1,475	609	584	99.38
28	60	23	64	36	41	99.96
52	18	8	23	33	18	99.98
78	2	4	3	6	3	99.99
104	Trace	6	Trace	<2	<1	99.99

tion after 8 weeks' exposure (*4, 5*), (*d*) that active virus was still present after 78 weeks' exposure, and (*e*) that virus was detectable in all lots after 104 weeks' exposure.

On the basis of results reported by Fox, Kossobudzki, and da Cunha (*8*), some persons vaccinated in the usual manner (vaccine diluted 1:10, and 0.50 ml. inoculated subcutaneously) with these vaccines which had been exposed for 2 years would develop immunity. The likelihood of immunity resulting from vaccination with such vaccine would increase as the amount of vaccine administered was increased. When occasion arises necessitating the use of vaccine of questionable potency, it is recommended that 10 to 20 times the usual quantity of vaccine be given.

STUDY NO. 7.—ALTERATIONS IN TITER OF DILUTED VACCINE HELD AT 37° C.

Object.—To find what changes in virus titer occur when vaccine is diluted with physiological saline and held for varying periods at a tropical temperature.

Vaccines.—Four lots were studied. Ampules contained 2.50 or 5.00 ml. each. All lots were prepared in like manner except for the seed virus; lots AB–494, AB–577, and AB–590 were made with a seed-virus preparation (lot 186) which had been passed through 225 tissue cultures and 8 chick embryos, and lot AB–592 with a seed virus (lot 309) which had been passed through 225 tissue cultures and 6 chick embryos. The two seed viruses were derived from a common progenitor (Columbia No. 88 virus) with the latter five passages of the first (lot 186) and the latter three passages of the second (lot 309) following different chick-embryo passage lines. Vacuum at termination of desiccation registered 0.50 to 1.25 microns.

Titrations.—Contents of one ampule or contents of two ampules pooled; fourfold dilutions; 2 to 11 different dilutions; 24 mice per dilution; mice 36 to 45 days old.

The average titer for each situation was determined from the results of the four individual lot titrations as shown in table 7. The 65 average titers listed in table 8 were derived in like manner from the 260 individual titrations composing the main study.

Procedure.—The four vaccines were studied in the same manner. The contents of one or two representative ampules were suspended in physiological sodium chloride solution at 37° C. and at once titrated for virus content. This same or similarly diluted vaccine was then held for variable periods at 37° C., as shown in tables 7 and 8, and was again titrated. Studies were made with the vaccines diluted 1:1, 1:10, 1:20, 1:50, and 1:100.

Supplementary study.—Near the termination of the investigations described, it was thought desirable to make a supplementary study to determine what titer change occurs when vaccine is diluted 1:100 and held for only 10 minutes at 37° C. The contents of four ampules of a single vaccine were suspended in saline solution at 37° C., pooled, diluted 1:100 with saline, and at once titrated as described. A second titration was then performed in an identical manner except that the diluted material was held for 10 minutes at 37° C. Each of the four vaccines was examined in like manner.

Results and comment.—Complete results for the 1:1 dilution study are given in table 7. The average titers of all five dilution studies are presented in table 8. The composite value of the primary titrations of the supplementary study was 83,456 and of the secondary, 87,040—not a significant difference.

TABLE 7.—*Virus content of four lots of yellow fever vaccine rehydrated to predesiccation volume with physiological saline, and held for variable periods at 37° C.*

Exposure in hours	Titers				
	Lot AB-494	Lot AB-577	Lot AB-590	Lot AB-592	Average
0	429,916	296,223	226,099	43,090	248,832
1	534,774	833,618	398,459	133,693	475,136
2	519,045	440,402	450,888	139,592	387,482
4	179,569	353,894	192,020	115,999	210,371
6	176,292	249,037	141,558	1,659	142,137
8	146,145	129,761	80,609	3,256	89,943
10	50,463	50,463	58,819	136	39,970
12	43,090	13,722	81,265	4	34,520
16	9,503	620	20,152	<1	7,569
20	371	20	335	<1	182
24	2	5	8	0	4
36	<1	0	0	<1	<1
48	0	0	0	0	0

TABLE 8.—*Average titers of four lots of yellow fever vaccine diluted with physiological saline and titrated before and after variable intervals at 37° C.*

Exposure in hours	Titer averages				
	Dilution 1:1	Dilution 1:10	Dilution 1:20	Dilution 1:50	Dilution 1:100
0	248,832	113,971	128,615	185,742	153,920
1	475,136	106,291	72,653	98,944	68,656
2	387,482	55,859	85,453	77,856	62,864
4	210,371	36,326	36,301	47,392	19,432
6	142,137	24,954	25,191	25,616	3,652
8	89,943	13,417	13,776	15,734	1,485
10	39,970	8,060	4,768	5,892	3,648
12	34,520	3,942	2,533	4,943	1,324
16	7,569	275	1,766	645	1,496
20	182	55	361	392	316
24	[3] Present	[4] Present	[4] Present	[4] Present	[4] Present
36	[2] Present	Absent	[2] Present	[3] Present	[3] Present
48	Absent	Absent	[1] Present	[1] Present	[2] Present

[1] 1 lot showed presence of virus.
[2] 2 lots showed presence of virus.
[3] 3 lots showed presence of virus.
[4] 4 lots showed presence of virus.

It is to be noted that every one of the four vaccines diluted 1:1 showed a significant elevation in titer after being held 1 and 2 hours at 37° C. as compared with the initial values. No comparable elevation occurred in the higher dilutions as may be seen from table 8. Why vaccine diluted 1:1 and held at 37° C. should increase in titer is unknown. The same type of behavior was encountered in study No. 5.

Further examination of table 7 reveals that vaccine AB–592 lost titer more rapidly than did the other lots. This markedly different behavior was also seen in the 1:10, 1:20, and 1:50 dilution studies, and to a lesser degree in the 1:100 dilution study. As lot AB–592 differed from the other vaccines only in that a different seed virus was employed in its preparation, it is believed that a substrain difference accounts for this disparity in behavior, despite the fact that the two seed viruses differ only slightly in their passage history. Another difference between these two seed viruses well established by many observations in this laboratory, is that lot 186 produced vaccines of much higher average titer than lot 309 despite all efforts to secure high-titer preparations with the latter. Previous reports (*8*, *17*, *18*, *19*, *20*) on 17D virus substrain differences support this explanation, and conversely, these observations extend the previously noted variations. Because of the superiority of the vaccines prepared with the substrain represented by seed virus 186, all vaccine now prepared in this laboratory is made from chick embryos infected with this substrain. The seed-lot system (*8*) is employed to control possible variations.

The Biologics Control Laboratory (*5*) recommends that each person vaccinated receive a minimum of 500 MLD of virus. As it is standard current practice to dilute yellow fever vaccine 1:10 and inject 0.50 milliliter per recipient, this means that the undiluted vaccine must contain a minimum of 10,000 MLD per milliliter (equivalent to a titer of 300) at time of dilution in order to comply with the recommendation. The titer of none of these diluted vaccines dropped to this minimum within 6 hours regardless of dilution employed. Six showed a titer greater than 300 after 20 hours. Table 8 shows the drop in titer on an averaged basis. It is to be noted that a figure of less than 300 was not reached until 16 hours. All 24-hour determinations, save one, showed the presence of active virus; 10 of the 20 titrations made at 36 hours indicated live virus present; and 4 of the 20 examinations performed at 48 hours showed some virus to be still active.

It is evident from the data presented that any one of these four vaccines may be satisfactorily used in a 1:100 dilution. In the employment of such a dilution the procedure followed by Fox, Kossobudzki, and da Cunha (*8*) is recommended: A primary dilution

of 1:10 is prepared followed by a secondary dilution of 1:100. This latter is made within a 10-ml. inoculating syringe by first drawing in 1.00 ml. of the primary dilution followed by 9.00 ml. of saline. After thorough mixing within the syringe the vaccine is promptly inoculated in a volume of 0.50 ml. per recipient. Not more than 10 minutes need be taken in preparing the secondary dilution and inoculating 20 persons. No significant inactivation of virus occurs during this allotted 10-minute period. As only 500 MLD (*4*, *5*) of virus per recipient are required for satisfactory vaccination (Bugher and Smith (*21*) set the figure at 100 MLD), material diluted and administered as outlined need have a titer of only 3,000 at time employed. Fox and colleagues (*8*) report the development of immunity in every one of a group of 288 persons vaccinated as described. Vaccination by the method set forth is a practical and dependable procedure provided properly prepared vaccine of ordinarily good quality is available.

DISCUSSION

Seven different studies relating to vaccine inactivation have been presented. From 4 to 20 different lots of vaccine were examined in like manner in each study. The examination consisted of titrating a sample from each vaccine to determine its virus titer, exposing a like sample to a definite environment for a certain period of time, and then titrating a sample of the exposed vaccine for virus content to determine what titer alteration may have occurred during the exposure period. The results afford new information of practical value in orienting certain laboratory and field procedures. These results, however, must be applied with caution to vaccines prepared in other laboratories, as employment of different techniques and seed-virus strains may result in vaccines which possess somewhat different characteristics from those reported in these studies.

We employ the term "hump phenomenon" to describe that unexpected and significant elevation in titer encountered with all 12 vaccines included in studies No. 5 and No. 7. That a real elevation of titer did take place following exposure of these vaccines to moderate heat is certain, but this is not to declare that an increase in actual virus content occurred. The explanation of this novel increase requires further investigation. This phenomenon and the variable nature of different 17D substrains are two factors which must be added to the already lengthy list of variables that must be considered in the titration of yellow fever virus.

Certain facts revealed by these studies are of particular value in the laboratory and field disposition of vaccine. Dried vaccine stored at about −22° C. or colder remains adequately stable for years,

whereas if stored at about −6° C. or warmer, inactivation is considerably more rapid. Some desiccated vaccines can be exposed for weeks at tropical temperatures and remain sufficiently potent for dependable use. Vaccine suspended in saline for as long as 20 hours at 37° C. may still contain ample virus for vaccination. Although vaccine may contain adequate virus for immunization after considerable exposure to a more or less deleterious environment, it must be kept in mind (*a*) that some lots possess a much lower initial content of virus than others, (*b*) that lots prepared with different 17D substrains may vary in resistance to inactivating influences, (*c*) that there is no rapid method of determining virus concentration, and (*d*) that employment of an impotent preparation may result in contraction of yellow fever by a person who believes himself protected.

SUMMARY AND CONCLUSION

Forty-nine different yellow fever vaccines were subjected to a variety of environments to determine what effect these environments might exert on the potency of the vaccines. The experiments are presented in seven studies.

Vaccine desiccated at "room temperature" is as stable as vaccine desiccated at 38° C. to 40° C.

Each of 20 desiccated vaccines held in cold storage (−9° C. to −32° C.) for 3 years was found to be adequately potent for use at the termination of the storage period. Vaccine stored at −5° C. to −7° C. and warmer showed considerable loss of active virus during a storage period of 2 years. It is recommended that desiccated vaccine be stored at −20° C. to −25° C. Electric ice-cream storage cabinets and commercial cold storage warehouses commonly afford such storage.

Desiccated vaccine may still be adequately potent for use after an exposure of several weeks to a tropical temperature. Exposed at 37° C., an average of 90 percent of virus was lost in 2 weeks and 99 percent in 8 weeks; active virus was present after 104 weeks. Each of eight different vaccines showed a significant increase in titer when exposed 7 or 8 hours at 25° C. to 37° C. Each of these same eight lots still contained adequate virus for immunization after 7 or 8 hours' exposure at 80° C.; an exposure of 7 or 8 hours at 110° C. and 100° C., respectively, was required to inactivate all virus.

Each of four vaccines diluted 1:1 with physiologic saline at 37° C. and held for 2 hours at that temperature showed a significant elevation in titer. Vaccine diluted 1:1 to 1:100 with saline remained adequately potent for from 6 to 20 hours when held at 37° C. Some dilutions showed active virus still present after 48 hours.

The inherent character of the 17D virus employed in vaccine manufacture is an important factor in determining the stability of the product. Only substrains of known good characteristics should be used for seed virus, and stabilization of the virus should be insured by employment of the seed-lot system.

One milliliter of vaccine of ordinary good quality is ample to successfully vaccinate 200 persons when the vaccine is diluted 1:100 and administered in a volume of 0.50 ml. per recipient.

Relative to vaccine administration it is recommended (*a*) that only preparations be employed which comply with the minimum requirements set up by the Biologics Control Laboratory, (*b*) that vaccine be stored at −20° C. or colder until time of use, (*c*) that neither desiccated nor diluted preparations be unnecessarily exposed to heat or light, (*d*) that 1:1 and 1:10 suspensions be used within 1 hour of preparation and 1:100 suspensions within 10 minutes, and (*e*) that if vaccine of questionable potency must be used, 10 to 20 times the usual quantity be administered.

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DEATHS DURING WEEK ENDED MAY 31, 1947

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

	Week ended May 31, 1947	Corresponding week 1946
Data for 91 large cities of the United States:		
Total deaths	8,001	8,124
Median for 3 prior years	8,271	
Total deaths, first 22 weeks of year	211,458	209,295
Deaths under 1 year of age	672	594
Median for 3 prior years	577	
Deaths under 1 year of age, first 22 weeks of year	16,837	13,153
Data from industrial insurance companies:		
Policies in force	67,303,577	67,201,982
Number of death claims	9,374	8,971
Death claims per 1,000 policies in force, annual rate	7.3	7.0
Death claims per 1,000 policies, first 22 weeks of year, annual rate	9.9	10.5

INCIDENCE OF DISEASE

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

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED JUNE 7, 1947

Summary

A total of 48 cases of poliomyelitis was reported for the week, as compared with 42 last week, (160 for the corresponding week last year), and a 5-year (1942–46) median of 60 cases. Only 4 States reported more than 2 cases—California 13 (last week 18), Texas 6 (last week 5), New York 4 (last week 1), and Nebraska 3 (last week 0). In the 12-week period since the approximate date of seasonal low weekly incidence (March 15), 390 cases have been reported, as compared with 725 for the corresponding period last year and a 5-year median of 357. Of these 390 cases, 292 occurred in the 11 States which have reported 10 or more cases each during the period, as follows (last year's corresponding figures in parentheses): California 124 (78), New York 35 (45), Texas 34 (129), Florida 20 (153), Illinois 15 (22), Nebraska 12 (0), North Dakota 11 (1), Kentucky 11 (5), Michigan 10 (3), Missouri 10 (6), Louisiana 10 (29).

Only 2 cases of smallpox were reported for the current week—1 each in Indiana and Alabama. The total to date this year is 136, as compared with 238 for the same period last year and a 5-year median of 251.

Of 79 cases of typhoid and paratyphoid fever (last week 61, corresponding week last year 88), Texas reported 13, Illinois and Virginia 8 each, and California 6. The total for the year to date is 1,164, as compared with 1,268 for the same period last year and a 5-year median of 1,425.

Cumulative figures to date are considerably above the respective expectancies for dysentery (all forms), 12,540 (5-year median, 9,370); tularemia, 709 (5-year median, 400); undulant fever 2,429 (2-year average, 2,018); and whooping cough 66,958 (5-year median, 57,437).

Deaths recorded for the week in 93 large cities of the United States totaled 9,160, as compared with 8,130 last week (next preceding week, 8,923), 9,171 and 8,890, respectively, for the corresponding weeks of 1946 and 1945, and a 3-year (1944–46) median of 8,890. The total for the year to date is 224,658, as compared with 222,588 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended June 7, 1947, and comparison with corresponding week of 1946 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 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46
	June 7, 1947	June 8, 1946		June 7, 1947	June 8, 1946		June 7, 1947	June 8, 1946		June 7, 1947	June 8, 1946	
NEW ENGLAND												
Maine	4	3	0	-------	-------	-------	50	203	139	0	0	1
New Hampshire	0	0	0	-------	1	-------	1	57	5	0	0	0
Vermont	0	0	0	-------	-------	-------	143	182	163	0	2	0
Massachusetts	8	1	2	-------	-------	-------	371	2,596	877	1	1	7
Rhode Island	0	0	0	-------	-------	-------	203	138	81	1	0	1
Connecticut	0	0	1	-------	1	1	1,011	636	342	0	1	1
MIDDLE ATLANTIC												
New York	9	29	8	[1] 1	[1] 2	[1] 2	711	3,745	1,268	7	14	21
New Jersey	5	4	4	5	3	2	573	3,575	713	2	6	6
Pennsylvania	9	11	11	(2)	(2)	(2)	285	1,639	715	4	5	13
EAST NORTH CENTRAL												
Ohio	9	6	4	5	3	3	799	888	315	2	5	14
Indiana	0	2	2	8	3	3	94	192	73	0	1	1
Illinois	3	11	11	6	7	7	340	585	401	12	5	10
Michigan [3]	5	6	6	-------	1	1	156	785	461	2	4	5
Wisconsin	0	3	1	9	22	21	648	1,776	1,431	5	3	3
WEST NORTH CENTRAL												
Minnesota	4	5	1	-------	-------	-------	714	93	309	1	1	1
Iowa	1	3	3	-------	-------	-------	381	244	105	0	0	0
Missouri	3	0	0	1	1	1	134	108	108	2	4	6
North Dakota	2	1	1	-------	-------	1	68	16	19	2	0	0
South Dakota	0	0	1	-------	-------	-------	39	12	12	0	0	0
Nebraska	1	0	2	-------	-------	-------	17	152	105	0	0	0
Kansas	4	13	3	8	2	-------	15	215	177	0	1	1
SOUTH ATLANTIC												
Delaware	0	0	0	-------	-------	-------	-------	24	10	0	3	0
Maryland [3]	7	13	6	2	-------	1	37	717	204	0	1	8
District of Columbia	0	1	1	1	-------	-------	7	137	60	0	0	1
Virginia	3	4	3	123	71	71	288	653	219	2	2	3
West Virginia	2	1	1	6	-------	-------	27	150	33	1	3	2
North Carolina	3	16	4	-------	-------	2	114	287	262	1	1	2
South Carolina	4	3	3	109	136	89	61	378	77	0	0	1
Georgia	1	2	3	1	7	6	62	64	37	1	1	2
Florida	1	5	2	5	2	2	95	93	71	0	1	1
EAST SOUTH CENTRAL												
Kentucky	8	5	2	-------	-------	-------	8	71	42	2	0	1
Tennessee	8	1	2	10	9	11	37	186	77	3	2	6
Alabama	0	5	2	8	23	18	110	157	71	1	3	2
Mississippi [3]	3	6	4	-------	-------	-------	11	-------	-------	0	4	3
WEST SOUTH CENTRAL												
Arkansas	5	1	4	9	21	12	39	131	68	0	0	0
Louisiana	3	0	1	6	1	1	27	34	34	1	0	0
Oklahoma	3	1	2	69	13	23	2	94	38	0	3	2
Texas	20	24	24	234	256	287	205	1,000	271	2	3	3
MOUNTAIN												
Montana	0	0	0	-------	-------	3	76	153	110	0	1	0
Idaho	0	1	0	5	8	2	19	58	29	0	0	0
Wyoming	1	0	0	-------	-------	-------	8	19	19	0	0	0
Colorado	3	4	8	4	3	22	36	303	151	1	0	0
New Mexico	1	1	1	5	1	1	75	61	12	0	0	0
Arizona	1	3	1	27	32	33	33	138	64	0	0	1
Utah [3]	0	0	0	2	-------	-------	107	212	212	0	0	1
Nevada	0	0	0	-------	-------	-------	1	1	4	0	0	0
PACIFIC												
Washington	1	6	4	-------	-------	1	28	116	223	0	0	2
Oregon	0	1	1	2	-------	7	7	205	105	1	1	1
California	7	27	17	20	8	42	312	1,762	1,762	3	11	11
Total	152	229	178	691	637	676	8,585	25,041	14,662	60	93	143
23 weeks	5,709	7,725	5,897	297,631	186,516	76,675	150,998	567,487	466,940	1,942	3,701	5,020
Seasonal low week [4]	(27th) July 5–11			(30th) July 26–Aug. 1			(35th) Aug. 30–Sept. 5			(37th) Sept. 13–19		
Total since low	13,275	19,369	14,743	330,606	548,764	112,537	173,885	593,611	504,953	2,914	5,205	7,472

[1] New York City only. [2] Philadelphia only.
[3] Period ended earlier than Saturday.
[4] Dates between which the approximate low week ends. The specific date will vary from year to year.

Telegraphic morbidity reports from State health officers for the week ended June 7, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever [5]		
	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46	Week ended—		Median 1942–46
	June 7, 1947	June 8, 1946		June 7, 1947	June 8, 1946		June 7, 1947	June 8, 1946		June 7, 1947 [3]	June 8, 1946	
NEW ENGLAND												
Maine	0	0	0	10	18	18	0	0	0	0	1	0
New Hampshire	0	0	0	8	17	9	0	0	0	0	0	0
Vermont	0	0	0	1	3	5	0	0	0	0	1	0
Massachusetts	1	0	0	72	112	251	0	0	0	0	0	4
Rhode Island	0	0	0	14	3	5	0	0	0	1	0	0
Connecticut	0	1	1	31	28	43	0	0	0	0	0	1
MIDDLE ATLANTIC												
New York	4	6	5	266	398	344	0	0	0	1	4	6
New Jersey	1	0	0	71	155	112	0	0	0	3	1	1
Pennsylvania	0	3	0	142	209	210	0	0	0	4	5	5
EAST NORTH CENTRAL												
Ohio	0	4	1	179	224	224	0	0	1	1	1	3
Indiana	0	1	1	40	37	54	1	0	0	1	3	1
Illinois	1	4	2	79	173	146	0	1	0	8	2	2
Michigan [3]	[6] 0	0	0	77	115	178	0	0	0	3	2	2
Wisconsin	0	0	0	55	76	151	0	0	0	0	0	1
WEST NORTH CENTRAL												
Minnesota	0	3	0	46	45	45	0	0	0	0	0	0
Iowa	1	1	0	8	33	28	0	1	0	0	0	0
Missouri	2	2	0	39	12	37	0	0	0	1	1	1
North Dakota	2	0	0	4	0	6	0	0	0	0	1	0
South Dakota	0	0	0	9	8	8	0	0	0	0	0	0
Nebraska	3	0	0	13	9	17	0	0	0	1	0	0
Kansas	0	7	0	14	23	24	0	1	0	0	0	1
SOUTH ATLANTIC												
Delaware	0	0	0	4	0	3	0	0	0	0	0	0
Maryland [3]	1	0	0	15	68	68	0	0	0	1	1	1
District of Columbia	1	0	0	13	13	13	0	0	0	0	0	0
Virginia	2	0	0	18	43	32	0	0	0	8	2	3
West Virginia	0	1	0	8	20	20	0	0	0	0	1	2
North Carolina	0	2	1	16	16	16	0	0	0	3	1	1
South Carolina	0	3	1	0	11	4	0	0	0	2	10	1
Georgia	0	1	0	2	7	9	0	0	0	3	5	5
Florida	1	33	1	1	2	2	0	0	0	1	2	4
EAST SOUTH CENTRAL												
Kentucky	2	0	0	12	16	23	0	0	0	2	6	5
Tennessee	2	3	1	18	11	24	0	0	0	4	1	3
Alabama	1	15	2	1	10	10	1	0	0	1	4	1
Mississippi [3]	0	1	1	3	5	5	0	0	0	1	0	0
WEST SOUTH CENTRAL												
Arkansas	0	1	1	3	4	4	0	0	1	4	5	5
Louisiana	0	9	3	4	5	4	0	0	0	4	4	4
Oklahoma	0	2	1	3	5	10	0	0	0	0	1	1
Texas	6	35	10	18	25	26	0	0	0	13	13	9
MOUNTAIN												
Montana	0	0	0	15	5	8	0	0	0	0	0	0
Idaho	0	0	0	2	2	7	0	0	0	0	2	0
Wyoming	0	0	0	1	10	10	0	0	0	0	0	0
Colorado	1	5	0	31	18	38	0	1	0	1	1	0
New Mexico	0	0	0	9	3	3	0	0	0	0	1	1
Arizona	0	1	0	7	4	8	0	0	0	0	1	1
Utah [3]	0	0	0	11	17	17	0	0	0	0	0	0
Nevada	0	0	0	0	0	0	0	0	0	0	0	0
PACIFIC												
Washington	1	1	1	26	19	20	0	0	0	0	0	0
Oregon	2	0	0	24	26	17	0	0	1	1	0	0
California	13	15	13	112	150	173	0	0	0	6	5	5
Total	48	160	60	1,555	2,213	2,294	2	4	6	79	88	104
23 weeks	[6] 1,000	1,193	659	55,740	77,487	87,636	136	238	251	1,164	1,268	1,425
Seasonal low week [4]	(11th) Mar. 15–21			(32d) Aug. 9–15			(35th) Aug. 30–Sept. 5			(11th) Mar. 15–21		
Total since low	390	725	357	82,426	116,058	125,957	190	314	368	679	793	840

[3] Period ended earlier than Saturday.
[4] Dates between which the approximate low week ends. The specific date will vary from year to year.
[5] Including paratyphoid fever reported separately, as follows: Indiana 1; Maryland 1; Virginia 2; Georgia 2; Texas 6; California 2.
[6] Correction: 17 of the 18 cases of poliomyelitis reported in Michigan for the week ended January 4 have been deducted from the previous totals, as they are stated to have been delayed reports of cases occurring in 1946.

Telegraphic morbidity reports from State health officers for the week ended June 7, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Whooping cough			Week ended June 7, 1947							
	Week ended—		Median 1942–46	Dysentery			Encephalitis, infectious	Rocky Mt. spotted fever	Tularemia	Typhus fever, endemic	Undulant fever
	June 7, 1947	June 8, 1946		Amebic	Bacillary	Unspecified					
NEW ENGLAND											
Maine	20	19	32								1
New Hampshire		5	2								
Vermont	3	38	32								6
Massachusetts	137	100	132	1	4						4
Rhode Island	39	28	28				1				
Connecticut	57	65	53		1						3
MIDDLE ATLANTIC											
New York	240	145	210	11	11		1			1	10
New Jersey	256	184	167					1			4
Pennsylvania	152	63	166					2			
EAST NORTH CENTRAL											
Ohio	171	72	128					1			2
Indiana	40	46	34					4			
Illinois	89	97	97	10			2	1	2		10
Michigan [3]	96	71	81	1							8
Wisconsin	134	100	100								4
WEST NORTH CENTRAL											
Minnesota	28	9	20						1		3
Iowa	126	14	14								
Missouri	50	13	20						1		1
North Dakota	1		3			1					
South Dakota	1							1			18
Nebraska	26	1	2								
Kansas	49	26	31						3		8
SOUTH ATLANTIC											
Delaware	2	1	1								
Maryland [3]	58	26	45			1		2			
District of Columbia	8	6	6								
Virginia	87	76	76			262	1	2			2
West Virginia	27	17	17					2			
North Carolina	98	108	158		1			1	2		
South Carolina	130	67	75	5	10					1	1
Georgia	39	5	21		1					2	11
Florida	41	27	19	1							3
EAST SOUTH CENTRAL											
Kentucky	36	33	55					2			
Tennessee	65	25	33			2			4		2
Alabama	42	45	45							4	1
Mississippi [3]	8								1	1	8
WEST SOUTH CENTRAL											
Arkansas	77		26	3		2			10		3
Louisiana	10		5	15	5				2	1	2
Oklahoma	39	8	9			1	1		1		
Texas	689	180	230	6	299	25			1	19	11
MOUNTAIN											
Montana	10	1	4					1			
Idaho	15	14	1								
Wyoming	1		2					1			
Colorado	36	19	25					1			1
New Mexico	23	10	7			2					
Arizona	29	17	11	1		16					
Utah [3]	13	12	42								1
Nevada											
PACIFIC											
Washington	15	29	29								2
Oregon	24	20	20			3					
California	310	44	274	2	1		2			2	6
Total	3,647	1,886	2,679	56	333	315	8	22	28	31	136
Same week, 1946	1,886			39	385	207	7	17	8	52	113
Median, 1942–46	2,679			39	385	172	13	18	18	52	[7] 104
23 weeks: 1947	66,958			1,122	6,861	4,557	152	104	709	835	2,429
1946	42,905			897	7,597	2,710	200	105	400	1,067	1,973
Median, 1942–46	57,437			721	6,740	1,909	201	105	400	1,067	[7] 2,018

[3] Period ended earlier than Saturday.
[7] 2-year average, 1945–46.

Anthrax: New York 1 case. *Leprosy*: Louisiana 1 case.
Alaska, week ended June 7: Chickenpox 6; measles 1.

WEEKLY REPORTS FROM CITIES [1]

City reports for week ended May 31, 1947

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.

Division, State, and City	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	1	0	31	1	1	0	3	0	0	7
New Hampshire:												
Concord	0	0	------	0	------	0	0	0	3	0	0	------
Vermont:												
Barre	0	0	------	0	3	0	1	0	0	0	0	------
Massachusetts:												
Boston	5	0	------	0	57	0	6	0	5	0	0	23
Fall River	0	0	------	0	13	0	0	0	2	0	0	1
Springfield	0	0	------	0	25	0	0	0	0	0	0	------
Worcester	0	0	------	0	23	0	7	0	3	0	0	13
Rhode Island:			------									
Providence	0	0		0	84	0	0	0	6	0	0	19
Connecticut:												
Bridgeport	0	0	------	0	53	0	3	0	1	0	0	3
Hartford	0	0	------	0	59	0	1	0	1	0	0	------
New Haven	0	0	------	0	88	0	0	0	5	0	0	11
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	------	0	------	1	4	0	5	0	0	1
New York	9	0	5	3	433	2	57	0	71	0	1	70
Rochester	1	0	------	0	------	0	5	0	10	0	0	9
Syracuse	0	0	------	0	------	0	0	0	10	0	0	15
New Jersey:												
Camden	0	0	------	0	------	0	1	0	2	0	0	1
Newark	0	0	------	0	6	0	2	0	11	0	1	53
Trenton	0	0	------	0	11	0	3	0	3	0	0	------
Pennsylvania:												
Philadelphia	3	0	1	0	32	1	15	0	25	0	0	34
Pittsburgh	0	0	------	0	11	1	4	0	6	0	0	8
Reading	0	0	------	0	1	0	0	0	4	0	0	------
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	1	0	------	0	2	0	3	0	6	0	0	2
Cleveland	1	0	1	1	130	1	6	0	35	0	0	46
Columbus	0	0	------	0	169	0	3	0	7	0	0	------
Indiana:												
Fort Wayne	0	0	------	0	1	0	1	0	0	0	0	------
Indianapolis	0	0	------	0	3	0	0	0	10	0	0	14
South Bend	0	0	------	0	27	0	0	0	3	0	0	1
Terre Haute	0	0	------	0	------	0	1	0	3	0		1
Illinois:												
Chicago	0	0	------	0	37	2	19	0	26	0	0	31
Springfield	1	0	------	0	------	0	2	0	1	0	0	------
Michigan:												
Detroit	0	0	------	0	1	0	13	0	33	0	0	78
Flint	0	0	------	0	------	0	1	0	2	0	0	------
Grand Rapids	0	0	------	0	8	0	2	0	10	0	0	8
Wisconsin:												
Kenosha	0	0	------	0	------	0	0	0	0	0	0	------
Milwaukee	0	0	------	0	32	1	4	0	6	0	0	31
Racine	0	0	------	0	1	0	1	0	15	0	0	7
Superior	0	0	------	0	------	0	0	0	1	0	0	------
WEST NORTH CENTRAL												
Minnesota:												
Duluth	0	0	------	0	1	0	0	0	3	0	0	1
Minneapolis	1	0	------	2	32	0	2	0	13	0	0	6
St. Paul	0	0	------	0	533	0	3	0	4	0	0	27
Missouri:												
Kansas City	0	0	------	0	1	0	0	0	5	0	0	7
St. Joseph	0	0	------	0	1	0	0	0	0	0	0	3
St. Louis	1	0	------	1	40	0	2	0	10	0	0	23

[1] In some instances the figures include nonresident cases.

City reports for week ended May 31, 1947—Continued

Division, State, and City	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	1	0	------	0	4	0	1	0	4	0	0	------
Kansas:												
Topeka	0	0	------	0	1	0	1	0	8	0	0	------
Wichita	0	0	------	0	------	0	1	0	1	0	1	6
SOUTH ATLANTIC												
Delaware:												
Wilmington	0	0	------	0	------	0	1	0	0	0	0	1
Maryland:												
Baltimore	3	0	1	1	27	0	2	0	9	0	0	82
Cumberland	0	0	------	0	------	0	1	0	0	0	0	------
Frederick	0	0	------	0	------	0	0	0	0	0	0	------
District of Columbia:												
Washington	0	0	------	0	10	1	5	0	4	0	0	22
Virginia:												
Lynchburg	0	0	------	0	1	0	1	0	0	0	0	1
Richmond	0	0	------	0	74	0	2	0	2	0	0	1
Roanoke	0	0	------	0	16	0	0	0	0	0	0	1
West Virginia:												
Wheeling	0	0	------	0	------	0	1	0	0	0	0	------
North Carolina:												
Raleigh	0	0	------	0	2	0	1	0	0	0	0	3
Wilmington	0	0	------	0	2	0	0	0	0	0	0	------
Winston Salem	0	0	------	0	11	0	0	0	0	0	0	------
South Carolina:												
Charleston	0	0	4	0	4	0	1	0	0	0	0	7
Georgia:												
Atlanta	0	0	------	0	9	0	0	0	0	0	0	------
Brunswick	0	0	------	0	------	0	0	0	0	0	0	------
Savannah	0	0	------	0	------	0	0	0	0	0	0	2
Florida:												
Tampa	1	0	------	0	1	0	1	0	0	0	0	5
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	0	0	------	0	6	1	7	0	2	0	0	24
Nashville	0	0	------	0	------	0	1	0	3	0	0	6
Alabama:												
Birmingham	0	0	5	1	6	0	3	0	0	0	0	6
Mobile	2	0	1	1	6	0	0	0	0	0	0	1
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0	------	0	------	0	0	0	0	0	0	3
Louisiana:												
New Orleans	1	0	2	0	34	0	3	0	4	0	0	6
Shreveport	1	0	------	0	------	0	2	0	1	0	0	------
Oklahoma:												
Oklahoma City	0	0	------	0	------	0	0	0	0	0	0	------
Texas:												
Dallas	1	0	------	0	107	0	2	0	1	0	0	7
Galveston	0	0	------	0	------	0	1	0	0	0	0	------
Houston	0	0	------	0	2	0	5	0	0	0	0	1
San Antonio	0	0	------	0	1	0	2	1	0	0	0	5
MOUNTAIN												
Montana:												
Billings	0	0	------	0	------	0	0	0	0	0	0	------
Great Falls	0	0	------	0	3	0	0	0	2	0	0	4
Helena	0	0	------	0	1	0	0	0	0	0	0	------
Missoula	0	0	------	0	3	0	1	0	0	0	0	------
Colorado:												
Denver	2	0	1	0	9	0	2	0	11	0	0	15
Pueblo	0	0	------	0	------	0	1	0	0	0	0	9
Utah:												
Salt Lake City	0	0	------	0	------	0	1	0	1	0	0	6

City reports for week ended May 31, 1947—Continued

Division, State, and City	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	1	0	------	0	4	0	1	0	5	0	0	8
Spokane	0	0	------	0	------	0	0	0	3	0	0	5
Tacoma	0	0	------	0	------	0	0	0	0	0	0	------
California:												
Los Angeles	3	0	2	1	5	1	3	6	22	0	0	31
Sacramento	0	0	------	0	1	0	0	0	1	0	0	7
San Francisco	2	0	1	0	8	0	7	1	3	0	0	3
Total	41	0	25	11	2,307	13	234	8	456	0	3	832
Corresponding week, 1946*	70	------	18	13	5,775	------	270	------	752	0	13	441
Average 1942–46*	61	------	36	[2] 12	[3] 4,888	------	[2] 280	------	1,068	1	15	785

[2] 3-year average, 1944–46.
[3] 5-year median, 1942–46.
*Exclusive of Oklahoma City.
Anthrax.—Cases: Philadelphia 1.
Dysentery, amebic.—Cases: New York 4; Chicago 2; Detroit 1; Baltimore 1; New Orleans 4; San Francisco 1.
Dysentery, bacillary.—Cases: New York 1; Charleston, S. C., 4; New Orleans 1; San Antonio 1.
Dysentery, unspecified.—Cases: Indianapolis 1; San Antonio 3.
Rocky Mt. spotted fever.—Cases: Philadelphia 1.
Typhus fever, endemic.—Cases: Los Angeles 1.

Rates (annual basis) per 100,000 population, by geographic groups, for the 88 cities in the preceding table (latest available estimated population, 34,500,700)

	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	13.1	0.0	2.6	0.0	1,140	2.6	49.7	0.0	76	0.0	0.0	201
Middle Atlantic	6.0	0.0	2.8	1.4	229	2.3	42.1	0.0	68	0.0	0.9	88
East North Central	1.8	0.0	0.6	0.6	250	2.4	34.1	0.0	96	0.0	0.0	133
West North Central	6.0	0.0	0.0	6.0	1,233	0.0	20.1	0.0	97	0.0	2.0	147
South Atlantic	6.7	0.0	8.4	1.7	263	1.7	26.8	0.0	25	0.0	0.0	209
East South Central	11.8	0.0	35.4	11.8	106	5.9	64.9	0.0	30	0.0	0.0	218
West South Central	7.6	0.0	5.1	0.0	366	0.0	38.1	2.5	15	0.0	0.0	56
Mountain	16.5	0.0	8.3	0.0	132	0.0	41.3	0.0	116	0.0	0.0	281
Pacific	9.5	0.0	4.7	1.6	28	1.6	17.4	11.1	54	0.0	0.0	85
Total	6.2	0.0	3.8	1.7	350	2.0	35.5	1.2	69	0.0	0.5	126

Puerto Rico

Notifiable diseases—5 weeks ended May 3, 1947.—During the 5 weeks ended May 3, 1947, cases of certain notifiable diseases were reported in Puerto Rico as follows:

Disease	Cases	Disease	Cases
Chickenpox	92	Syphilis	221
Diphtheria	52	Tetanus	18
Dysentery, unspecified	9	Tetanus, infantile	2
Gonorrhea	241	Tuberculosis (all forms)	919
Influenza	141	Typhoid and paratyphoid fever	16
Malaria	204	Typhus fever (murine)	7
Measles	9	Whooping cough	65
Poliomyelitis	2		

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended May 17, 1947.—During the week ended May 17, 1947, 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		19		142	266	30	40	33	25	555
Diphtheria		1		23	1		3			28
Dysentery, bacillary				3						3
Encephalitis, infectious							1			1
German measles				50	55	6	6	5	9	131
Influenza		3			7	10			26	46
Measles	66	32	5	70	252	248	36	100	112	921
Meningitis, meningococcus					1			1		2
Mumps		28		52	360	25	42	10	121	638
Poliomyelitis			1							1
Scarlet fever		1	4	42	95	3	2	7		154
Tuberculosis (all forms)		6	10	105	41	30	20	33	40	285
Typhoid and paratyphoid fever		1	1	5	2				4	13
Undulant fever				6	3					9
Venereal diseases:										
Gonorrhea		9	10	42	95	(1)	34	37	77	304
Syphilis		16	1	147	52	(1)	4	12	40	272
Other forms						(1)			4	4
Whooping cough			1	10	146	30		8	31	226

[1] Report from Manitoba for the current period not received.

WORLD DISTRIBUTION OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

From consular reports, international health organizations, medical officers of the Public Health Service, and other sources. The reports contained in the following tables must not be considered as complete or final as regards either the list of countries included or the figures for the particular countries for which reports are given.

CHOLERA

[C indicates cases]

NOTE.—Since many of the figures in the following tables are from weekly reports, the accumulated totals are for approximate dates.

Place		January–March 1947	April 1947	May 1947—week ended—				
				3	10	17	24	31
ASIA								
Burma	C	93	25	10	2	29		
Moulmein	C	12	10	4	2	7		
China: Formosa (Island of)	C	14						
India	C	14,848	13,810					
Calcutta	C	[1] 815	1,359	232	[1] 158	[1] 141		
Cawnpore	C	6	2	1	1	1	1	
Chittagong	C	[2] 1	[2] 1	[1] 2	2		[2] 1	
Lucknow	C	2	1					
Madras	C	2						
India (French)	C	41	3					

[1] Includes imported cases.

[2] Imported.

CHOLERA—Continued

Place		January–March 1947	April 1947	May 1947—week ended— 3	10	17	24	31
Indochina (French):								
Cambodia	C	230			[3] 17			
Cochinchina	C	124	50					[4] 71
Bien Hoa	C		1					
Cholon	C	14	8				[5] 8	
Giadinh	C	11						
Longxuyen	C	6						
Mytho	C		3					
Rachgia	C	11	7				[5] 1	
Saigon	C	78	19	12	6	7	6	
Vinh-long	C	4	3					
Siam (Thailand)	C	1,522	200	33		20	3	
Bangkok	C	338	176	33		20	3	

[3] For the period May 1–10, 1947.
[4] For the period May 1–20, 1947.
[5] For the period May 11–20, 1947.

PLAGUE

[C indicates cases]

AFRICA								
Belgian Congo	C	[1] 5	4					
British East Africa:								
Kenya	C	12	10					
Uganda	C	1						
Egypt: Alexandria	C			2				
Madagascar	C	139	12					
Union of South Africa	C	19						
ASIA								
Burma	C	1,124	26	1	1	2		
Bassein	C	[2] 2						
Mandalay	C	17						
Rangoon	C	8	4					
China:								
Chekiang Province	C	13						
Fukien Province	C	255	6					
Amoy	C		6					
Kiangsi Province	C	19	24					
Nanchang	C	7	22					
Kiangsu Province: Shanghai	C	28						
Kwangtung Province	C	1						
Yunnan Province	C	16						
India	C	50,131	14,521					
Indochina (French):								
Annam	C	3	14		[3] 3			
Cochinchina	C	3			[3] 6			
Java	C	[4] 33	3					
Palestine	C	1						
Siam (Thailand)	C	31						
Syria	C		6					
Turkey: Akcakale	C	5	13					
EUROPE								
Portugal: Azores	C	1						
Turkey (see Turkey in Asia).								
SOUTH AMERICA								
Argentina: Santa Fe Province	C	2						
Ecuador:								
Chimborazo Province	C	2						
Loja Province	C	2						
Peru:								
Lambayeque Department	C		4					
Libertad Department	C	8						
Lima Department	C	12						
Piura Department	C	58	19					
OCEANIA								
Hawaii Territory: Plague infected rats [5]		1						

[1] Includes 4 cases of pneumonic plague.
[2] Imported.
[3] For the period May 1–10, 1947.
[4] Includes imported cases.
[5] Plague infection was also reported in Hawaii Territory as follows: On Jan. 9, 1947, in a pool of 31 rats; on Mar. 20, 1947, in a pool of 32 fleas collected from 59 rats.

SMALLPOX

[C indicates cases; P, present]

Place		January–March 1947	April 1947	May 1947—week ended—				
				3	10	17	24	31
AFRICA								
Algeria	C	85						
Basutoland	C	1						
Bechuanaland	C	14						
Belgian Congo	C	[1] 306	[1] 250	37				
British East Africa:								
Kenya	C	155	63	16				
Nyasaland	C	344	79	5	10	3	7	
Tanganyika	C	711	40	21	46			
Uganda	C	99	10	5	2			
Cameroon (French)	C	15						
Dahomey	C	30	18				[2] 25	
Egypt	C	243	91	20				
Ethiopia	C	17	2					
French Equatorial Africa	C	3						
French Guinea	C	122	34					
Gambia	C		4		1			
Gold Coast	C	460	19	2	33			
Ivory Coast	C	618	195		[3] 61			
Liberia	C	35			2			
Libya	C	1,116	239	79	96	60		
Mauritania	C	22						
Morocco (French)	C	43	8		[3] 3			
Morocco (Int. Zone)	C	12						
Morocco (Spanish)	C	15						
Nigeria	C	2,110						
Niger Territory	C	994	394					
Portuguese Guinea	C	3						
Rhodesia:								
Northern	C	6						
Southern	C	[4] 4	2					
Senegal	C	10	2					
Sierra Leone	C	120	2					
Sudan (Anglo-Egyptian)	C	[1] 26	[1] 29	8		11		
Sudan (French)	C	239	26					
Swaziland	C	10						
Togo (French)	C	77	8					
Tunisia	C	450	41					
Union of South Africa	C	267	P	P	P	P		
ASIA								
Burma	C	1,639	437	79	136	78		
Ceylon	C	1						
China	C	1,286	508	128	112	152	69	
India	C	16,918	12,111					
India (French)	C	8	1					
India (Portuguese)	C	3						
Indochina (French)	C	844	211		[3] 187			
Iran	C	21	4					
Iraq	C	6			3			
Japan	C	183	61	9	25			
Korea [5]	C	95	30					
Malay States (Federated)	C	2,174	319	52				
Manchuria	C	4						
Siam (Thailand)	C	642	64	1				
Straits Settlements	C	91	4		1	1		
Syria	C	1	1					
Turkey (see Turkey in Europe).								
EUROPE								
Belgium	C		[1] 19	3				
France	C	32	3		1			
Germany	C	11	1					
Great Britain: England and Wales	C	18	15	1	2	8	6	9
Italy	C	46						
Luxemburg	C				1			
Portugal	C	7		1				
Spain	C	16	2					
Turkey	C	2						

[1] Includes alastrim.
[2] For the period May 11–20, 1947.
[3] For the period May 1–10, 1947.
[4] Includes 1 imported case.
[5] Smallpox has also been reported in Korea as follows: Nov. 1946, 45 cases; Dec. 1946, 41 cases.

SMALLPOX—Continued

Place		January–March 1947	April 1947	May 1947—week ended— 3	10	17	24	31
NORTH AMERICA								
Guatemala	C	3				2		
Mexico	C	64						
SOUTH AMERICA								
Argentina	C	2						
Brazil	C	[1] 22	2	1				
Colombia	C	565	326					
Ecuador	C	49	50					
Paraguay	C	[1] 88	[1] 11					
Peru	C	117						
Uruguay	C		[6] 183					
Venezuela	C	[1] 323	[1] 129	35	63	185	67	

[1] Includes alastrim. [6] For the period Jan. 1 to Apr. 23, 1947.

TYPHUS FEVER *

[C indicates cases; P, present]

AFRICA								
Algeria	C	113						
Basutoland	C	3						
Belgian Congo	C	149	33	5				
British East Africa:								
Kenya	C	4	1					
Uganda	C	1						
Egypt	C	37	10					
Eritrea	C	291	66	15				
Ethiopia	C	31	9					
French West Africa [1]	C	2						
Gold Coast	C	2						
Libya	C	64	11	1	3	16		
Morocco (French)	C	80	11		1			
Morocco (International Zone)	C	5						
Morocco (Spanish)	C	18						
Nigeria	C	3						
Tunisia	C	174	209					
Union of South Africa	C	113	P	P	P			
ASIA								
Arabia	C		1					
Burma	C	3						
China [2]	C	30	14			1		
India	C	6						
Indochina (French): Annam	C				2			
Iran	C	87	16					
Iraq	C	56	32	8	5	4	11	
Japan	C	500	138	14	20			
Java	C	1						
Korea [3]	C	917	344					
Malay States (Federated)	C	9						
Palestine [2]	C	14	14		8	3		
Straits Settlements	C	[4] 2						
Syria	C	8	10	9	1			
Trans-Jordan	C	5	3		1			
Turkey (see Turkey in Europe).								
EUROPE								
Austria	C	1	1	1			1	
Bulgaria	C	369	27					
Czechoslovakia	C	6	5	2				
France	C	3						
Germany	C	7	1	1				
Great Britain: Malta and Gozo [1]	C	3	1					
Greece [2]	C	65	22	5	17	4	1	
Hungary	C	306	104	38	21	16	20	
Italy	C	10						
Sicily	C	7						
Netherlands	C	1						
Poland	C	204	42					
Portugal	C	1	1					
Rumania	C	6,590	3,457					

*Reports from some areas are probably murine type, while others probably include both murine and louse-borne types.

For footnotes, see page 968.

TYPHUS FEVER*—Continued

Place		January-March 1947	April 1947	May 1947—week ended—				
				3	10	17	24	31
EUROPE—continued								
Spain	C	28	30					
Switzerland [1]	C	1	1					
Turkey	C	297	45	10	8	8	5	
Yugoslavia	C	35						
NORTH AMERICA								
Costa Rica [1]	C	46	28	5	3	5		
Cuba [1]	C	2	2					
Guatemala	C	112				3		
Jamaica [1]	C	11	1		1			
Mexico	C	581						
Panama Canal Zone	C	5	1					
Panama (Republic)	C	[4] 16						
Puerto Rico [1]	C	7	6	1	2	3		
SOUTH AMERICA								
Argentina	C	6						
Brazil	C		1					
Chile [2]	C	114						
Colombia	C	424	130					
Ecuador [2]	C	152	51					
Peru	C	287						
Venezuela [2]	C	16						
OCEANIA								
Australia [1]	C	32	12					
Hawaii Territory [1]	C	9						

*Reports from some areas are probably murine type, while others probably include both murine and louse-borne types.

[1] Murine type.
[2] Includes cases of murine type.
[3] Typhus fever was also reported in Korea as follows: Nov. 1946, 93 cases; Dec. 1946, 117 cases.
[4] Includes imported cases.

YELLOW FEVER

[C indicates cases; D, deaths]

Place								
SOUTH AMERICA								
Colombia:								
Antioquia Department	C	3						
Caldas Department	D	3						
Cundinamarca Department	D	2						
Santander Department	D	25						
Tolima Department	D	2						

×