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MECHANICAL AIDS FOR STREAM SURVEYS

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Man's material gains and accomplishments are largely due to his ability in devising, adapting, and using tools as aids to help him in going about his work. Such tools have ranged from the first stone, crudely used as a hammer or a weapon, to the modern complex precision machine tools and marvelously delicate scientific apparatus now in everyday use. No matter how simple, how complex, or how delicate the device may be, it is merely a tool which, when properly applied, aids in the accomplishment of a task.

As in all other fields of human endeavor, stream surveys require the devising, adoption, and use of tools in order to obtain part of the data from which the final conclusions are drawn. As is usually the case with all finished products, the attention of the beholder is upon the end result and there is little or no thought given to the role played by the devices, without the aid of which, perhaps, some of the data might not have been obtained. It is the purpose of this paper to describe some of the devices used by the Public Health Service in connection with the Ohio River Pollution Survey and with other stream surveys of the United States Public Health Service, and to show their place in the accumulation of laboratory data.

WATER SAMPLING DEVICES

An important part of a stream survey is the analysis of a considerable number of samples from various points along the stream under study. The analysis of these stream samples, supported by physical data, is the basis from which the conclusions as to the condition of the stream are drawn. It is obvious, then, that these samples must be collected with the utmost care and should be representative of the waters at the place and time of collection. The usual analyses are physical, chemical, and biological, including bacteriological tests.

For the collection of samples in small, shallow streams, no special apparatus may be involved, the samples being taken directly into the sampling bottles and reliance being placed on the technique of collection, the details of which are not here described. In the case

of samples for dissolved oxygen determination, the simplest sampling device may consist merely of a two-holed stopper inserted into the neck of the collection bottle and fitted with two tubes, one extending to the bottom of the bottle and the other extending a short distance above the stopper and acting as an air vent. A further extension of this device is so constructed that several samples may be taken at the same time. Illustrated is one of these samplers as developed for use in the Ohio River Pollution Survey (fig. 1). It consists of a central pole at the bottom of which is arranged a holder for three bottles, one bacteriological sample bottle and two dissolved oxygen sample bottles. A sliding wire rod with a clip at the end is attached to one side of the central pole and arranged to permit raising the stopper of the bacteriological sample bottle slightly after the sampler is in place. This allows the bottle to be filled and permits the reinsertion of the stopper immediately after the bottle has been filled. The dissolved oxygen samples are collected by inserting stoppers equipped as previously described with water inlet and air exhaust tubes into the necks of the dissolved oxygen sample bottles and allowing them to fill completely upon submergence.

In the deeper and larger streams, sampling becomes more difficult. The streams become too deep and wide for wading and for the use of shallow depth samplers. For these conditions sampling devices have been made which are capable of operation from a boat or from a bridge and which are arranged to collect several samples simultaneously. Essentially, this type of sampler consists of a suitably weighted metal can with a tight fitting cover, an inside rack for holding the sample bottles, water inlet tubes for the dissolved oxygen sample bottles, an arrangement for the insertion of a sterilized water inlet tube to the bacteriological sample bottle, and an air outlet from the can which may or may not be valved to permit the collection of samples at given depths. The sampling can usually has a capacity such that the water in the dissolved oxygen sampling bottles is displaced several times before the can becomes filled to the level of the air vent. The air vent level and bottle holder are adjusted so that the filling stops when the water level in the can reaches the shoulder of the bacteriological bottle, while just completely submerging the dissolved oxygen bottles. This arrangement protects the bacteriological sample from contamination by the overflow from the dissolved oxygen bottles and from the sampling can, and at the same time assures the complete filling of the dissolved oxygen sampling bottles. Details of this type of sampler are shown in figures 2 and 3. Figure 2 is the sampler used on the Illinois River study (1921–22) and figure 3 shows the type used on the Ohio River Pollution Survey in 1939–40.

This type of sampler is used in all streams where there is sufficient depth of water to allow complete submergence of the can and water

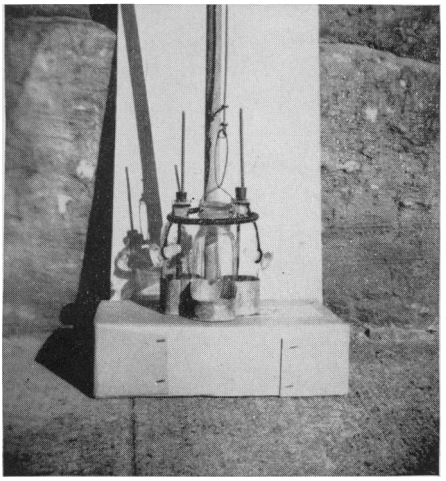


FIGURE 1.—Shallow depth sampler (sampling stick) ready for use.

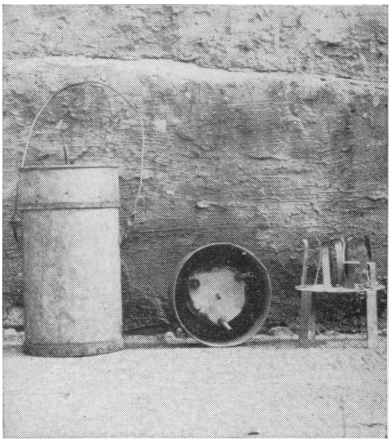


FIGURE 2.—Illinois River Survey sampler.

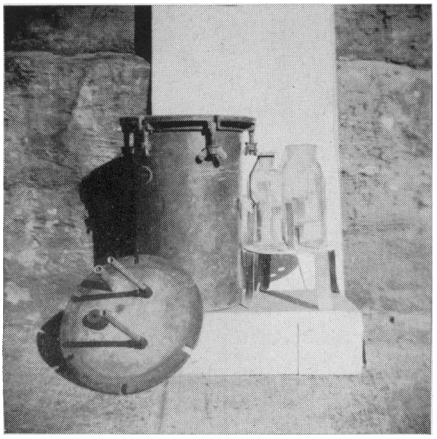


FIGURE 3.—Ohio River Pollution Survey sampling can.

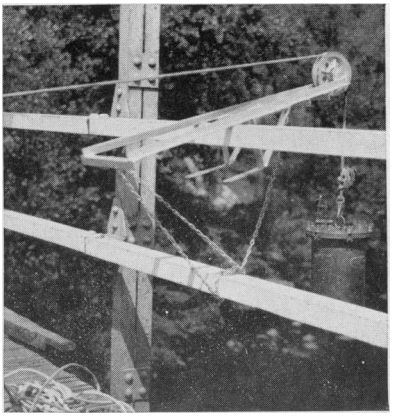


FIGURE 4.—Bridge hoist for raising sampling cans.

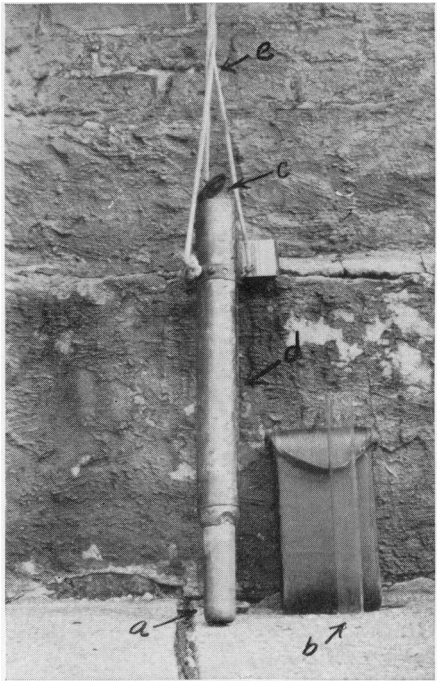


FIGURE 5.—Bottom sampler. (a) Steel tube; (b) glass cylinder for sample; (c) free-acting flap valve; (d) lead casing for added weight; (e) lifting rope.

FIGURE 6.—Purdy mud scoop, showing method of action.

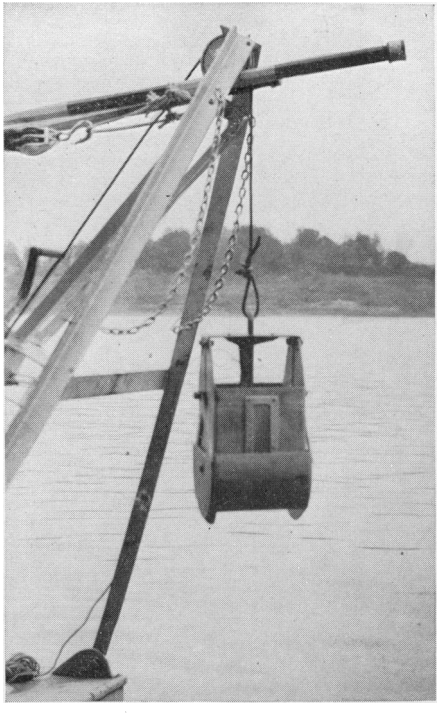


FIGURE 7.—Ohio River Pollution Survey bottom sediment sampler suspended from derrick and ready to descend.

inlet tube. A possible improvement, particularly where the sampling can has an air release valve permitting sampling at various depths, would be the addition of a vane or rudder to keep the can from twisting in the current and fouling the air valve release line; or, better, the suspension of the sampler by means of a spring arrangement which would permit the air valve to be opened by means of a sharp jerk on the lifting line when the desired depth has been reached. This would obviate the need of more than one line to the sampling can.

In those instances where bridges, used as sampling points, are high above the water elevation, as is the case with most navigable streams, it is difficult to hoist the filled sampler hand over hand for a vertical distance which may be 80 feet or more. Portable sample hoisting equipment has been devised for such cases. This hoist, shown in figure 4, consists of an A-frame designed to permit its attachment to the bridge railing and is held in place by light chains fore and aft. The rope to the sampler is passed through the pulley on the overhanging end.

MUD SAMPLING DEVICES

The examination and analysis of bottom sediment samples is of much interest and value in connection with stream surveys. The present methods of obtaining representative samples of bottom materials leave much to be desired. It is not the province of this article to deal with the actual difficulties and problems of collecting representative bottom deposit samples, but only to describe some of the devices which can be and have been utilized for this purpose.

Ordinary core drilling apparatus of reasonably large diameters might well be used for obtaining a picture of the nature and disposition of the bottom deposits. The high cost of this type of work and the more or less elaborate equipment necessary makes the use of such methods out of the question for the usual stream survey.

A device which consists essentially of a heavily weighted and sharpened tube which is dropped to the bottom and which may or may not be driven to refusal with a weighted hammer operating along the lifting cable can be used in streams where a clay bottom is present; the clay forms a tight plug in the bottom of the tube and thus retains the sample as the tube is raised to the surface. Figure 5 shows a sampler of this type.

In this sampler an open ended glass tube is inserted into the weighted steel shell and rests on a ledge above the cutting edge. This glass container receives the core sample. A stopper is placed in the upper end of the glass tubing after the sampler is raised to the surface and the tube is removed from the shell by inverting the sampler and pushing the glass container out by means of a suitable ramrod.

Various types of weighted scoops may be used to dredge up samples of bottom deposits. Such a scoop was designed by Special Expert W. C. Purdy, of the United States Public Health Service, for use in the Illinois River and on other stream surveys of the Public Health Service. This scoop is thrown out into the stream and, owing to the weighting on the handle, falls into a position on the bottom as shown in figure 6 so that the cutting edges on the sides will dredge up a sample when the scoop is hauled into the boat or to the shore.

The Richardson dredge has also been used for obtaining bottom sediments. This dredge is essentially a clam-shell bucket constructed of heavy gage sheet metal. The bucket is closed on submergence by means of a strong spring and a sample of the bottom deposit is caught up by the dredge. This dredge will not operate well in very stiff or heavy materials.

An adaptation of the clam-shell dredge was worked out for the Ohio River Pollution Survey by the present writer. A rugged bucket was constructed of heavy boiler plate with an upper box section to receive the dredged material. The sides of the bucket were equipped with transparent windows of thick cellulose acetate so that the captured material could be observed for stratification before emptying the bucket. This apparatus can be operated in very stiff materials such as clays as well as in softer bottom sludges, and will bring up a sizable portion for analysis—one-half cubic foot or more under favorable conditions. Gravel is not so readily brought up by this bucket unless it is intermixed with clay, sand, or silt. Because of its weight (about 100 pounds when empty), some sort of derrick and winch equipment is necessary for handling the bucket, as shown in figure 7. As first designed, this bucket contained a rather deep chamber for receiving the dredged materials. This was found unnecessary for ordinary work as the bucket did not take a large enough "bite" to utilize the full-bucket depth. Also, the deep reservoir raised the center of gravity of the dredge so as to cause it to fall on the side at times and thus miss a collection. This often necessitated several attempts before a sample was obtained. Changes made in the original design cut down the height of the reservoir and made the apparatus easier to handle. The revised design works much better and faster and brings up a good sample.

For the rapid examination of the surface layer of river bottom deposits a special light-weight sampler was devised by the writer for use in the Ohio River Pollution Survey. A somewhat similar but more elaborate device for the same sort of work was described in the Annual Report of the Metropolitan Water Board (London) for 1938. The Ohio River sampler was built of standard brass pipe fittings and structural shapes. The construction is such that when the sampler is suspended freely at the end of the lifting cable with the cup and

scraper in the open position it remains in such a position during descent until the base plate comes to rest on the bottom. A further slacking of the lifting cable permits a free-moving, slightly conical, heavy bronze wedge to drop of its own weight and the cup and scraper are forced together by the steel springs. This action scrapes a portion from the upper layer of the deposit and forces it into the cup.

Upon hauling upon the line for the return trip, a concave depression in the top of the wedge engages the roller lugs on the operating arms and holds the jaws tightly closed against a sponge rubber gasket while the sampler is being lifted. The cup and scraper are adjusted in relation to the base plate so as to remove a sample from the top half inch or so of the bottom deposit when the base plate is resting on the surface of the bottom deposit. Details of this sampler are shown in figure 8. Tests of this apparatus show that it is useful in making a rapid survey of bottom materials. The apparatus seems to work equally well in clay, sand, small gravel, silt (except in suspensions), and in various combinations of these substances. About 100 to 150 ml. of material is brought up in each sample.

LABORATORY EQUIPMENT

It is often necessary to devise special equipment to assist in laboratory analysis of the samples as well as in collection. A description of some of the special apparatus constructed for the analysis of river muds in the Ohio River Pollution Survey might be of interest.

To obtain the sand or grit content of mud samples, an upward flow washer has been devised which washes a portion of the sample free from silt and light suspended matter (fig. 9). This washer consists of a glass tube 2½ inches in diameter containing a home-made diffusing apparatus in the lower end to distribute the wash water flow uniformly and to prevent streaming, and a rate-of-flow meter by which the wash rate may be gauged. In operation, a known portion of the sample is placed in the tube above the diffuser, and, after the upper stopper and outlet drain have been replaced, wash water is introduced from the bottom at a predetermined rate and is permitted to flow until the effluent becomes clear. The water remaining in the washer is then drained off through a bypass valve in the bottom and the grit and other heavy materials are removed from the washer for measurement.

In order to determine the biochemical oxygen demand of the bottom sediment samples by the dilution method, it is desirable to keep that portion of the mud in each test bottle in continual suspension so as to prevent anaerobic conditions which might otherwise occur in the underlying portions if the mud were allowed to settle to the bottom of the bottle and remain undisturbed. To achieve this, a special container was built in which the samples were placed while undergoing

incubation for the required period. This container consists of a wooden box (fig. 10) made of ¾-inch plywood with hinged covers over each row of bottles. The bottles are separated from each other by ¼-inch plywood "egg crate" partitions. This entire box, holding 56 bottles, is fitted at each end with a short section of steel shaft and suspended on bearings so as to rotate freely about its central axis. By means of suitable gearing and pulley arrangements the speed of rotation is fixed at about 1 r. p. m. when driven by a standard 1,750 r. p. m., ⅛ horsepower electric motor. This gives sufficient agitation to keep the materials in each bottle in suspension and thus maintain aerobic conditions in each bottle up to the limit of the oxygen content of the dilution water. The entire mechanism is installed within a 20° C. constant temperature room.

MOBILE LABORATORY UNITS

Among mechanical aids to stream surveys, we may consider mobile laboratory units. The mobile unit permits the laboratory procedure to be brought to the stream and increases greatly the area of operation beyond that which would be possible from a single fixed laboratory. The experience of the Public Health Service in the operation of 6 such units over the entire Ohio River Basin (2 units in 1939 and 4 additional units in 1940), for both routine and special work, has shown that such units have a definite place in stream survey operations and that they are well adapted to rapid and reliable work. Figure 11 shows a typical unit in operation during the Ohio River Pollution Survey in 1940.

No less an aid than the mobile trailer laboratory is the floating laboratory for larger streams. The advantages of such equipment in this work are only too obvious.

The floating laboratory boat "Kiski" (a reconditioned and remodeled U. S. Army Engineer Department quarter boat) shown in figure 12, used by the Public Health Service on the Ohio River Survey, is somewhat unique. It is constructed upon a steel barge and is fitted with complete laboratory equipment, including its own power plant and heating equipment. Figure 13 shows the floor plan and laboratory arrangements for the "Kiski." Samples are supplied to the "Kiski" by both motor boat and automobile collection agencies. Owing to the completeness of the laboratory, a wide range of work can be carried out, comparable in scale to that of a fixed land laboratory. The reach is confined to a field of approximately 60 to 75 miles from the boat. The laboratory is towed from one location to the next as the progress of the survey may require. Here again, our experience with this piece of equipment has been most satisfactory.

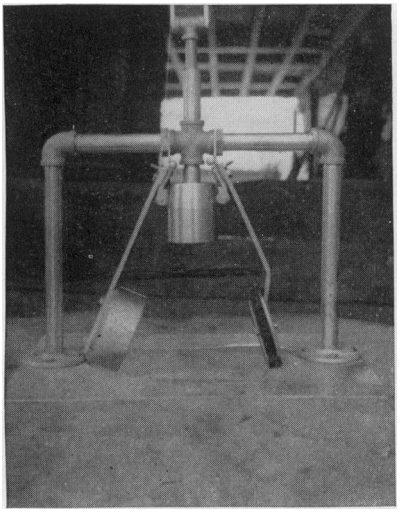


FIGURE 8.—Surface sampler for bottom deposits.

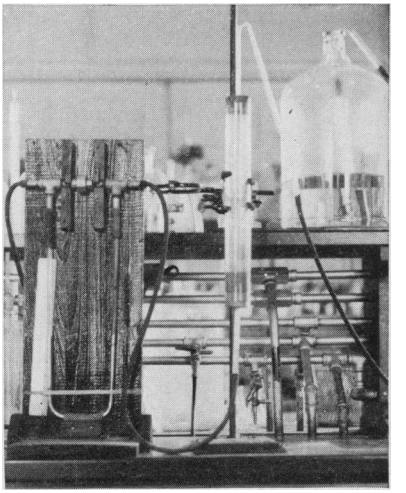


FIGURE 9.—Grit washer.

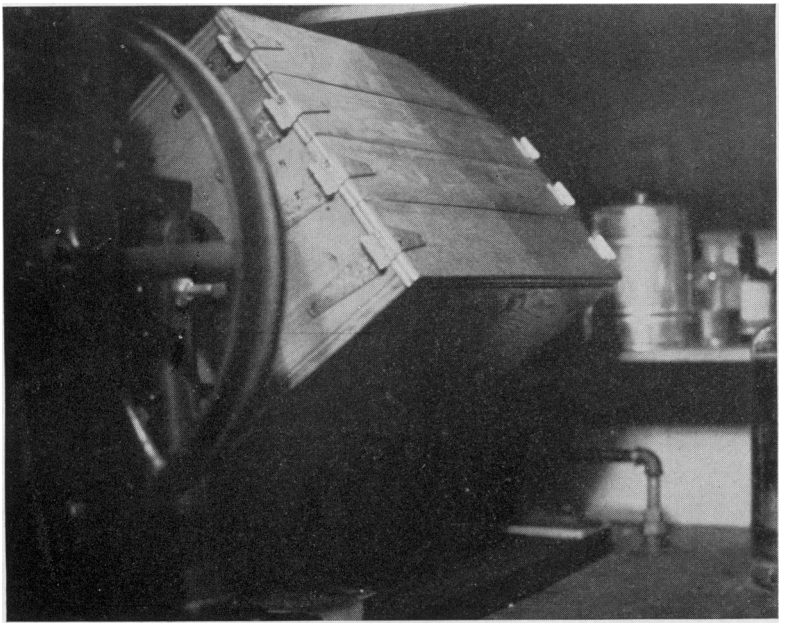


FIGURE 10.—B. O. D. agitation box.

FIGURE 11.—Mobile laboratory unit in operation at the Harlan, Ky., water plant (Ohio River Pollution Survey, 1940).

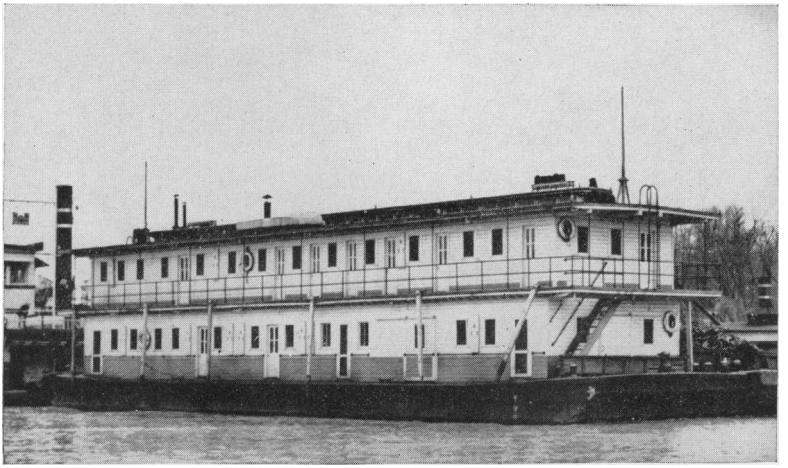
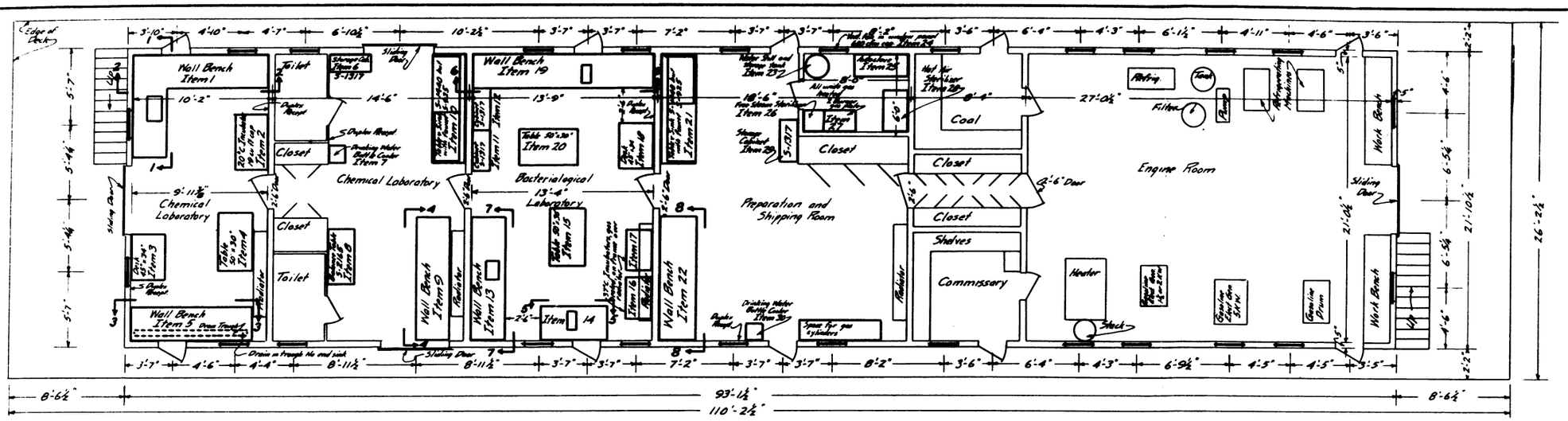
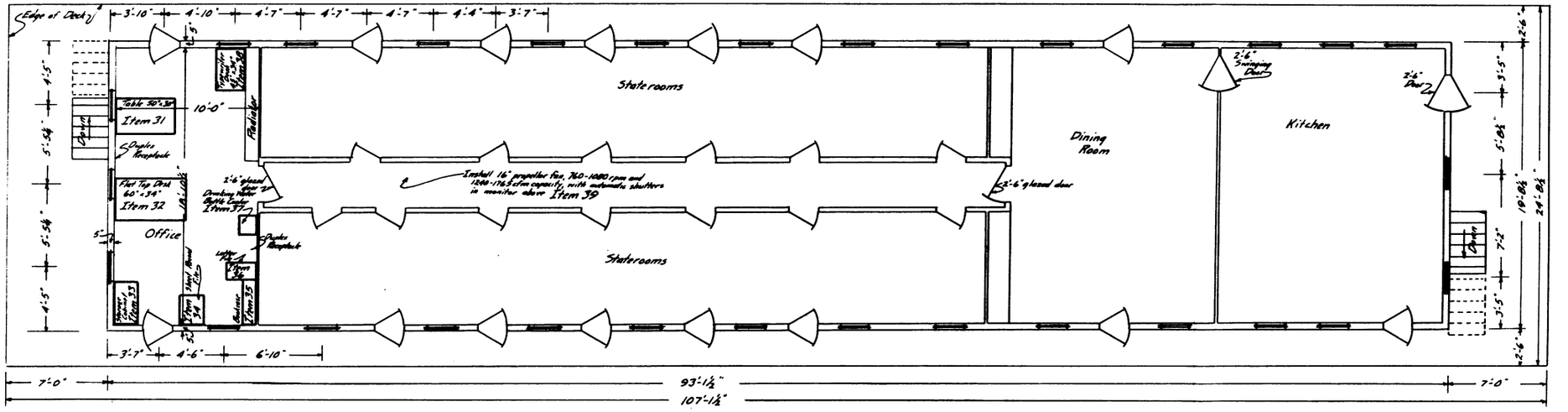


FIGURE 12.—Laboratory boat "Kiski."



MAIN DECK PLAN

NOTE:
All doors 2'-0" wide except as noted
All windows 2'-0" wide
Gas, Water and Electric lines shall be run under upper deck beams and down to benches entering benches either under recessed shelves or through end panels
Drain lines shall pass through main deck and connect to existing drains in hold.
Catalogue nos. (5-1317 etc.) shown for various items refer to Government Catalogue of Metal Laboratory Furniture and are for descriptive and dimensional purposes only.



UPPER DECK PLAN

U.S. Public Health Service
Stream Pollution Investigations Sta
Cincinnati, Ohio
FLOATING LABORATORY
(U.S.E.D. Quarterboat "Kiski")
FLOOR PLANS
Oct. 20, 1938
Scale: ¼" = 1'-0"

SHEET 1 OF 2 SHEETS

(Face p. 820)

FIGURE 13.—Floor plan of laboratory boat "Kiski."

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OTHER EQUIPMENT AND APPARATUS

In addition to the equipment and apparatus which must of necessity be built to suit each job in hand, there is constant development and improvement taking place in laboratory apparatus and techniques which tend to make the results more accurate and which may make possible the routine use of determinations not previously found practical.

We must pay our respects to the multitude of ordinary laboratory apparatus and equipment in daily use which we take for granted quite without thought as to the possible difficulties involved should such equipment not be available, to the automobile as well as other improved methods of transportation and communication which have so greatly increased our working range and efficiency, and, finally, to the computing machines and typewriters which speed up our computations and record our results.

THE NEED OF TRAINED AND SKILLED PERSONNEL

It cannot be too strongly stressed that these many and varied tools have but little value unless they can be intelligently applied by competently trained and reliable personnel who are interested in and skilled at the work in which they are engaged. In this respect, stream studies are no different than other forms of human endeavor which require trained and skilled operators. The deft and sure movements of the skilled worker often make the task look easy to the uninitiated and tend to minimize in the eyes of the observer the actual value of the time and effort spent in the education and training of that worker. The constant improvements being made in apparatus and equipment are generally directed towards the reduction of the amount of human skill and knowledge necessary to accomplish a task accurately. This serves to reduce human effort and at the same time to standardize the accuracy of the output. Many operations can thus be carried out with great accuracy by nontechnically trained but skilled machine operators, leaving the technically trained personnel available for work not as yet adapted to machine methods. While many phases of laboratory operations have become "streamlined" and "mechanized" so that the technician is largely a skilled and specialized machine operator, the far larger part of such work still requires a competent, skilled, well-trained, and experienced personnel for successful and accurate work, and because of the inherent nature of such work human "machines" will probably predominate at the laboratory bench for some time to come.

STUDIES ON IMMUNIZING SUBSTANCES IN PNEUMOCOCCI

XI. EFFECT OF VARIATION IN DOSAGE OF ANTIGENIC POLYSACCHARIDE ON SERUM ANTIBODY TITER IN HUMAN BEINGS [1]

By LLOYD D. FELTON, *Senior Surgeon, United States Public Health Service*, W. ROSS CAMERON, *Deputy State Health Officer, Maryland*, and PERRY FRANKLIN PRATHER, *Consultant, United States Public Health Service*

Ever since the isolation of the pneumococcus as etiologic agent in lobar pneumonia, many investigators have sought practical methods of active immunization of human beings as a means of prevention of this disease. In recent years, the possibility of using an antigenic polysaccharide of pneumococci in lieu of the intact cell vaccine previously tried has received considerable attention. Inasmuch as it has been found possible to prepare such an antigen in a form which is water-soluble, easily sterilized and standardized, and free from producing untoward reactions, an opportunity is afforded for evaluation of this active agent. Obviously, in any program of immunization in human beings, the optimum dose must be determined. This in turn, at least with the pneumococcus antigenic polysaccharide, requires tests on large numbers of individuals because of the wide variation observed in individual response to any one dose. In a preliminary study on a small group (*1*), it appeared that just such variation occurred in the measure of serum antibody titer stimulated by a constant dose of antigen. A more recent study (*2*) on over 1,000 individuals has confirmed this observation, for with a constant dose of antigen the serum antibody titer ranged from zero to protection against a million lethal doses of pneumococci. In other words, the capacity of individuals to manufacture antibody may differ as much as a million fold—truly a significant immunological variable. It has been suggested by us that this difference in individuals may indicate degree of susceptibility to pneumococcus infections; those able to manufacture antibody may be relatively resistant, and those able to manufacture antibody to slight extent or not at all may be susceptible.

Since the demonstration of great variation in host response makes determination of optimum dose possible only when tests are run on large numbers of human beings, significant deductions cannot be made from the work of earlier investigators because of the small numbers of persons tested. For instance, in the 2 reports of Tillett and Francis (*3*) in which skin test doses of the polysaccharide were observed to stimulate antibodies, the studies were made on 19 and 18 pneumonia patients, respectively. In like manner, Finland and Sutliff (*4*) reported on 41 nonserum-treated patients with demonstration of serum antibodies following injection of doses of 0.01 mg. In normal

[1] From the Division of Infectious Diseases, National Institute of Health, and the State Department of Health, Washington County, Md. This is one of a series of studies carried out in part under a grant from the Influenza-Pneumonia Commission of the Metropolitan Life Insurance Co.

individuals, Finland and Sutliff (*5*) reported the presence of protective antibody in serum of 29 individuals following injection of doses of 0.01 mg. Felton, Sutliff, and Steele (*1*) tested, in small groups of individuals, various antigenic fractions of the pneumococcus in 1-mg. dose. More recently, Ruegsegger and Finland (*6*) studied the effects of different doses and of different routes of injection on the response to type VIII polysaccharide in human beings. The routes used were intravenous, subcutaneous, and intracutaneous, with doses ranging from 5 mg. to 0.001 mg., 1 mg. to 0.001 mg., and 0.15 mg. to 0.0001 mg., respectively. There were 31 individuals in the first group, 32 in the second, and 28 in the third, with a maximum of 12 individuals for any 1 dose. Although the response in human beings against this type VIII polysaccharide, as measured by serum antibody titer, was comparable to that obtained with types I, II, or III polysaccharides (Finland and Ruegsegger (*7*)) and the conclusions drawn may later prove to be correct, it is our opinion that insufficient numbers of individuals were tested in each group. In like manner, Finland and Brown (*8*) used type-specific polysaccharides of types I, IV, V, VII, and XIV, in doses of 1 mg. subcutaneously or 0.01 mg. intracutaneously in groups of from 3 to 6 individuals only. It is justifiable to conclude only that their work demonstrated the antigenicity of these polysaccharides in human beings. Francis (*9*) compared the so-called acetylated and deacetylated polysaccharides in 2 groups of 7 individuals. Zozaya and Clark (*10*), testing 10 individuals with 5 weekly injections of 0.01 mg. each, observed protective antibodies with maximum protection against 10,000 lethal doses 1 week after the last injection. These references are given as examples in which it is believed insufficient numbers were studied to wårrant any other conclusion than the fact that the specific polysaccharide is antigenic for human beings.

In the present study results are reported on 533 individuals with doses of 1 polysaccharide antigen ranging from 0.01 mg. to 1 mg. In addition, preliminary observations were made in small groups on the effect of 2 injections and also the specificity of the response to polysaccharide antigen. Comparison was also made of the antigenicity of the polysaccharide prepared by the calcium phosphate method (*11*) with that of the Heidelberger (*12*) preparation.

MATERIALS AND METHODS

For determining the optimum dose, 1 polyvalent polysaccharide antigen types I and II prepared by the calcium phosphate method was used. Unfortunately materials for this polyvalent antigen were pooled before analyses were made, so that antigenicity only could be evaluated. Monovalent type-specific polysaccharides were used for

the comparison of antigenicity and specificity of response to preparations by the calcium phosphate method and the Heidelberger method. With the calcium phosphate technique there was 1 preparation each of type I (186–F) and type II (184–F). For comparison, preparations were made by the Heidelberger method from the same 4-day growth of pneumococci (186–H for type I and 184–H for type II), and, in addition, because the supply of 186–H was exhausted, a preparation of type I, 193–H, was used for making comparison in the 0.4- and 0.04-mg. dose series. The strain of pneumococci, the kind of medium, and the period of growth were the same as used in making the 186–F preparation. The medium was double meat infusion broth with 1 percent peptone, 0.5 percent glucose, and 0.2 percent disodium phosphate. Results of chemical tests of the 3 type I preparations were similar but not identical. The nitrogen content for 186–F was 5.05 percent; for 186–H, 4.32 percent; and for 193–H, 3.13 percent; hydrolyzable sugar percentages were 20.4 percent, 24.4 percent, and 19.6 percent, respectively; the amount of protein precipitated from serum with a dilution of 1:5,000 of polysaccharide was 0.318, 0.426, and 0.370 mg.; optical rotation was $[\alpha]_D = +190$, $+180$, and $+220$; the precipitin titer was not determined exactly but the 3 preparations were all over 1:2,000,000; active immunity produced by 0.5 cc. of 1:1,000,000 dilution in white mice was approximately the same for all; mice so injected were immune to 500,000 lethal doses. There is some difference in results of the chemical analyses of the 2 type II preparations. Nitrogen was high in both: 184–F was 1.76 percent and 184–H 1.48 percent; glucose number after hydrolysis was 56 percent in the former and 64 percent in the latter; protein precipitated from immune serum was 0.314 and 0.296 mg., respectively; optical rotation was $[\alpha]_D = +55$ and $+50$; active immunity in white mice was the same in both; mice withstood a 1:1,000 dilution of culture of such virulence that 0.5 cc. of a 1:500,000,000 dilution caused a fatal infection in 24 hours, or the mice were protected against at least 500,000 lethal doses.

All antigens were injected in 0.5 cc. volume by subcutaneous route. As described in previous publications, the degree of response is measured by mouse protective titer of the serum; 0.1 cc. serum from bleedings before immunization and 14 days afterward was tested for protection in mice against doses of virulent types I and II cultures ranging logarithmically from 1 to 1,000,000 lethal doses.

The question of the correlation of antigenicity of the polysaccharide in mice and in human beings has not been solved. For that reason, as an initial experiment toward the solution of this problem, results are recorded of the tests of this activity in mice of the polyvalent antigen used here. This assay was carried out in the following manner: 80 mice each for types I and II were injected with 0.5 cc. of 1:1,000,000

dilution of polysaccharide, and on the seventh day afterward, in groups of 20, they were injected intraperitoneally with 0.5 cc. containing 5,000, 50,000, 500,000, and 1,000,000 lethal doses. With our cultures these represented dilutions of 1:100,000, 1:10,000, 1:1,000, and 1:500, respectively. Results of the titrations are given in table 1. In the case of type I, 50 percent of the mice survived a 1:10,000 dilution of culture, or approximately 50,000 lethal doses. The control antigen used in this mouse experiment had an endpoint nearer 1:1,000 culture dilution, or 500,000 lethal doses. With type II, no endpoint was observed; 2 mice survived 1:1,000, 6 survived 1:10,000, and 3 survived 1:100,000 dilution of culture. In our experience, type I preparations have been more uniformly of a higher antigenic titer for white mice than type II. However, preparations of this latter type have been made in which antigenicity in mice was as great as in any type I. Contrariwise, in human beings, almost irrespective of the degree of antigenicity in mice, type II polysaccharides have resulted in stimulation of higher titer antibody than type I samples. Yet it has been observed that any type I or type II preparation which is highly antigenic in mice is also antigenic in human beings. In the present antigen both type I and type II are considered to be of relatively low titer as estimated by the active immunity developed in mice. The more recent preparations, when used in a single injection of 0.5 cc. of 1:1,000,000 dilution, immunize 50 percent of mice against 1,000,000 or 500,000 lethal doses.

TABLE 1.—*Active immunity in mice in response to antigen No. 5*

(Test mice received intraperitoneal injections of 0.5 cc. of a 1:1,000,000 dilution of sample, and 7 days later 0.5 cc. of dilutions of virulent culture as designated below)

Sample	Type	Culture dilutions							
		2×10^{-3}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	2×10^{-9}
No. 5	I	[1] 2	3	11	13	------	------	------	------
Control P-205C	I	5	8	17	15	------	------	------	------
Control organisms	I	------	------	------	------	[2] 22	22	24	24
						46	22	46	24
						46	24	46	46
No. 5	II	------	2	6	3	------	------	------	------
Control P-193A	II	------	8	8	10	------	------	------	------
Control organisms	II	------	------	------	------	22	22	26	26
						26	26	26	26
						26	26	26	S

[1] Numbers indicate survivals of 20 mice.
[2] Numbers indicate hours of survival; S indicates survival.

DETERMINATION OF OPTIMUM DOSE FOR ONE SAMPLE OF POLYVALENT ANTIGEN

In this attempt to establish for human beings the optimum dose of one sample of antigenic polysaccharide polyvalent types I and II, tests were made on 533 persons. The individuals chosen were hospitalized

ambulatory patients and also healthy persons in the general population. Ages ranged from 15 to 70 years with the majority between 30 and 50 years. Because of the small number in any age decade, and also because of the evidence that there is very little difference in response at various ages (*2*), the age factor is not considered in the present observations. The doses of antigen, as indicated in tables 2 and 3, include 0.01, 0.1, 0.2, 0.3, 0.5, and 1.0 mg. The largest numbers studied were injected with 0.5- or 1.0-mg. doses. This was done because it appeared from preliminary work that 0.5 mg. was optimum. Since 1 mg. had been the dose used in most of our earlier work, it was desired to test sufficient numbers of individuals to establish the relative activity of these two doses.

TABLE 2.—*Antibody titer in human sera before and after immunization with antigen No. 5*

TYPE I

Dose of antigen (mg.)	Total number persons (*n*)	Number of persons (*X*) whose sera [1] protected against the following lethal doses (*Y*)								Mean L. D.[3]
		0	1	10	100	1,000	10,000	100,000	1,000,000	
	Before immunization									
0.01	12	10	1	0	0	1	0	0	(2)	83
0.1	52	39	3	3	4	1	2	0	0	412
0.2	90	68	11	6	2	3	0	0	0	36
0.3	52	40	3	4	3	1	1	0	0	218
0.5	218	139	50	4	11	8	6	0	0	317
1.0	109	72	23	4	4	3	3	0	0	307
	After immunization									
0.01	12	3	0	2	0	5	2	0		2,085
0.1	52	5	0	6	11	10	8	12	0	24,830
0.2	90	5	4	14	15	19	15	18	0	21,896
0.3	52	3	0	3	9	12	11	11	3	81,210
0.5	218	8	7	7	15	48	64	51	18	109,126
1.0	109	2	1	4	3	21	37	33	8	107,260

[1] 0.1 cc. volume.
[2] Not tested.
[3] Mean L. D.$=\frac{\Sigma XY}{n}$.

For comparison, calculation was made of the simple mean of the number of lethal doses against which 0.1 cc. of serum protected mice. This mean was calculated by multiplying the number of individuals having a given endpoint by the corresponding number of lethal doses, then adding the products for all who received the same dose of antigen, and dividing by the total number who received that dose. As shown in table 2, the average before immunization in the case of type I was relatively small, owing to the fact that the titer was low in those who had any serum antibodies. After immunization, the mean was significantly higher in all, irrespective of the dose of polysaccharide, with a gradual increase from 2,000 lethal doses with 0.01

mg. to 109,000 lethal doses with 0.5 mg. of type I. There was no appreciable difference between 0.5 and 1.0 mg., for 0.1 cc. serum protected against averages of 109,000 and 107,000 lethal doses, respectively. With type II the mean number of lethal doses against which there was protection before immunization was somewhat higher than with type I, but like type I the majority of individuals had no measurable serum protective antibody prior to immunization. It was later observed that there was an increase in the mean number of lethal doses for which there was protection from that with 0.01 mg. to that with 0.2 mg. (59,000 to 189,000, respectively). Although there was variation in the number of lethal doses protected by 0.1 cc. serum in mice, it is difficult to choose the optimum with higher doses, 0.3, 0.5, and 1.0 mg. This variation is no doubt due to unequal distribution with respect to the number of individuals whose serums protected against a million lethal doses. By smoothing the curves, these differences are less pronounced, and it would appear that approximately the same response is obtained in human beings with doses of from 0.3 to 1.0 mg. of this antigen. A larger number of individuals is now being tested to establish this point.

TABLE 3.—*Antibody titer in human sera before and after immunization with antigen No. 5*

TYPE II

Dose of antigen (mg.)	Total number persons (*n*)	Number of persons (*X*) whose sera[1] protected against the following lethal doses (*Y*)								Mean L. D.[3]
		0	1	10	100	1,000	10,000	100,000	1,000,000	
	Before immunization									
0.01	12	9	2	0	1	0	0	0	[2]	9
0.1	52	30	9	1	7	2	3	0	0	629
0.2	90	67	15	1	3	2	2	0	0	248
0.3	52	33	9	5	1	0	4	0	0	772
0.5	218	131	44	6	21	8	6	2	0	1,239
1.0	109	54	30	3	18	2	2	0	0	218
	After immunization									
0.01	12	1	0	1	0	2	1	7	----------	59,334
0.1	52	1	0	1	4	8	17	18	3	95,738
0.2	90	3	0	5	12	16	21	18	15	189,191
0.3	52	1	0	3	5	6	12	13	12	258,202
0.5	218	2	1	4	3	17	74	85	32	189,253
1.0	109	1	1	0	1	9	30	31	36	361,551

[1] 0.1 cc. volume.
[2] Not tested.
[3] Mean L. D. $= \frac{\Sigma XY}{n}$.

As shown in a previous study, certain individuals fail to respond to the polysaccharide antigen. A study of these individuals in the present investigation reveals that certain numbers failed to respond against one type, but did respond to average extent against the other;

and in others there was no indication of stimulation of antibodies against either type. Of the 533 individuals studied (table 4), there were 5 without antibodies to either type, 21 without antibodies against type I but with average reponse to type II, and 3 without antibodies to type II but with some response to type I antigen. These observations suggest again the importance of the host factor in an investigation of active immunization. How far this individual variation is a contributing factor which may influence the incidence of pneumonia is problematic. Yet the question arises whether such variation in response to specific antigen may indicate individual susceptibility to a given type of pneumococcus infection and in turn perhaps may account for the larger number of type I than type II cases of lobar pneumonia. Of course if active immunization can be shown to be a possible means for the prevention of lobar pneumonia, the isolation or synthesis of an antigen active against all types, and more important, sufficiently antigenic to stimulate production of antibody in all individuals, is the ultimate goal.

TABLE 4.—*Failures in response to one type of a polyvalent antigen No. 5 injected in 533 persons*

Number of failures	Number of these positive to other type	Titer of serum antibodies when positive						
		Type	Number of persons whose sera protected against the following lethal doses					
			1	10	100	1,000	10,000	100,000
Type I, 26	21	II	2	1	3	4	5	6
Type II, 8	3	I	1	1	0	1	0	0

EFFECT OF TWO INJECTIONS OF ANTIGEN

Certain observations indicate that it is difficult with any pneumococcus antigen to produce hyperimmunity in the human being. The investigators who have used skin test doses in the study of antibody production in human beings for the most part used repeated injections. Zozaya and Clark (*10*) injected 10 normal individuals with 0.1 mg. in 5 weekly doses and found that 3 out of 10 had negative skin tests but all had some serum antibody. Francis (*9*), in 14 individuals, 7 each with so-called acetylated and deacetylated polysaccharide, used 3 weekly injections of 0.01 mg. each. There was apparently a negative response in 1, very little in 3, and good in the remainder. Finland and Sutliff (*5*), in 19 individuals, gave single injections of 0.01 mg. in 7 against type I, 6 against type II, and 6 against type III, and a similar dose in 10 other individuals, 3 type I, 3 type II, and 4 type III, consisting of 4 successive daily injections. They concluded from their observations that there is no advantage in giving repeated daily doses in skin test amounts as esti-

mated by antibody titer 14 days after the last injection. In groups of approximately 20 individuals, Finland and Dowling (*13*) injected (*a*) 0.01 mg. twice, a week apart; (*b*) 0.05 mg. in single injection; (*c*) 4 to 6 injections of 0.01 mg. at 3- or 4-day intervals; and (*d*) 4 injections of 0.01 mg. at ½-hour intervals. They stated that although there were wide variations in the response of different individuals to the same materials given in the same manner, very little difference was observed in the collective response of different groups of subjects to the same substance regardless of method or total dosage given.

At this time one experiment is reported on the influence of repeated injection of the same polyvalent antigen No. 5 in a group of 15 individuals ranging in age from 21 to 57 years. The first dose of 0.1 mg. was followed in 14 days by 0.2 mg. The usual method of estimating antibody titer, protection of mice by 0.1 cc. serum against varying doses of culture, was used, and also a second method, recorded in table 5, with variation of serum with 50 percent increment against a 1:1,000,000 culture dilution representing 500 lethal doses. All sera were tested on the same day with the same culture. It can be seen that in the case of type I, protection increased in 1 individual from that produced by 0.1 cc. to double that amount, or 0.05 cc. serum; 6 remained the same, and 5 decreased. With type II, 3 showed an increase, 6 remained the same, and 3 decreased. Data are not complete on the others. The group is small, and inasmuch as variation represents in most cases half or double the amount of serum when there is increase or decrease respectively, it is perhaps inadvisable to make any conclusion other than that there is no advantage in 2 injections of this antigen at an interval of 14 days, with the first dose 0.1 mg. and the second 0.2 mg.

TABLE 5.—*Effect of two injections of antigen No. 5, 0.1 and 0.2 mg., respectively, at 14-day interval*

Name	Amount of serum to protect 3 mice against 1:1,000,000 dilution of culture					
	Type I			Type II		
	Before injection	After 0.1 mg.	After 0.2 mg.	Before injection	After 0.1 mg.	After 0.2 mg.
		cc.	cc.		cc.	cc.
D	Negative	0.1	0.1	Negative	0.05	0.1
Car	do	.1	.05	0.05	.006	.012
Cha	do	.1	----	Negative	.1	----
Mu	do	.05	.1	do	.025	.025
McM	do	.05	----	do	.025	----
Raf	do	.025	.05	0.05	.006	.012
Mag	do	.025	.05	0.025	.025	.012
Cas	do	.025	.05	Negative	.05	.05
He	do	.012	.012	do	.012	.012
W	do	.012	.012	do	.012	.006
B	do	.012	.012	do	.05	.05
Ray	do	.012	.012	do	.012	.012
Ro	do	.006	.025	do	.025	.025
Ha	do	----	.05	do	----	.05
F	0.05	.1	.1	do	.05	.025

COMPARISON OF PREPARATIONS MADE BY CALCIUM PHOSPHATE AND BY HEIDELBERGER METHODS

Although in our opinion it has been clearly shown that the acetyl group on type I polysaccharide, if present at all or simply as a contaminant, does not influence its antigenicity in mice (*14*), several experiments were run to compare the activity on human beings with type-specific polysaccharides made by the calcium phosphate method and by the Heidelberger method. Efforts were made to follow the Heidelberger method exactly as published. In the type I prepared by this method, there was some acetic acid following vacuum distillation of a sample hydrolyzed in phosphoric acid. There was no demonstrable acetic acid obtained from the other preparations of type I or type II.

These experiments were run for a twofold purpose: First, to ascertain the relative antigenicity of the two preparations in human beings; and second, to compare the degree of heterologous response. It has been reported in a previous work (*15*) that in 12 children type I polysaccharide (prepared by calcium phosphate method) stimulated as much antibody against type II as against type I, while for mice the response to these antigens was definitely homologous. It is realized that this inference was drawn from all too few individuals. Additional data will be necessary to determine whether or not our observations were the result of unequal distribution or whether they represent a constant phenomenon.

TABLE 6.—*Comparison of preparations made by calcium phosphate and by Heidelberger methods*

TYPE I

Total number of persons	Sample	Dose (mg.)	Type organisms in titration	Number of persons whose sera protected against the following lethal doses														Mean lethal doses	
				Before injection							After injection							Before injection	After injection
				0	1	10	100	1,000	10,000	100,000	0	1	10	100	1,000	10,000	100,000		
22	186	1.0	I	12	7	1	0	0	0	2	0	4	1	0	3	3	11	9,092	51,501
			II	10	5	3	2	0	1	1	2	2	4	3	0	9	2	5,011	13,198
15	186-H	1.0	I	6	7	0	1	0	0	1	0	3	1	3	1	1	6	6,674	40,754
			II	10	3	1	0	0	0	1	9	2	1	1	1	0	1	6,667	6,741
11	186	.4	I	8	2	1	0	0	0	0	1	1	1	0	3	3	2	1	21,183
9	193-H	.4	I	5	2	2	0	0	0	0	2	0	1	1	1	1	3	2	34,568
9	186	.04	I	4	3	1	1	0	0	0	3	0	1	2	1	1	1	12	12,357
11	193-H	.04	I	6	1	3	0	0	1	0	1	0	2	2	2	2	2	912	20,202
			II	4	3	1	1	1	1	0	5	2	1	1	0	2	0	1,010	1,828

In summarizing the results in this comparison, the uncorrected mean was calculated as an aid, as in tables 2 and 3. As seen in table 6, 1.0 mg. of type I polysaccharide 186–F (calcium phosphate method)

stimulated antibody such that 0.1 cc. of serum protected mice against an average of 51,000 lethal doses of type I pneumococci. With the same dose of 186–H (Heidelberger method), the average response was against 40,000 lethal doses of type I. This represents the specific response. In this respect there was apparently no significant difference between the antigenicity of these two type I preparations. In contrast, 186–F stimulated a heterologous immunity such that 0.1 cc. of serum protected against an average of 13,000 lethal doses of type II pneumococci, whereas the 186–H preparation showed no difference in titer of type II antibody before and after immunization.

In the 0.4- and 0.04-mg. doses of the two preparations, there was a satisfactory specific response. However, in neither was there observed any indication of heterologous activity.

In the tests of the type II preparations in human beings, a 1-mg. dose was used for each. Twenty-eight were injected with 184–F (calcium phosphate method) and 18 with 184–H (Heidelberger method). As seen from table 7, the highest number of lethal doses used in a test was 100,000; consequently, the average number of lethal doses protected against by 0.1 cc. serum was low in comparison with that given above in the experiment with polyvalent antigen. Although definite conclusions cannot be drawn as to the relative activity of these 2 preparations because of the small number of individuals it may be mentioned that there was a higher percentage of individuals whose sera protected against the highest number of lethal doses with the 184–F antigen than with 184–H; also the smallest number of the low value occurred with the 184–F. The average lethal doses protected against by 0.1 cc. serum in the 2 groups were, respectively, 86,000 and 49,000.

TABLE 7.—*Comparison of preparations made by calcium phosphate and by Heidelberger methods*

TYPE II

Total number of persons	Sample	Dose (mg.)	Type organisms in titration	Number of persons whose sera protected against the following lethal doses														Mean lethal doses	
				Before injection							After injection							Before injection	After injection
				0	1	10	100	1,000	10,000	100,000	0	1	10	100	1,000	10,000	100,000		
28	184	1.0	II	14	11	0	2	1	0	0	0	0	0	0	1	3	24	43	86,821
18	184–H	1.0	II	10	7	0	1	0	0	0	1	0	0	0	1	8	8	5	48,944

DISCUSSION

The main purpose of this paper is to report an attempt to establish for human beings the optimum dose of one preparation of polyvalent types I and II antigenic polysaccharide as measured by serum anti-

body content. The antigen used was prepared by the calcium phosphate method. It was not ideally antigenic as a stimulant for antibody formation in mice. Although an adequate number of experiments may not have been performed, sufficient work nevertheless has been done to suggest that a sample may or may not be antigenic for mice and yet be antigenic in man. It may be advantageous to use on human beings the polysaccharide which is highly antigenic for mice. Efforts are now being made to determine whether such antigens are more active for human beings than the one used in the present study.

Work done prior to the present investigation, by Francis and Tillett, Francis, Finland, and Sutliff, Ruegsegger and Finland, ourselves, and others, unfortunately is of only qualitative nature because of the small numbers of persons studied. The present results indicate that with the type I preparation used, a 0.5-mg. dose is the smallest amount that can be used to stimulate antibody production in the highest titer and in the greatest number of individuals. One mg. is no better. Information is lacking as to what may occur when larger amounts are used. Small numbers of individuals have been tested with 2, 5, and 10 mg., but certainly not enough to draw a significant conclusion. The suggestion of Ruegsegger and Finland that a 5-mg. dose is too large would not be justifiable from the five individuals tested by them. On the other hand, it is shown here that small doses stimulated surprisingly high titer serum antibody in certain individuals. However, the larger the dose up to 1 mg., the larger the number of individuals who showed a good response, and the smaller the number of those who failed to respond. Thus, beginning with the dose of 0.1 mg., in which there were sufficient numbers of individuals injected to indicate significant results, the percentage of failures decreased from 9.6 to 1.8 percent with 1 mg. It should be noted, however, that the percentage of those negative before immunization by chance distribution showed a decrease from 75 percent in those injected with 0.1 mg. to 66 percent in the group injected with 1.0 mg.

The results with type II antigen in the same individuals are similar to those with type I. However, in general, human beings respond much better to type II antigenic polysaccharide than to the same dose of type I. In our study the highest uncorrected mean with type II is 361,000 lethal doses as compared to 109,000 with type I; i. e., 0.1 cc. serum protects mice against these average numbers of lethal doses of the two respective types. It is a little difficult to select the optimum dose with type II inasmuch as the mean for 0.2 mg. is 189,000 lethal doses, for 0.3 mg. 258,000, for 0.5 mg. 189,000, and for 1.0 mg. 361,000 lethal doses. However, it would appear that the high average in the case of the 1 mg. group may be due to an unequal distribution. Thirty-six, or 33 percent of the total number in the group, showed protection against 1,000,000 lethal doses, and of those receiving 0.5

mg. only 32, or 15 percent of the total, showed the same protective titer. As with type I the number of individuals with higher titer of antibody increases with increasing amount of antigen up to 0.2 mg. In addition, the percentage of poor responders decreased with an increasing amount of antigen up to 0.5 mg. The fact that only 50 percent of the total number were negative before immunization with a 1-mg. dose may also be an indication of unequal distribution, for in a previous report on 1,099 individuals (*2*), in the case of both type I and type II, it was shown that 67 percent of the individuals were negative before immunization.

It has been pointed out that the individual variation in response to a given antigen is indicative of relative susceptibility to pneumococcus invasion. It was also suggested that it might be possible to separate those who are able to manufacture antibody from those who are unable to do so, as an initial classification for the study of relative susceptibility of these two groups to pneumococcus. If it is found that poor reactors are more prone to contract pneumonia, then means for increasing resistance of this group might be developed with a resultant decrease in pneumonia incidence. The problem becomes more complex because of the observation made in this study that some individuals respond to polysaccharide from one type of pneumococcus and not to another. Thus, if active immunization becomes the only means of prophylaxis, it would be necessary to determine the response of individuals to more than one antigen and then apply corrective measures against the type in which there is poor response. Certainly these observations indicate the importance of the host factors in any procedure for active immunization. The antigen also must play an important role. In the present report, confirming earlier work, it is shown that type I polysaccharide stimulates antibody in certain individuals against both type I and type II pneumococci. In the polysaccharide prepared by the Heidelberger method, this heterologous response was not evident. This brings up again the question of whether or not there is present a substance or form of antigenic polysaccharide which is common to all types of pneumococci. The failure of one polysaccharide to stimulate antibody against other types may be due to a certain configuration of the molecule which in itself inhibits the heterologous activity. If this is not true, then there may be a concomitant substance present in the polysaccharide prepared by the calcium phosphate method and absent in the Heidelberger preparation which induces the heterologous activity. If either of these two suppositions is true, the possibility exists of isolating a polysaccharide, or altering the specific polysaccharide, to insure a broad non-type-specific response which indeed may be the common denominator of the multiplicity of types found in man.

Some evidence has been presented which would indicate the difficulty of hyperimmunization in human beings with the polysaccharide antigen. This was observed early in our work, and for that reason injections were limited to one dose. Zozaya and Clark showed that repeated injections of skin test doses did not significantly increase antibody titer above that following the first injection. Finland and Sutliff also, in groups of 20 individuals injected singly or in repeated small doses, demonstrated that there was no advantage, as measured by antibody titer, of repeated over single injections. The suggestion from their work that those receiving repeated injections had longer duration of antibody is founded on results with only 2 individuals in a group of 20. In the present report it is shown that not only may repeated injection not be an advantage, but it may even be a disadvantage, at least at an interval of 14 days, for, following the second injection, apparently more than half the persons injected showed a decrease in the case of type I and half the total number in the case of type II. However, as explained above, this variation may simply be due to the lack of sensitivity of the mouse protection test. The interval of 14 days was chosen because it was found that in most individuals optimum titer of antibodies occurred in that time. It is conceivable that a different range of doses at a different interval might result in higher antibody titer; however, our results thus far, as well as those reported by others, have not indicated this possibility. The problem is important, and its solution might well result in the development of a procedure which would decrease individual variation in antibody production, and thus cause a decrease in the number of individuals who failed to respond. Inasmuch as those who fail to respond constitute the most difficult problem, obviously a procedure of active immunization might well become a practical means of the prophylaxis of pneumonia.

SUMMARY AND CONCLUSIONS

Attempts have been made to establish the optimum dose for human beings of one preparation of antigenic polysaccharide of pneumococci, polyvalent types I and II. With this antigen, 0.5 cc. of 1:1,000,000 dilution of which protects mice against 50,000 lethal doses of type I pneumococci, and a slight amount of type II, tests were made in a group of 533 individuals to determine the optimum dose as measured by serum protective antibody titer. The doses ranged from 0.01 mg. to 1.0 mg. of both type I and type II. It may be inferred that for type I 0.5 mg. was as effective as 1 mg. and more effective than 0.3 mg. With type II it is difficult to determine the exact amount; it would appear that 0.3 mg. is as effective as a larger dose.

It has been shown that in this group of 533 individuals, 21 who failed to respond to type I responded well to type II antigen, and 3 who were negative to type II responded to type I.

Two injections of 0.1 and 0.2 mg., respectively, at an interval of 14 days did not result in a significant increase of serum antibody titer either for type I or for type II.

Comparison of polysaccharides made by the calcium phosphate method and by the recent method of Heidelberger gave the following results: The homologous response to 1 mg. of both type I and type II preparations made by the former method was at least as high as that stimulated by preparations by the Heidelberger method; with type I there was heterologous response against type II with the calcium phosphate preparation and none with the Heidelberger preparation; with 0.4- and also 0.04-mg. doses there was no heterologous response; with type II the preparations made by the two methods showed no heterologous antibody stimulation; both stimulated a type-specific response.

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STUDIES ON TRICHINOSIS

XIII. THE INCIDENCE OF HUMAN INFECTION WITH TRICHINAE AS INDICATED BY POST-MORTEM EXAMINATION OF 3,000 DIAPHRAGMS FROM WASHINGTON, D. C., AND 5 EASTERN SEABOARD CITIES[1]

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This report presents the results of the examination for trichinae of 3,000 diaphragms in the so-called "base" series of a general survey which is being conducted for the purpose of ascertaining the distribution of *Trichinella spiralis* in the general population of the United States. Hall and Collins (*1*) have reported on the first 300 cases in this series and Nolan and Bozicevich (*2*) on the first 1,000 cases. It is believed that the number of examinations in this particular

[1] From the Division of Zoology, National Institute of Health.

Previously published papers in this series are:

I. The incidence of trichinosis as indicated by post-mortem examinations of 300 diaphragms. By Maurice C. Hall and Benjamin J. Collins. Pub. Health Rep., **52**: 468–490 (1937).

II. Some correlations and implications in connection with the incidence of trichinae found in 300 diaphragms. By Maurice C. Hall and Benjamin J. Collins. Pub. Health Rep., **52**: 512–527 (1937).

III. The complex clinical picture of trichinosis and the diagnosis of the disease. By Maurice C. Hall. Pub. Health Rep., **52**: 539–551 (1937).

IV. The role of the garbage-fed hog in the production of human trichinosis. By Maurice C. Hall. Pub. Health Rep., **52**: 873–886 (1937).

V. The incidence of trichinosis as indicated by post-mortem examinations of 1,000 diaphragms. By M. O. Nolan and John Bozicevich. Pub. Health Rep., **53**: 652–673 (1938).

VI. Epidemiological aspects of trichinosis in the United States, as indicated by an examination of 1,000 diaphragms for trichinae. By Maurice C. Hall. Pub. Health Rep., **53**: 1086–1105 (1938).

VII. The past and present status of trichinosis in the United States, and the indicated control measures. By Maurice C. Hall. Pub. Health Rep., **53**: 1472–1486 (1938).

VIII. The antigenic phase of trichinosis. By John Bozicevich and Laszlo Detre. Pub. Health Rep., **55**: 683–692 (1940).

IX. The part of the veterinary profession in the control of human trichinosis. By Willard H. Wright. J. Am. Vet. Med. Assoc., **94**: n. s. **47**: 601–608 (1939).

X. The incidence of light infestations of dead trichinae in man. By Leon Jacobs. J. Wash. Acad. Sci., **28**: 452–455 (1938).

XI. The epidemiology of *Trichinella spiralis* and measures indicated for the control of trichinosis. By Willard H. Wright. Am. J. Pub. Health, **29**: 119–127 (1939).

XII. The preparation and use of an improved trichina antigen. By John Bozicevich. Pub. Health Rep., **53**: 2130–2138 (1938).

XIV. A survey of municipal garbage disposal methods as related to the spread of trichinosis. By Willard H. Wright. Pub. Health Rep., **55**: 1069–1077 (1940).

[2] Resigned September 21, 1937.

series has reached a figure which will provide statistically significant conclusions. The series has therefore been discontinued and the present paper represents a final report on the incidence and intensity of infection. The epidemiological aspects of the 3,000 examinations will be dealt with in a separate communication.

The material comprising the present survey was furnished by 10 hospitals in Washington, D. C., and 4 United States Naval Hospitals and 2 United States Marine Hospitals in eastern seaboard cities. Hall and Collins (*1*) have pointed out that necropsy examinations of persons from the District of Columbia would be more representative of the population of the country as a whole than material examined from any other one section because of the cosmopolitan character of the Washington population. The inclusion of the Service hospitals provided a representative sampling of the military and merchant marine groups.

As noted by Hall and Collins (*3*), the sources of material were such as to provide an adequate sampling as regards sex, age, race, occupation, social-economic status, and mental derangement. The type of case usually represented in each of the cooperating hospitals follows: Gallinger Municipal Hospital, cases of relatively low social-economic status, white and colored; Garfield Memorial Hospital, George Washington University Hospital, and Georgetown University Hospital, cases of somewhat higher social-economic status, white and colored; Children's Hospital, children, white and colored, up to 13 years of age; Freedmen's Hospital, cases from the Negro population; St. Elizabeths Hospital, mentally deranged cases more commonly hospitalized over long periods of time; the Veterans' Administration Facility, Mount Alto, cases comprising a one-time military group but now a civilian group; Walter Reed General Hospital, cases from the military land forces, war veterans, and members of the Civilian Conservation Corps; and the United States Naval Hospital, cases from the military population with activities at sea. The following hospitals outside of Washington, D. C., supplied diaphragm material from war veterans and individuals primarily associated with maritime activities: the United States Naval Hospitals at Norfolk, Va., Philadelphia, Pa., Brooklyn, N. Y., and Chelsea, Mass., covering a military population with activities at sea; and the United States Marine Hospitals at Baltimore, Md., and Stapleton, N. Y., covering a civilian population with activites at sea.

EXPERIMENTAL PROCEDURE

The survey was based entirely on the examination of diaphragm muscle taken from routine necropsies without regard to a clinical or anatomical diagnosis of trichinosis. So far as is known, none of the persons represented in the survey died of trichinosis. With the

exception of two cases, the medical history of the infected individuals has not been examined. Therefore, no attempt is made to correlate the trichina infection with a possible occurrence of trichinosis during the life of the individual. One of the two exceptions is a case cited by Hall and Collins (*1*), in which a very heavy trichina infection was encountered at necropsy. The past history, as obtained on admission to the hospital, showed only measles and a gunshot wound. As measles is one of the numerous erroneous diagnoses which have been made in trichinosis, it is possible that this patient was actually suffering from trichinosis at the time this diagnosis was made. The other case concerned an individual on whom we were able to obtain rather complete hospital anamneses.[3] Several days were spent in examining these records and it was evident that this patient, who was found to be heavily infected at necropsy, had probably suffered from trichinosis 2 years before his death, the condition at that time involving a myalgia followed by an "acute nontuberculous inflammatory pulmonary process of undetermined type."

Instructions to the cooperating pathologists called for as much of the diaphragm other than the tendinous portion as was available. We usually received that portion of the diaphragm attached to the central tendon and rarely, if ever, the pillars.

The specimens from the hospitals in Washington were collected once a week. Those from points outside of Washington were forwarded by mail. These specimens were packed in containers with an amount of powdered boric acid sufficient to preserve the specimen while en route. The preservation of the specimens in this manner did not affect the viability of any trichina larvae which may have been in the tissue.

Prior to examination, diaphragms shipped in boric acid were thoroughly washed for more than an hour in running tap water to remove all of the preservative. In the preparation of the diaphragms, all tendinous tissue, fat, and adhering mesenteric tissue were removed. A representative 1-gm. sample was then taken for direct microscopic examination. The remaining portion was weighed and all of it was saved if it weighed 20 gm. or less. If the specimen weighed between 20 and 75 gm., it was trimmed so that its final weight was taken at the nearest 5-gm. division and, if it weighed more than 75 gm., it was trimmed to the nearest 25-gm. division. The weight of the diaphragms ranged from 3 to 200 gm. with a mean of 72.6 gm. In this connection, the average weight of the 300 diaphragms reported on by Hall and Collins (*1*) was 113 gm., while the average weight of the 1,000 diaphragms examined by Nolan and Bozicevich (*2*) was 98 gm.

[3] We are indebted to Passed Asst. Surg. Frederick J. Brady for the examination and evaluation of the clinical records in this case.

In order to ascertain whether significant differences existed between the net weight of the fresh tissue and that of preserved tissue because of the possible drying effect of the boric acid, we examined a series of 100 samples consisting of two equal groups of specimens, one not subjected to boric acid and one preserved by boric acid. The procedure was as follows: A 1- to 10-gm. sample was weighed to the nearest hundredth of a gram and then placed in a vacuum desiccator over concentrated sulfuric acid. The sample was weighed at intervals of several days to a week. The final dry weight was taken when the last two weighings agreed within 0.05 gm. The mean percentage moisture content of the 50 samples preserved with boric acid was 70.6, with a standard deviation of 7.5, and the mean percentage moisture content in the 50 samples not subjected to the boric acid preservation was 77.1, with a standard deviation of 4.9. These results indicate that the boric acid did remove some of the normal moisture content of the muscle but not an amount sufficient to affect significantly the estimated numbers of larvae present in a given amount of tissue.

The examinations for trichinae were carried out essentially by the same two methods used by Hall and Collins (*1*) and by Nolan and Bozicevich (*2*). In the direct microscopic method of examination, the fascia was removed from the muscle and the 1-gm. sample was then cut into small pieces with scissors and compressed between heavy plate glass slides in a steel frame, as described by Nolan and Bozicevich (*2*). The press preparation was examined directly with the low power (12.5 ocular and 1.0 objective) of a dissecting microscope. Positive cases were recorded in terms of the number of trichina cysts present and the type and approximate degree of calcification, if such was present. The state of the larvae within the cysts was recorded as living or dead, and, if dead, their condition was noted as degenerate, partially or completely calcified.

As might be expected, the amount of connective tissue fascia on the 1-gm. sample varied a great deal. Since the fascia was removed before the examination of the muscle, an effort was made to determine the average weight of the tissue discarded. The average weight of the fascia in 236 specimens was 107 ± 3.5 mg.[4] Of these specimens, 116 were from diaphragms preserved in boric acid; the fascia from these specimens had an average weight of 115 ± 5.7 mg. The 120 remaining specimens were from unpreserved diaphragms and the fascia from these specimens was found to have an average weight of 100 ± 4.4 mg. Therefore, the actual weight of the average 1-gm. sample of unpreserved muscle examined was 0.9 gm. and the actual weight of the preserved specimens examined was slightly less than 0.9 gm.

[4] Standard deviation of the mean.

The digestion-Baermann technique used by Nolan and Bozicevich (*2*) was modified slightly. After the diaphragm was weighed, it was finely ground in a meat chopper and placed in artificial gastric juice consisting of 15 gm. of commercial pepsin, 21 cc. of concentrated hydrochloric acid, and 3 liters of water. As prepared, the digestive fluid was about pH 1.25 and at the end of the period of digestion about pH 1.4. The material was then placed in an incubator room and maintained at a temperature of 37° C. for approximately 18 hours, during which time it was stirred continuously by means of an apparatus devised for that purpose. This technique was a departure from the method used by Nolan and Bozicevich (*2*) in which the material was stirred by hand several times during the early part of the digestion process. The continuous stirring resulted in more efficient digestion and was therefore a distinct improvement over the method used previously.

After removal of the digestate from the incubator room the sediment was allowed to settle for 1 hour, following which time two-thirds of the supernatant fluid was drawn off. The Baermann apparatus, consisting of an 80-mesh screen fitted into the top of a 3-liter funnel, was partially filled with water at a temperature of 37° to 45° C. The remainder of the digestate was then poured into the apparatus and water at the above-mentioned temperature was added until the bottom of the screen was covered. The mixture was then allowed to stand for an hour or longer before drawing off about 200 cc. into a conical sedimentation jar. The sediment which settled to the bottom of this jar was then examined for living and dead trichinae and undigested trichina cysts, which were usually calcified. Following the examination of diaphragm No. 1400, this procedure was changed, as follows: Instead of drawing off the fluid from the Baermann apparatus into sedimentation jars, small funnels of about 300 cc. capacity with a short neck closed by means of rubber tubing and a Hofmann clamp were filled with the diluted digest. Two draws were taken from each Baermann funnel at intervals of 1 hour. After these small funnels had stood for an hour or longer, two draws from each were made into Syracuse watch glasses of about 10 cc. capacity. These were immediately examined with the low power (12.5 ocular and 1.0 objective) of a dissecting microscope. The specimens were considered negative if no trichinae or trichina cysts were found in the sediment in the 4 watch glasses. If trichinae or trichina cysts were found, more draws were made into Syracuse watch dishes until 3 consecutive negative draws were secured. In addition, the Baermann apparatus was refilled with warm water and placed in the incubator overnight. The following morning a third small funnel was filled and examined as described above.

Great care was taken to insure that all apparatus was free from contamination with trichinae which may have remained from previous examinations. After being thoroughly washed, all glassware was placed either in a 10-percent solution of sodium hydroxide overnight, a process which destroys any trichinae that may be present, or was subjected to dry heat sterilization. Furthermore, all metal equipment, such as grinders and Baermann screens, was either sterilized with dry heat at 180° C. for 2 hours or flamed after thorough washing and rinsing.

INCIDENCE OF INFECTION

The data concerning the 314 diaphragms found positive in examinations 1,001 to 3,000, inclusive, are listed in table 1. The data on the 174 positive cases found in the first 1,000 examinations were given in like fashion by Nolan and Bozicevich (*2*). Thus, a total of 488 diaphragms were found infected with trichinae in the 3,000 specimens examined, an incidence of 16.3 percent.

If units of 100 consecutive examinations are taken, of which there are 30, the following number of positive specimens per unit were obtained: 22 occurred once; 12, 15, 17, 20, 21, and 24 occurred twice; 11, 13, 14, and 18 occurred three times; and 16 occurred five times. There was thus a wide range of variation in the number of positives found in any 100 cases. The standard deviation of the distribution of the number of positives per 100 cases is 3.67, which divided by the square root of the number of units of 100 gives the figure 0.67 as the standard deviation of the mean. Considering the 3,000 cases as a unit, the standard deviation of the incidence of 16.3 percent is also 0.67 when computed by the formula $\sqrt{\frac{pq}{n}}$, where p is the percentage of positive cases, q the percentage of negative cases, and n the total number of cases examined.

The reports of previous studies on the incidence of trichina infection in the United States have been summarized by Wright (*4*). Since the publication of that paper several other papers on the subject have appeared. Evans (*5*) has reported an incidence of 36 percent in 100 consecutive autopsies at Cleveland, Ohio. In this study relatively large samples of the sterno-mastoid and intercostal muscles were examined in addition to the entire diaphragm. The direct microscopic and digestion-Baermann methods were used. In the diaphragm examinations alone, Evans found 26 percent of the specimens infected with trichinae. The remaining 10 percent were found only in the other two muscles examined. Walker and Breckenridge (*6*), using both the digestion-Baermann and microscopic methods, have found an incidence of trichinae of 33 percent in 100 autopsies in Alabama. As determined by the examination of the diaphragms alone, the inci-

TABLE 1.—*Findings for positive cases*

Positive number	State of trichinae	Findings		Microscopic		Digestion-Baermann			
		Microscopic	Digestion	Number of cysts per gram	State of cysts	Amount of diaphragm digested (gm.)	Total number of larvae recovered	Number per gram	State of larvae
175	Live	Negative	Positive	0		75	3	0.04	Live.
176	Dead	Positive	Negative	1	Degenerated	30	0	0	
177	Mixed	do	Positive	180	All stages of calcification	50	364	7.28	101 live and 263 dead.
178	Dead	do	Negative	1	Polar calcification	75	0	0	
179	Mixed	do	Positive	1	Partial calcification; larva dead	40	4	.1	Live.
180	do	do	do	1	Uncalcified; larva dead	75	2	.03	Do.
181	do	do	do	1	Polar calcification; larva dead	75	3	.04	Do.
182	Live	Negative	do	0		75	1	.01	Do.
183	do	do	do	0		100	2	.02	Do.
184	do	do	do	0		100	5	.05	Do.
185	Dead	Positive	Negative	3	Wholly or partly calcified; larvae dead	30	0	0	
186	Live	Negative	Positive	0		150	2	.01	Do.
187	do	do	do	0		50	1	.02	Do.
188	Dead	Positive	do	3	Calcified; larvae degenerated	40	10	.25	Dead.
189	Live	Negative	do	0		20	1	.05	Live.
190	Mixed	Positive	do	3	Wholly or partly calcified; larvae dead	125	12	.01	7 live and 5 cysts.
191	Dead	do	Negative	1	Calcified; larva degenerated	50	0	0	
192	Live	do	Positive	2	Polar calcification; larvae alive	70	40	.57	Live.
193	do	Negative	do	0		50	3	.06	Do.
194	Dead	Positive	Negative	6	Partly or wholly calcified; larvae degenerated	50	0	0	
195	do	do	do	16	Calcified	100	0	0	
196	Live	Negative	Positive	0		50	14	.28	Do.
197	Dead	Positive	Negative	8	Calcified	125	0	0	
198	Mixed	do	Positive	4	Partial calcification; 3 live larvae, 1 dead	75	1	.01	Do.
199	do	do	do	1	Partial calcification; larva calcified and dead	75	1	.01	Do.
200	Dead	do	Negative	1	Partial calcification	75	0	0	
201	do	do	do	9	Calcified	75	0	0	
202	Live	Negative	Positive	0		30	9	.3	Do.
203	Dead	Positive	Negative	1	Degenerated	50	0	0	
204	do	do	do	2	Polar calcification	16	0	0	
205	do	do	do	1	Calcified	75	0	0	
206	do	do	Positive	8	do	100	1	.01	Dead.
207	Live	Negative	do	0		100	3	.03	Live.
208	do	Positive	do	1	Uncalcified	50	52	1.04	Do.
209	Mixed	do	do	18	Calcified; larvae dead	19	1	.05	Do.
210	Live	Negative	do	0		125	9	.07	Do.
211	do	do	do	0		75	5	.07	Do.

212	Dead	Positive	Negative	21	Calcified	75	0	0	
213	Live	Negative	Positive	0		21	7	.33	Do.
214	do	do	do	0		75	1	.01	Do.
215	Dead	Positive	Negative	1	Calcified	50	0	0	
216	do	Negative	Positive	0		100	1	.01	Dead.
217	do	Positive	Negative	3	Calcified	50	0	0	
218	Live	Negative	Positive	0		125	15	.12	Live.
219	Dead	Positive	Negative	5	Calcified and degenerated	75	0	0	
220	do	do	do	5	do	50	0	0	
221	do	do	do	2	Calcified	75	0	0	
222	Live	do	Positive	11	Polar calcification	100	40	.4	Do.
223	Dead	Negative	do	0		125	2	.02	Dead.
224	do	Positive	Negative	1	Calcified	10	0	0	
225	do	do	do	1	Uncalcified; larva dead	10	0	0	
226	Live	Negative	Positive	0		35	9	.75	Live.
227	do	do	do	0		100	4	.04	Do.
228	Dead	Positive	Negative	1	Uncalcified; larva dead	75	0	0	Do.
229	Live	do	Positive	3	Polar calcification	50	63	1.3	Do.
230	do	Negative	do	0		50	2	.04	Do.
231	do	do	do	0		75	2	.03	Do.
232	do	do	do	0		150	1	.01	Do.
233	Dead	Positive	Negative	1	Polar calcification	125	0	0	
234	do	do	do	1	Uncalcified; larva degenerated	75	0	0	
235	do	do	do	5	Uncalcified and calcified; larvae degenerated	75	0	0	
236	Live	Negative	Positive	0		75	2	.03	Do.
237	Dead	Positive	Negative	1	Calcified	50	0	0	
238	do	do	do	2	Uncalcified; larvae dead	75	0	0	
239	Live	Negative	Positive	0		35	11	.31	Do.
240	Dead	Positive	Negative	1	Uncalcified; larva dead	50	0	0	
241	Live	do	Positive	1	Uncalcified; larva alive	50	1	.02	Do.
242	Dead	do	Negative	1	Polar calcification	50	0	0	
243	Live	do	Positive	8	Uncalcified; larvae alive	75	4	.05	Do.
244	Mixed	do	do	1	Calcified; larva dead	100	15	.15	14 live and 1 cyst.
245	Live	Negative	do	0		125	2	.02	Live.
246	Dead	Positive	Negative	1	Partial calcification	75	0	0	
247	do	do	do	1	do	25	0	0	
248	do	do	do	1	Calcified	25	0	0	
249	do	do	do	1	do	13	0	0	
250	Live	Negative	Positive	0		75	1	.01	Do.
251	do	do	do	0		40	1	.03	Do.
252	do	do	do	0		75	1	.01	Do.
253	Dead	Positive	Negative	9	Calcified and uncalcified; larvae degenerated	50	0	0	
254	Live	do	Positive	1	Uncalcified; larva alive	75	3	.04	Do.
255	do	Negative	do	0		26	2	.08	Do.
256	Dead	Positive	Negative	1	Polar calcification	50	0	0	
257	Live	Negative	Positive	0		75	1	.01	Do.
258	do	Positive	do	1	Uncalcified	75	5	.07	Do.
259	Dead	do	do	5	Calcified	75	1	.01	Dead.
260	do	do	Negative	1	do	25	0	0	
261	do	do	do	20	do	50	0	0	
262	do	do	do	4	Uncalcified; larvae dead	12	0	0	
263	do	do	do	2	Calcified	10	0	0	
264	do	do	do	1	do	100	0	0	

TABLE 1.—*Findings for positive cases*—Continued

Positive number	State of trichinae	Findings		Microscopic		Digestion-Baermann			
		Microscopic	Digestion	Number of cysts per gram	State of cysts	Amount of diaphragm digested (gm.)	Total number of larvae recovered	Number per gram	State of larvae
265	Livh	Positive	Negative	1	Calcified	75	0	0	
266	Live	Negative	Positive	0		25	11	.44	Live.
267	Dead	Positive	Negative	1	Calcified	100	0	0	
268	Live	do	Positive	58	Uncalcified	50	1,200	24.0	Do.
269	do	Negative	do	0		75	3	.04	Do.
270	do	do	do	0		75	6	.08	Do.
271	Dead	Positive	Negative	32	Calcified	50	0	0	
272	Live	do	Positive	1	Polar calcification	40	5	.12	Do.
273	Dead	do	Negative	16	Calcified	50	0	0	
274	do	do	do	4	Partially calcified; larvae degenerated	50	0	0	
275	Mixed	do	Positive	9	Calcified; larvae degenerated	50	3	.06	Do.
276	Dead	do	Negative	1	Calcified	50	0	0	
277	Live	Negative	Positive	0		75	23	.3	Do.
278	do	Positive	do	1	Uncalcified; larva alive	40	2	.05	Do.
279	Dead	do	Negative	1	Calcified	50	0	0	
280	do	do	do	11	do	50	0	0	
281	Live	Negative	Positive	0		50	5	.1	Do.
282	do	Positive	do	1	Uncalcified	50	4	.08	Do.
283	do	Negative	do	0		50	5	.1	Do.
284	Mixed	Positive	do	1	Calcified; larva dead	50	7	.14	Do.
285	Dead	do	Negative	3	Calcified	50	0	0	
286	do	do	do	1	do	50	0	0	
287	do	do	do	1	do	75	0	0	
288	do	Negative	Positive	0		50	1	.02	Dead; calcified.
289	do	Positive	Negative	1	Calcified	50	0	0	
290	do	do	do	1	do	50	0	0	
291	do	do	do	11	do	10	0	0	
292	Mixed	do	Positive	2	1 with polar calcification; larva alive—1 calcified; larva dead.	125	56	.5	Live.
293	Dead	do	Negative	1	Calcified	75	0	0	
294	Live	do	Positive	1	Uncalcified; larva alive	25	16	.6	Do.
295	do	Negative	do	0		25	2	.08	Do.
296	do	Positive	do	188	Polar calcification	50	2,300	46.0	Do.
297	do	Negative	do	0		25	1	.04	Do.
298	Dead	Positive	Negative	17	Calcified	100	0	0	
299	Live	do	Positive	13	Polar calcification	24	33	1.38	Do.
300	Dead	do	Negative	3	Partially calcified	75	0	0	
301	Live	Negative	Positive	0		100	26	.26	Do.
302	Dead	Positive	Negative	1	Partially calcified	50	0	0	

303	do	do	do	3	do	13	0	0	
304	Live	do	Positive	12	Polar calcification	50	38	.76	Do.
305	Dead	do	Negative	54	Calcified	75	0	0	
306	Live	do	Positive	1	Uncalcified	75	7	.09	Do.
307	do	Negative	do	0		75	5	.07	Do.
308	Dead	Positive	Negative	26	Polar calcification or totally calcified	100	0	0	
309	Live	do	Positive	18		23	106	4.61	Do
310	do	Negative	do	0		40	1	.03	Do.
311	Dead	Positive	Negative	21	Calcified; larvae degenerated	42	0	0	
312	do	do	do	2	1 with polar calcification, the other totally calcified; larvae dead.	100	0	0	
313	Live	Negative	Positive	0		100	4	.04	Do.
314	Dead	Positive	Negative	3	2 cysts with polar calcification, 1 cyst slightly calcified; larvae dead or degenerated.	50	0	0	
315	Mixed	do	Positive	3	1 cyst uncalcified, larva degenerated; 2 cysts with polar calcification, larvae alive.	50	8	.16	Do.
316	Live	Negative	do	0		50	4	.08	Do.
317	do	do	do	0		75	1	.01	Do.
318	do	Positive	Negative	3	1 cyst slightly calcified, others with polar calcification; larvae apparently alive.	50	0	0	
319	do	do	Positive	1	Slight polar calcification	40	51	1.25	Do.
320	Dead	do	Negative	1	Calcified; larva dead	48	0	0	
321	Live	do	Positive	2	Polar calcification; larvae alive	75	44	.58	Do.
322	Dead	do	Negative	1	Calcified	150	0	0	
323	do	do	do	1	Polar calcification	75	0	0	
324	do	do	do	1	1 pole very slightly calcified	125	0	0	
325	do	do	do	7	Polar or complete calcification	36	0	0	
326	Live	Negative	Positive	0		50	8	.16	Do.
327	do	Positive	do	3	Uncalcified or with very slight polar calcification	50	3	.06	Do.
328	Dead	do	Negative	1	Polar calcification	50	0	0	
329	Live	Negative	Positive	0		50	30	.6	Do.
330	do	do	do	0		75	5	.07	Do.
331	Dead	do	do	0		50	1	.02	1 calcified cyst, larva degenerated.
332	do	Positive	do	104	All stages of calcification; larvae degenerated	150	3	.02	3 calcified cysts, larvae degenerated.
333	Mixed	do	do	3	1 cyst with unipolar calcification, larva alive; 1 cyst with heavy bipolar calcification, larva dead; 1 cyst uncalcified, larva degenerated.	125	59	.47	Live.
334	Dead	do	Negative	1	Cyst uncalcified; larva degenerated	50	0	0	
335	do	do	do	12	Lightly calcified; larvae degenerated	50	0	0	
336	Live	do	Positive	1	Polar calcification	50	1	.02	Do.
337	Dead	do	Negative	3	Calcified	75	0	0	
338	do	do	do	1	Polar calcification	150	0	0	
339	do	do	do	2	Uncalcified	50	0	0	
340	do	do	do	1	Calcified; larva degenerated	75	0	0	
341	do	do	Positive	1	Cyst with 1 pole heavily calcified, lighter general calcification, larva dead.	75	3	.04	Dead.
342	Live	Negative	do	0		43	2	.05	Live.
343	Dead	Positive	Negative	1	Polar calcification; larva dead	150	0	0	
344	Live	do	Positive	1	Live	75	38	.5	Do.
345	Dead	do	Negative	1	Calcified; larva degenerated	100	0	0	
346	Live	Negative	Positive	0		38	2	.05	Do.

TABLE 1.—*Findings for positive cases*—Continued

Positive number	State of trichinae	Findings		Microscopic		Digestion-Baermann			
		Microscopic	Digestion	Number of cysts per gram	State of cysts	Amount of diaphragm digested (gm.)	Total number of larvae recovered	Number per gram	State of larvae
347	Live	Negative	Positive	0		75	4	.05	Live.
348	do	Positive	do	1	Polar calcification	100	11	.11	Do.
349	Dead	Negative	do	0		48	1	.02	1 calcified cyst; larva degenerated.
350	Mixed	Positive	do	11	Calcified; larvae dead or degenerated	13	1	.07	Live.
351	Dead	Negative	do	0		75	2	.02	Dead.
352	Live	do	do	0		150	3	.02	Live.
353	do	do	do	0		38	1	.03	Do.
354	Dead	Positive	Negative	81	Partially or wholly calcified	125	0	0	
355	do	do	do	1	Polar calcification	50	0	0	
356	do	do	do	1	Calcified	3	0	0	
357	do	do	do	2	do	16	0	0	
358	do	Negative	Positive	0		90	6	.07	Dead.
359	do	do	do	0		35	1	.03	Do.
360	do	do	do	0		19	1	.05	Do.
361	Mixed	do	do	0		120	13	.11	1 live, 12 dead.
362	Dead	Positive	Negative	27	Calcified; larvae degenerated	130	0	0	
363	Live	Negative	Positive	0		50	2	.04	Live.
364	Dead	do	do	0		45	1	.02	Cyst; larva dead.
365	Live	do	do	0		60	2	.03	Live.
366	Dead	Positive	do	1	Calcified; larva degenerated	35	1	.03	Cyst; larva dead.
367	do	do	Negative	1	Calcified; larva dead	55	0	0	
368	do	do	do	3	Calcified	30	0	0	
369	do	do	do	4	do	100	0	0	
370	Mixed	do	Positive	1	Calcified, larva dead	55	7	.13	Live.
371	Dead	Negative	do	0		70	1	.01	Calcified cyst; larva dead.
372	Mixed	Positive	do	1	Calcified; larva degenerated	35	10	.31	7 live, 3 calcified cysts with dead larvae.
373	Live	Negative	do	0		100	6	.06	Live.
374	do	Positive	do	4	Uncalcified	55	17	.3	Do.
375	Mixed	Negative	do	0		11	2	.18	1 live, 1 cyst with dead larva.
376	Dead	Positive	Negative	5	Calcified; larvae degenerating	50	0	0	
377	Mixed	do	do	3	Calcified; 1 dead and 2 live larvae	60	0	0	
378	Live	Negative	Positive	0		50	1	.02	Live.
379	do	do	do	0		30	2	.07	Do.
380	Mixed	Positive	do	15	All degrees of calcification, but chiefly bipolar; 10 live larvae, 5 dead.	30	52	1.7	42 alive, 10 dead.

381	do	do	do	1	Calcification complete	125	7	.06	5 alive, 2 dead.
382	Dead	Negative	do	0		50	1	.02	Dead.
383	Live	do	do	0		40	1	.03	Live.
384	Mixed	Positive	do	1	Calcified, larva degenerated	100	4	.04	Do.
385	do	do	do	25	6 live, 19 dead; all show bipolar calcification	70	1	.01	Do.
386	Dead	do	Negative	24	Even calcification; some larvae calcified	70	0	0	
387	Live	do	Positive	1	Cyst calcified, larva alive	55	3	.05	Do.
388	Dead	do	Negative	8	Calcified	45	0	0	
389	Mixed	do	Positive	1	Calcified, larva dead	30	2	.07	Do.
390	Live	Negative	do	0		125	15	.12	Do.
391	Dead	Positive	Negative	3	Calcified	75	0	0	
392	Live	Negative	Positive	0		95	1	.01	Do.
393	Dead	Positive	Negative	1	Calcified	70	0	0	
394	Mixed	do	Positive	2	Slightly calcified, larvae alive	45	36	.8	34 alive, 2 dead.
395	do	do	do	14	Bipolar calcification heavier at one pole, 9 live, 5 dead.	45	541	12.02	485 alive, 54 dead, 2 cysts with dead larvae.
396	Dead	do	Negative	5	Internal calcification	85	0	0	
397	Live	Negative	Positive	0		55	2	.04	Live.
398	Mixed	Positive	do	9	All calcified, some with bipolar calcification, alive	95	49	.51	47 alive, 2 dead.
399	Live	do	do	1	Calcified	65	7	.1	Live.
400	do	do	Negative	1	do	40	0	0	
401	Mixed	do	Positive	1	Bipolar calcification, larva alive	10	2	.2	1 cyst, 1 dead larva.
402	Dead	do	Negative	1	Calcified	16	0	0	
403	Live	Negative	Positive	0		90	7	.08	Live.
404	do	do	do	0		110	16	.15	Do.
405	do	do	do	0		55	1	.02	Do.
406	Mixed	Positive	do	14	All cysts calcified, 3 calcified larvae, 11 live larvae	95	3	.03	1 live, 2 dead.
407	Dead	do	Negative	1	Calcified	10	0	0	
408	Mixed	do	Positive	1	Unipolar calcification, larva dead	75	4	.05	Live.
409	Live	do	do	2	Calcified	75	23	.3	Do.
410	Mixed	Negative	do	0		75	3	.04	2 live, 1 dead.
411	Live	Positive	do	2	Slightly calcified	65	6	.09	Live.
412	Mixed	do	do	1	Bipolar calcification, larva degenerated	100	9	.09	8 live, 1 cyst.
413	Live	Negative	do	0		14	2	.14	Live.
414	Dead	Positive	Negative	2	Calcified, larvae calcified	22	0	0	
415	Mixed	do	Positive	2	Bipolar calcification; 1 live, 1 dead larva	75	215	2.87	1 cyst, 55 dead, 159 alive.
416	Live	Negative	do	0		7	21	3	Live.
417	Dead	Positive	Negative	2	Bipolar calcification, 1 larva calcified, the other degenerated.	50	0	0	
418	do	Negative	Positive	0		65	1	.02	Cyst, dead.
419	do	Positive	Negative	2	Calcified, larvae calcified	50	0	0	
420	Mixed	do	Positive	1	Slightly calcified, larva dead	10	4	.4	3 dead, 1 alive.
421	Live	Negative	do	0		20	1	.05	Live.
422	do	do	do	0		40	2	.05	Do.
423	Dead	Positive	Negative	6	Calcified, larvae degenerated	25	0	0	
424	do	do	do	1	Bipolar calcification	125	0	0	
425	Mixed	Negative	Positive	0		19	10	.53	7 live, 3 dead.
426	Live	do	do	0		75	4	.05	Live.
427	Dead	Positive	Negative	9	Calcified, larvae calcified	100	0	0	
428	Live	Negative	Positive	0		15	7	.46	Do.

TABLE 1.—*Findings for positive cases*—Continued

Positive number	State of trichinae	Findings		Microscopic				Digestion-Baermann			
		Microscopic	Digestion	Number of cysts per gram	State of cysts	Amount of diaphragm digested (gm.)	Total number of larvae recovered	Number per gram	State of larvae
429	Mixed	Positive	Negative	2	Slight bipolar calcification, 1 larva degenerated and 1 calcified.	30	22	.73	14 dead, 8 live.
430	Dead	do	Negative	1	Slight calcification, larva calcified	40	0	0	
431	Live	Negative	Positive	0		15	2	.13	Live.
432	do	Positive	do	4	Bipolar calcification, larvae alive	45	2	.05	Do.
433	do	Negative	do	0		50	3	.06	Do.
434	Dead	Positive	Negative	1	Bipolar calcification, larva dead	60	0	0	
435	Mixed	do	Positive	1	Larva alive	30	14	.47	12 live, 2 dead.
436	Dead	do	Negative	9	Slightly calcified, larvae dead, calcified or degenerate	65	0	0	
437	Live	do	Positive	1	Slight bipolar calcification, larva alive	70	1	.01	Live.
438	do	Negative	do	0		50	1	.02	Do.
439	Mixed	do	do	0		45	24	.53	23 live, 1 dead.
440	Dead	Positive	Negative	2	Slightly calcified, larvae degenerate	7	0	0	
441	do	do	do	1	Larva degenerate	45	0	0	
442	do	do	do	1	Larva dead and calcified	50	0	0	
443	do	do	do	8	Larvae dead, cysts with varying calcification	35	0	0	
444	Mixed	Negative	Positive	0		35	6	.17	3 live, 3 dead.
445	do	Positive	do	1	Slightly calcified, larva calcified	75	20	.27	Live.
446	Dead	Negative	do	0		25	1	.04	Cyst, larva calcified.
447	Mixed	do	do	0		100	3	.03	2 live, 1 dead.
448	Dead	do	do	0		20	1	.05	Dead.
449	do	Positive	Negative	1	Larva degenerate, cyst calcified	25	0	0	
450	Mixed	Negative	Positive	0		25	18	.72	16 live, 2 dead.
451	Dead	Positive	Negative	1	Cyst and larva calcified	35	0	0	
452	Live	Negative	Positive	0		25	2	.08	Live.
453	Dead	Positive	do	2	Calcified, larvae degenerate	75	2	.03	Cysts, dead.
454	Live	Negative	do	0		75	4	.05	Live.
455	do	do	do	0		55	1	.02	Do.
456	Dead	Positive	Negative	1	Calcified	50	0	0	
457	Mixed	do	Positive	1	Slight bipolar calcification, larva alive	30	20	.67	18 live, 2 dead.
458	Dead	do	Negative	6	Bipolar calcification, 1 larva calcified, 5 degenerate	100	0	0	
459	Mixed	do	Positive	2	1 cyst with bipolar calcification, larva alive, 1 generalized calcification.	25	2	.08	Live.
460	Live	Negative	do	0		100	5	.05	Do.
461	Dead	Positive	Negative	8	Bipolar calcification, larvae calcified	75	0	0	
462	Mixed	do	Positive	1	do	70	5	.07	4 live, 1 dead.
463	Live	do	do	1	Very slightly calcified	55	82	1.5	Live.
464	Mixed	Negative	Positive	0		60	14	.23	9 dead, 5 live.
465	Dead	do	do	0		100	2	.02	2 dead.

466	Mixed	do	do	0		18	4	.2	3 dead, 1 live.
467	Live	do	do	0		55	10	.2	Live.
468	Dead	Positive	Negative	2	Calcified, larvae degenerate	70	0	0	
469	Mixed	do	Positive	1	Calcified, larva alive	100	13	.13	12 live, 1 dead.
470	do	do	do	6	Larvae and cysts calcified	35	1	.03	Live.
471	Dead	do	Negative	2	1 larva and cyst calcified, 1 polar calcification, larva dead.	14	0	0	
472	Mixed	do	Positive	1	Slight bipolar calcification, larva degenerate	65	1	.02	Do.
473	Dead	Negative	do	0		65	1	.02	Cyst, dead.
474	Live	do	do	0		35	1	.03	Live.
475	Dead	Positive	Negative	2	Calcified	35	0	0	
476	do	do	do	1	do	25	0	0	
477	Mixed	Negative	Positive	0		25	3	.12	2 live, 1 dead.
478	Live	do	do	0		55	1	.02	Live.
479	do	do	do	0		30	1	.03	Do.
480	do	do	do	0		55	1	.02	Do.
481	Mixed	do	do	0		150	21	.14	14 dead, 7 live.
482	do	Positive	do	34	15 dead; 2 calcified, 4 heavily calcified cysts; all but 1 cyst with bipolar calcification, more than 1 larva in several cysts.	65	1,315	20.2	2 cysts; more than 50 percent of larvae dead.
483	Dead	do	Negative	1	Larva and cyst calcified	30	0	0	
484	do	do	do	1	do	100	0	0	
485	do	do	Positive	28	Larvae and cysts heavily calcified	100	6	.06	Cysts, dead.
486	Mixed	do	do	4	3 live, 1 calcified larva. Bipolar calcification	30	11	.37	2 live, 8 dead, 1 cyst.
487	Dead	do	Negative	4	Polar calcification	40	0	0	
488	do	do	do	2	Bipolar calcification, larvae calcified	40	0	0	

dence was 25 percent, the remaining positives being found in the intercostal, rectus abdominis, and pectoral muscles. Hood and Olson (*7*) have examined the diaphragms from 428 necropsies in the Chicago area. In the first 208 examinations, in which only the digestion method was used, 12 were found positive for trichinae, an incidence of 5.77 percent. The remaining 220 examinations were carried out by the digestion and microscopic methods and 25, or 11.36 percent, were found positive; a higher incidence was obtained when greater quantities of diaphragm muscle were used. Sawitz (*8*) reported an incidence of 6 percent in 400 examinations of diaphragm and pectoral muscle from unselected autopsies in New Orleans. The examination of the diaphragms revealed 87 percent and of the pectoral muscle 56.5 percent of the positives. Butt and Lapeyre (*9*) at Los Angeles found 18.2 percent of 170 diaphragms infected with trichinae.

The reports of Evans, Walker and Breckenridge, and Hood and Olson illustrate the increase in incidence which is obtained by using either more muscle or other muscles in addition to the diaphragm, and both the direct microscopic and digestion-Baermann methods. Our data further substantiate the results as regards the latter point, for the microscopic method detected an incidence of 10.7 percent and the digestion-Baermann method an incidence of 10.2 percent in the 3,000 examinations. Sixty-six percent of the 488 positive specimens were detected by the microscopic method and 62.7 percent by the digestion method. The use of either technique alone would have failed to detect approximately one-third of the infections. In addition, one of us (Jacobs (*10*)), using the direct microscopic method, studied a 10-gm. sample from each of 100 specimens received and recorded as negative by routine methods. He found 6 positive specimens in these 100 examinations, thus indicating that our incidence figure is probably less than the true incidence. It is therefore obvious that we have not uncovered all of the infections in the cases from which specimens of diaphragm muscle have been examined. However, the methods outlined above have disclosed all the heavy infections which undoubtedly represented clinical trichinosis at some time or other as well as numerous light infections of unknown bearing on the health of the individual. Probably our technique has failed to disclose some infections of dead trichinae of the order of less than one larva per gram.

From the practical standpoint of the health of the individual, the cases with less than one larva per gram are probably without significance. However, they are of value as adding emphasis to existing data showing the widespread distribution of the parasite in the population and of delineating further the potential hazards involved in the present haphazard methods of dealing with this important public health problem.

The efficiency of the two methods of examination with respect to the state of the larvae is given in table 2. It will be noted that the digestion method detected 128, or 73.1 percent, of the 175 infections with live larvae only and 261, or 98.9 percent, of the 264 infections in which live larvae were encountered, including cases with mixed live and dead larvae. The microscopic method detected 179, or 79.9 percent, of the 224 infections in which only dead larvae were found and 275, or 87.9 percent, of the 313 infections in which dead larvae were encountered, including cases in which both live and dead larvae were present. As would be expected, the microscopic method was more efficient in detecting infections with dead larvae and the digestion method more effective in detecting infections with live larvae.

TABLE 2.—*The respective efficiency of the microscopic and digestion-Baermann methods, singly and together, in detecting infection with live, dead, and mixed live and dead trichinae in 488 positive cases examined by both methods*

State of larvae	Positive cases		Efficiency of methods of examination employed					
			Cases detected only by microscopic method		Cases detected only by digestion method		Cases detected by both methods	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Live	175	35.9	2	1.2	128	73.1	45	25.7
Dead	224	45.9	179	79.9	23	10.3	22	9.8
Mixed live and dead	89	18.2	1	1.1	15	16.9	73	82.0
Total	488	100	182	37.3	166	34.0	140	28.7

TABLE 3.—*Cooperating hospitals listed with relation to the number of diaphragms furnished, percent of total diaphragms, and number and percent of positive cases*

Hospital	Number of diaphragms furnished	Percent of total diaphragms	Number of diaphragms positive	Incidence percent
A. Washington, D. C., hospitals				
Gallinger Municipal Hospital	634	21.1	112	17.7
Veterans' Administration Facility	229	7.6	40	17.5
George Washington Hospital	30	1.0	5	16.7
Freedmen's Hospital	162	5.4	26	16.0
St. Elizabeths Hospital	581	19.5	90	15.5
Garfield Memorial Hospital	154	5.1	23	14.9
Georgetown Hospital	7	.2	1	14.3
U. S. Naval Hospital	51	1.7	7	13.7
Walter Reed General Hospital	410	13.6	55	13.4
Children's Hospital	72	2.4	3	4.2
Total	2,330	77.7	362	[1] 15.5
B. Hospitals outside of the District of Columbia				
U. S. Marine Hospital, Baltimore, Md	334	11.1	72	21.6
U. S. Naval Hospital, Brooklyn, N. Y	5	.2	1	20.0
U. S. Naval Hospital, Chelsea, Mass	59	2.0	11	18.6
U. S. Naval Hospital, Philadelphia, Pa	206	6.9	35	17.0
U. S. Marine Hospital, Stapleton, N. Y	63	2.1	7	11.1
U. S. Naval Hospital, Norfolk, Va	3	.1	0	0
Total	670	22.3	126	[2] 18.8
Grand total	3,000	100.0	488	[3] 16.3

[1] Standard deviation of 15.5 percent is ±0.75.
[2] Standard deviation of 18.8 percent is ±1.57.
[3] Standard deviation of 16.3 percent is ±0.67.

Table 3 shows the number of specimens received from the various cooperating hospitals and the incidence of infection for each hospital. In order to secure a local incidence figure for the District of Columbia, the cooperating hospitals in Washington, D. C., have been listed separately from those located in other cities. While it is recognized that material from such hospitals as Walter Reed, the Naval Hospital, and the Veterans' Administration Facility may not necessarily come from local residents and that the inclusion of the data from these hospitals may weight the series, it is believed that the figure, 15.5 percent, with a standard deviation of 0.75, probably represents the incidence for the District of Columbia.

The examination of the 670 diaphragms received from hospitals located outside of Washington, D. C., revealed a trichina incidence of 18.8 percent with a standard deviation of 1.57. Many of these diaphragms came from individuals who, because of their military or merchant marine connection, probably moved periodically from place to place and therefore had been subjected to varying opportunities for infection in the various localities in which they lived. Since this incidence is not significantly different from that found in the diaphragms from the hospitals in the District of Columbia, it seems probable that the incidence of 16.3 percent for the series as a whole is not materially different from that which may be found in other sections of the United States.

There is, however, a possible further qualification of this figure in that the population represented is for the most part an urban population. Swine fed on raw garbage are the chief source of human trichinosis and most of the garbage-fed hogs are marketed in cities. It is thus reasonable to expect a higher incidence of trichinae in an urban population than in a rural population. The proof of this supposition remains to be verified by a survey of the rural population which is being conducted at the present time and on which a report will be made later.

INTENSITY OF INFECTION

Hall and Collins (*1*) and Nolan and Bozicevich (*2*) classified their positive cases into seven arbitrary groups on the basis of the intensity of the infection. This grouping is also used in this paper. The numbers of cases in the various groupings are presented in table 4. The assignment to the various groups was made on the basis of the microscopic findings, when positive, because of their direct and positive character; the digestion-Baermann findings per gram were used for the other cases. All of the cases in group 1 are classified on the basis of the digestion-Baermann findings. The cases in the remaining groups, with the exception of two in group 2, are classified on the basis of the microscopic findings.

TABLE 4.—*Intensity of infection in terms of larvae per gram in 488 positive diaphragms*

Group number	Larvae per gram	Number of cases	Percent	Number of cases with larvae in the various states		
				Live	Dead	Mixed
1	Less than 1	167	34.2	128	24	15
2	1–10	258	52.9	39	162	57
3	11–50	48	9.8	5	29	14
4	51–100	7	1.4	1	4	2
5	101–500	5	1.0	2	2	1
6	501–1,000	3	.6	0	3	0
7	Over 1,000	0	0	0	0	0
Total		488	100.0	175	224	89

The percentage of positive cases falling in each group shows no significant change from that reported by Nolan and Bozicevich (*2*). If those cases with over 100 larvae per gram are considered as representing possible cases of clinical trichinosis, as has been suggested by Hall and Collins (*1*), then 8, or 1.6 percent, of our 488 positive diaphragms were from individuals who at one time probably suffered from clinical trichinosis.

Hall and Collins suggested the theory that the rapidity with which trichinae die and calcify is proportional to the degree of infection. It is felt that the data obtained subsequent to that for which the theoretical explanation was offered neither strengthen nor disprove the explanation. Cases with relatively heavy infections are too few to warrant any conclusions at this time.

SUMMARY

This paper presents a final report of the results of the examination for trichinae of 3,000 diaphragms in a series of specimens obtained from 10 hospitals in Washington, D. C., and 4 United States Naval Hospitals and 2 United States Marine Hospitals in eastern seaboard cities. Results of the first 300 examinations in this series were reported by Hall and Collins (*1*), and the results of the first 1,000 examinations by Nolan and Bozicevich (*2*). A total of 488, or 16.3 percent, of the 3,000 diaphragms were found positive for trichinae. The standard deviation of the incidence figure is 0.67.

Of the 3,000 diaphragms, 2,330 came from hospitals in Washington, D. C. Of these 2,330 specimens, 362, or 15.5 percent, were infected with trichinae. The standard deviation of this incidence figure is 0.75. The remaining 670 diaphragms came from Service hospitals located in cities other than Washington, D. C. Of these 670 specimens, 126, or 18.8 percent, were positive for trichinae. The standard deviation of this figure is 1.57. It is believed that the percentage of individuals positive for trichinae in the present series will not differ materially from that which may be found in similar population groups in other parts of the United States.

Both the direct microscopic and the digestion-Baermann methods were used in examining the diaphragms. The direct microscopic method was almost 90 percent effective in detecting infections in which dead larvae were present; the digestion-Baermann method detected all but one of the infections in which live trichinae were present. Of the 488 positive diaphragms, 220 contained dead larvae only, 175 contained live larvae only, and 89 were found infected with both live and dead larvae.

The findings in the majority of the positive cases indicated that the individuals represented had fairly light trichina infections. On the other hand, 1.6 percent of the positive diaphragms contained more than 100 larvae per gram, and in such cases it is reasonable to assume that the persons represented probably suffered from clinical trichinosis at some time.

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MEDICAL AND NURSING SERVICES FOR THE MATERNAL CASES OF THE NATIONAL HEALTH SURVEY [1]

Record of the amount and kind of medical and nursing care received in cases of illness occurring during a 12-month period was obtained in the National Health Survey, an enumeration of 2,500,000 white and colored persons in 83 cities. The cities were so selected according to size and geographic region as to give a sample representative in general of cities in the United States. The present report deals with the extent to which certain medical and nursing services were received by confinement cases.

White women in urban communities.—Care of the confinement case in cities was largely under the supervision of physicians, at least 95 percent of the cases in each economic group being so attended. Hospitalization rose sharply with income; the rate in the total group was 65 percent. For the proportion of cases reported as receiving no care from physicians, the reverse relation obtains. These relations are observed in cities of different sizes and in different regions, but the degree of change with income varies. Small cities (under 25,000) of the South deviate from the experience of the total group most strikingly, the increase in hospitalization with income and the inverse rela-

[1] Goddard, Jennie C.: Medical and Nursing Services for the Maternal Cases of the National Health Survey. Public Health Bulletin No. 264. U. S. Government Printing Office, 1941. Available from the Superintendent of Documents, Washington, D. C., at 15 cents per copy.

tion in the proportion receiving no medical care being more pronounced than in other city-size and region groups.

About 80 percent of the maternal cases received nursing care. Among the more important findings relative to the proportion of maternal cases which received nursing care are (*a*) the tendency for increase with income among the total group of cases and among those in cities of different sizes and in different regions; (*b*) the greater variation in small than in large cities; and (*c*) the relatively greater frequency of visiting nursing service among cases in families of low income than among the more well-to-do.

Among that third of the cases which were not hospitalized, 38 percent received nursing care. Although women in relief families received nursing care with greater frequency than those in the nonrelief groups except the group with incomes of $2,000 and over, care of those in the relief group consisted largely of visiting nursing service and receipt of care from private-duty nurses increased markedly with income. These inequalities are of importance in view of the diverse character of the two types of care. In each region, a higher proportion of cases in the relief group received nursing care than of those in the nonrelief groups in large cities (100,000 and more); the reverse is true in small cities (under 25,000). Maternal cases among women of comparatively low income received the bulk of the visiting nursing service, especially in the large cities; rise with income in the proportion receiving bedside care from private-duty nurses obtains regardless of size of city or region of residence.

Colored women in urban communities.—(Residents of cities under 100,000 population except in the South and residents of the West were excluded.) Among colored women receipt of medical and nursing care varied widely according to size of city and region; in cities of 100,000 and more population in the Northeast, 72 percent were hospitalized and 3 percent were reported as receiving no medical care; in cities of 25,000 to 100,000 in the South, 8 percent were hospitalized and 59 percent received no medical care. By relief status, fluctuations were not so marked.

Comparisons of receipt of medical care by maternal cases among white and among colored women show that: (*a*) In relief families living in the large cities of the Northeast and North Central States, hospital care was received with somewhat greater frequency by the colored than by the white women, the cases reported as receiving no medical care comprising a somewhat smaller proportion of the colored; among nonrelief families in these cities, hospital care was received with greater frequency by white women. (*b*) In large cities in the South, among relief families white women received hospital care with greater frequency and there were relatively fewer cases not receiving medical care than among the colored; among the nonrelief families these

differences obtained but the variations were considerably more marked. (*c*) It is in the smaller cities of the South that the greatest inequalities in receipt of medical care are found. In cities of 25,000 to 100,000 about 60 percent of the maternal cases among the colored population were reported as receiving no medical care and only 8 percent were hospitalized in comparison with rates among the white of less than 5 percent receiving no medical care and around 40 to 60 percent receiving hospital care. In smaller cities there were also marked contrasts in receipt of medical care by the white and by the colored maternal cases.

Receipt of nursing care by all maternal cases among the white and among the colored women showed contrasts similar to those observed for medical care.

Women in selected rural areas.—Both medical and nursing care were received by women in the rural areas surveyed decidedly less frequently than among women in urban communities.

Prenatal and operative services.—Receipt of prenatal care by non-hospitalized cases manifests a close relation to economic status; this relation holds true for the total group of cases and for the various city-size groups. Moreover, on the average, pregnant women were under supervision for a longer time in cities with population of 100,000 and more and in those of less than 10,000 than in cities of intermediate size; women pregnant for the first time were also under supervision for a longer time, on the average, than those who had previously experienced pregnancy.

In cities under 25,000 population, the proportion of women receiving Wassermann examinations during pregnancy rose with income (non-hospitalized cases only), while the reverse was true in larger cities. The percentage of pregnant women receiving this service was lowest in cities of less than 10,000 population, about twice as high in cities of 10,000 to 100,000 as in the smaller cities, and about three times as high in cities of 100,000 and more. Receipt of Wassermann examinations appears to bear little relation to the amount of prenatal supervision received.

The relation between receipt of maternal services and economic status is strikingly apparent with respect to obstetric techniques employed during delivery. For each of the techniques studied (cesarean section, episiotomy, and forceps), a sharp rise with income is found in the proportion of cases in which the technique was employed.

COURT DECISION ON PUBLIC HEALTH

Mere possession of unwholesome poultry held not violative of sanitary code provision.—(New York Supreme Court, Appellate Division, Second Department; *People* v. *Swift & Co., Inc.*, 25 N.Y.S.2d 512; decided March 3, 1941.) The defendant company, a wholesale dealer in food, was convicted of a violation of section 163 of the Sanitary Code of New York City, which section, so far as material, provided: "No meat, * * * not being then healthy, fresh, sound, wholesome, or safe for human food * * * shall be brought into the city of New York or held, kept, offered for sale or sold as such food or kept or stored anywhere in the said city. * * * The term 'meat' as used herein shall include * * * fowl. * * *" It appeared that the defendant's procedure relative to poultry was as follows: Poultry was delivered to the defendant's storage room packed in boxes, each box containing 12 chickens and weighing approximately 45 pounds. After the classification of a shipment for size, quality, and color, 3 to 5 boxes of each classification were opened and the birds examined. If they appeared sound the covers were replaced and the lot placed in a cooler. When poultry was required on the sales floor 20 or 25 boxes were requisitioned from the cooler and 3 to 5 boxes were opened and the contents examined in the storage room for the second time. If they appeared to be sound the lot was sent to the sales room. Before the poultry was sold every box was opened in the presence of the customer and the contents again examined, this third examination being by both the defendant's salesman and the customer. Each bird was removed from the box only when "they look as if they are in any way off condition."

On a certain date 2 health department inspectors examined 20 boxes of a lot of between 100 and 125 boxes in the cooler. They found 22 chickens which concededly were unwholesome. The lower court held that the merchandise in the cooler was being kept for sale within the meaning of the sanitary code section and found the defendant guilty.

On appeal by the company the appellate court reversed the judgment, dismissed the information, and remitted the fine. The court cited a recent court of appeals case as authority for the proposition that possession alone, without intent to sell unwholesome food, was not a violation of the involved section and said that in its opinion the defendant made an honest effort to ascertain whether the poultry was unwholesome and did not intend to sell it if inspection disclosed that it was unsound.

DEATHS DURING WEEK ENDED APRIL 5, 1941

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

	Week ended Apr. 5, 1941	Corresponding week, 1940
Data from 88 large cities of the United States:		
Total deaths	8,575	9,214
Average for 3 prior years	8,878	
Total deaths, first 14 weeks of year	132,285	133,297
Deaths under 1 year of age	470	546
Average for 3 prior years	523	
Deaths under 1 year of age, first 14 weeks of year	7,574	7,258
Data from industrial insurance companies:		
Policies in force	64,571,281	65,866,801
Number of death claims	12,661	13,926
Death claims per 1,000 policies in force, annual rate	10.2	11.1
Death claims per 1,000 policies, first 14 weeks of year, annual rate	10.8	10.7

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 APRIL 12, 1941

Summary

Decreases were recorded during the current week for each of the 9 important communicable diseases included in the following table, with the exception of smallpox, for which the same number of cases (33) was reported for the two weeks. This figure is lower than that reported for any prior corresponding week.

The number of reported cases of measles decreased from 56,338 for the preceding week to 53,256, with the highest incidence rates still being recorded for the Middle Atlantic, East North Central, and South Atlantic States. The largest decrease for the current week was shown for the Middle Atlantic area, and this was more than sufficient to offset the slight increases in some of the other geographic areas.

A total of 435,181 cases of measles has been reported to date (first 15 weeks of the year), as compared with 488,032 cases for the corresponding period in 1938, the latest preceding "measles year." With the peak coming later during the current year, it appears likely that the final total for 1941 will exceed that for 1938.

The number of cases of meningococcus meningitis dropped from 70 for the preceding week to 48, and of poliomyelitis from 21 to 18. Six of the cases of poliomyelitis were reported in Florida (5 last week). Eight cases of meningococcus meningitis were reported in Mississippi, 6 in Pennsylvania, 5 in New York, and 4 in North Carolina.

Of 12 cases of Rocky Mountain spotted fever, 7 cases occurred in Montana, 3 in Oregon, and 2 in Wyoming.

One case of psittacosis was reported in Washington, D. C.[1]

The death rate for the current week for 93 major cities in the United States was 11.9 per 1,000 population, as compared with 12.0 for the preceding week and with a 3-year average (1938–40) of 12.2 for the corresponding week (88 cities).

[1] See p. 863.

Telegraphic morbidity reports from State health officers for the week ended April 12, 1941, and comparison with corresponding week of 1940 and 5-year median

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

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median 1936–40	Week ended—		Median 1936–40	Week ended—		Median 1936–40	Week ended—		Median 1936–40
	Apr. 12, 1941	Apr. 13, 1940		Apr. 12, 1941	Apr. 13, 1940		Apr. 12, 1941	Apr. 13, 1940		Apr. 12, 1941	Apr. 13, 1940	
NEW ENG.												
Maine	0	1	1	2	2	19	56	533	114	1	0	0
New Hampshire	0	0	0	2	----	----	58	93	29	0	0	0
Vermont	0	0	0	----	----	----	18	6	48	0	0	0
Massachusetts	3	6	6	----	----	----	921	604	714	2	0	2
Rhode Island	0	2	2	----	----	----	3	156	75	0	0	0
Connecticut	3	1	1	----	5	5	228	89	91	2	1	0
MID. ATL.												
New York	19	11	34	[1] 18	[1] 14	[1] 14	7,601	641	1,839	5	7	10
New Jersey	4	5	12	9	10	10	2,299	533	533	2	0	2
Pennsylvania	18	25	25	----	----	----	5,316	211	737	6	8	8
E. NO. CEN.												
Ohio	6	11	15	14	78	26	8,945	27	237	1	0	3
Indiana	13	2	9	7	24	24	1,301	5	26	0	0	2
Illinois	13	17	30	30	13	33	3,854	92	92	0	1	3
Michigan [2]	2	3	11	8	25	11	4,745	464	324	0	0	4
Wisconsin	1	0	3	89	134	60	1,622	463	463	1	0	1
W. NO. CEN.												
Minnesota	0	2	2	1	3	1	10	178	178	1	0	1
Iowa	3	9	9	84	9	9	309	370	196	1	0	0
Missouri	3	5	11	2	----	48	274	71	31	0	3	1
North Dakota	1	3	1	7	28	22	7	10	10	0	0	0
South Dakota	0	3	2	----	----	----	2	9	0	0	0	0
Nebraska	0	0	1	----	----	----	17	24	67	0	0	0
Kansas	2	4	4	6	21	21	1,328	597	47	0	2	1
SO. ATL.												
Delaware	0	0	0	----	----	----	282	1	13	0	0	0
Maryland [2 3]	1	1	2	14	11	11	215	8	247	3	1	1
Dist. of Col. [4]	3	2	4	1	----	1	341	3	68	0	0	1
Virginia	3	13	10	229	328	328	1,862	102	486	2	2	4
West Virginia	5	10	9	38	59	59	637	18	53	0	4	6
North Carolina [3]	6	12	12	[2] 84	14	43	1,776	177	248	4	0	2
South Carolina	10	11	4	408	442	429	804	27	41	0	0	0
Georgia [3]	7	10	8	92	94	201	787	89	89	1	0	1
Florida [3]	5	3	4	185	7	7	1,099	127	95	0	0	3
E. SO. CEN.										0		
Kentucky	4	2	9	4	10	34	1,784	93	93	2	0	5
Tennessee	4	4	6	87	96	154	647	145	69	1	1	1
Alabama [3]	8	9	10	119	142	365	639	144	134	8	4	4
Mississippi [2 3]	4	5	5	----	----	----	----	----	----		1	1
W. SO. CEN.												
Arkansas	8	7	5	168	99	99	390	24	24	0	0	1
Louisiana	5	9	9	20	25	26	167	5	15	0	1	1
Oklahoma	6	5	7	58	171	171	136	18	61	0	1	2
Texas [3]	36	17	33	1,232	641	646	1,127	882	535	3	0	2
MOUNTAIN												
Montana [5]	1	1	1	1	12	12	74	23	16	0	0	0
Idaho	0	3	1	1	5	5	4	52	39	0	0	0
Wyoming [5]	0	2	0	----	----	----	58	29	29	0	0	0
Colorado	12	12	10	19	23	----	375	25	25	1	0	1
New Mexico	1	4	3	6	----	4	260	29	35	0	1	1
Arizona	4	1	2	101	93	93	53	53	53	0	0	0
Utah [2]	0	0	0	6	7	----	21	636	110	0	0	0
Nevada	0	----	----	----	----	----	0	----	----	0	----	----
PACIFIC												
Washington	1	0	0	3	----	1	110	763	378	0	0	0
Oregon [5]	3	5	2	10	11	44	354	642	70	0	0	0
California [3]	13	14	16	304	186	186	340	455	541	1	1	1
Total	241	272	397	3,439	2,842	3,201	53,256	9,746	11,559	48	39	69
15 weeks	4,358	5,485	7,637	576,751	155,283	129,527	435,181	95,996	128,696	742	[6] 614	1,295

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended April 12, 1941, and comparison with corresponding week of 1940 and 5-year median—Continued

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended—		Median 1936–40	Week ended—		Median 1936–40	Week ended—		Median 1936–40	Week ended—		Median 1936–40
	Apr. 12, 1941	Apr. 13, 1940		Apr. 12, 1941	Apr. 13, 1940		Apr. 12, 1941	Apr. 13, 1940		Apr. 12, 1941	Apr. 13, 1940	
NEW ENG.												
Maine	0	0	0	15	13	15	0	0	0	1	0	1
New Hampshire	0	0	0	5	7	7	0	0	0	1	0	0
Vermont	0	0	0	25	3	9	0	0	0	0	0	0
Massachusetts	1	0	0	206	187	308	0	0	0	0	0	0
Rhode Island	0	0	0	5	12	18	0	0	0	0	0	0
Connecticut	0	0	0	64	97	102	0	0	0	3	3	0
MID. ATL.												
New York	1	1	1	727	998	998	0	0	0	4	5	5
New Jersey	0	0	0	220	435	214	0	0	0	1	3	2
Pennsylvania	0	0	0	420	482	482	0	0	0	6	6	6
E. NO. CEN.												
Ohio	0	1	0	296	310	389	1	1	2	0	4	4
Indiana	0	0	0	137	162	172	0	0	14	0	5	2
Illinois	0	0	1	426	773	773	3	0	10	2	1	4
Michigan [2]	0	1	0	306	373	474	0	0	3	4	0	2
Wisconsin	1	0	0	116	122	175	3	2	3	1	2	
W. NO. CEN.												
Minnesota	0	0	0	48	29	113	0	3	4	0	1	0
Iowa	1	0	0	53	78	204	3	19	47	1	1	1
Missouri	0	0	0	109	41	167	6	3	23	0	1	2
North Dakota	0	0	0	4	7	16	0	0	5	0	1	1
South Dakota	0	0	0	13	17	23	0	2	9	0	0	0
Nebraska	0	0	0	26	15	36	0	0	8	0	0	0
Kansas	1	0	0	41	52	153	1	0	37	0	2	1
SO. ATL.												
Delaware	0	0	0	19	5	10	0	0	0	0	0	0
Maryland [2 3]	1	0	0	25	35	50	0	0	0	1	1	1
Dist. of Col. [4]	0	0	0	18	25	21	0	0	0	3	0	1
Virginia	0	0	0	32	39	29	0	0	0	1	3	3
West Virginia	0	2	1	71	66	39	1	0	0	1	1	1
North Carolina [3]	1	0	0	21	28	28	2	0	0	8	0	2
South Carolina	0	0	0	6	0	3	1	0	0	3	2	2
Georgia [3]	0	0	0	15	12	12	0	0	0	3	4	3
Florida [3]	6	0	0	2	4	6	0	0	0	2	0	3
E. SO. CEN.												
Kentucky	1	0	0	167	79	57	0	0	2	3	5	5
Tennessee	1	1	1	104	80	28	0	6	1	0	4	4
Alabama [3]	0	0	0	11	15	12	0	1	0	1	3	2
Mississippi [2 3]	0	1	1	10	7	6	0	2	0	1	1	1
W. SO. CEN.												
Arkansas	0	0	0	8	4	3	6	3	1	0	4	1
Louisiana	0	0	0	5	7	12	1	0	0	0	3	6
Oklahoma	0	0	0	10	33	33	0	0	7	0	2	1
Texas [3]	2	0	1	63	25	118	3	5	11	5	2	13
MOUNTAIN												
Montana [5]	0	0	0	41	30	30	0	0	9	0	2	0
Idaho	0	0	0	3	16	16	0	1	3	0	1	0
Wyoming [5]	0	0	0	12	4	7	0	0	2	0	2	0
Colorado	0	0	0	26	44	43	0	18	6	0	3	0
New Mexico	1	0	0	8	16	16	0	0	0	0	1	1
Arizona	0	0	0	7	6	11	0	0	0	0	1	1
Utah [3]	0	1	0	7	15	21	0	0	0	1	0	0
Nevada	0			4			0			0		
PACIFIC												
Washington	0	1	0	14	44	39	0	0	6	3	1	1
Oregon [5]	0	0	0	13	14	35	2	1	4	2	0	1
California [3]	0	2	3	124	129	192	0	5	18	2	4	4
Total	18	11	14	4,108	4,995	5,690	33	72	306	64	85	98
15 weeks	390	388	307	55,778	71,706	90,774	671	1,075	4,698	1,125	1,165	1,644

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended April 12, 1941, and comparison with corresponding week of 1940—Continued

Division and State	Whooping cough Week ended— Apr. 12, 1941	Apr. 13, 1940
NEW ENG.		
Maine	43	38
New Hampshire	4	20
Vermont	9	28
Massachusetts	158	175
Rhode Island	21	5
Connecticut	40	24
MID. ATL.		
New York	283	440
New Jersey	69	99
Pennsylvania	348	357
E. NO. CEN.		
Ohio	426	174
Indiana	23	41
Illinois	76	114
Michigan [2]	330	137
Wisconsin	88	91
W. NO. CEN.		
Minnesota	83	30
Iowa	65	9
Missouri	40	7
North Dakota	25	12
South Dakota	30	2
Nebraska	30	8
Kansas	115	50
SO. ATL.		
Delaware	4	2
Maryland [2 3]	64	180
Dist. of Col. [4]	18	10
Virginia	148	38
West Virginia	44	49
North Carolina [3]	312	106
South Carolina	129	21
Georgia [3]	61	14
Florida [3]	13	19
E. SO. CEN.		
Kentucky	40	115
Tennessee	48	55
Alabama [3]	48	31
Mississippi [2 3]	----------	----------
W. SO. CEN.		
Arkansas	12	24
Louisiana	9	43
Oklahoma	25	20
Texas [3]	339	386
MOUNTAIN		
Montana [5]	24	3
Idaho	17	15
Wyoming [5]	0	3
Colorado	108	22
New Mexico	29	45
Arizona	21	37
Utah [2]	69	119
Nevada	4	----------
PACIFIC		
Washington	63	55
Oregon [5]	19	39
California [3]	445	305
Total	4,419	3,617
15 weeks	65,057	44,968

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Typhus fever, week ended Apr. 12, 1941, 25 cases as follows: Maryland, 1; North Carolina, 1; Georgia, 8; Florida, 2; Alabama, 4; Mississippi, 1; Texas, 7; California, 1.
[4] Psittacosis, week ended Apr. 12, 1941, Dist. of Col., 1 case.
[5] Rocky Mt. spotted fever, week ended Apr. 12, 1941, 12 cases as follows: Montana, 7; Wyoming, 2; Oregon, 3.
[6] Delayed reports of 16 cases in New York City included.

PSITTACOSIS IN WASHINGTON, D. C.

Report has been received of the occurrence of a case of psittacosis, with onset April 7, 1941, in an employee in the birdhouse of the National Zoological Park in Washington, D. C.

WEEKLY REPORTS FROM CITIES

City reports for week ended March 29, 1941

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	120	429	97	5,773	776	2,192	24	385	19	1,163	------
Current week [1]	50	343	43	20,159	494	1,490	0	334	14	1,213	------
Maine:											
Portland	0	1	0	0	4	1	0	1	0	19	25
New Hampshire:											
Concord	0	------	0	0	0	0	0	0	0	0	9
Manchester	0	------	0	0	0	2	0	0	0	0	24
Nashua	0	------	0	0	0	0	0	0	0	0	7
Vermont:											
Barre	------	------	------	------	------	------	------	------	------	------	------
Burlington	0	------	0	0	0	0	0	0	0	0	10
Rutland	0	------	0	0	1	0	0	1	0	0	4
Massachusetts:											
Boston	1	------	0	304	11	73	0	10	0	47	234
Fall River	0	------	0	0	1	4	0	1	0	7	27
Springfield	0	------	0	4	0	7	0	2	0	8	36
Worcester	0	------	0	52	8	8	0	2	0	1	80
Rhode Island:											
Pawtucket	0	------	0	0	0	1	0	0	1	0	15
Providence	0	1	1	5	3	5	0	1	0	19	69
Connecticut:											
Bridgeport	0	------	2	1	2	5	0	1	0	2	37
Hartford	0	3	0	1	2	9	0	0	0	0	40
New Haven	0	2	1	0	3	21	0	1	0	11	41
New York:											
Buffalo	0	------	0	100	5	46	0	3	0	10	125
New York	13	28	6	6,666	100	318	0	78	5	85	1,623
Rochester	0	------	1	81	3	7	0	1	0	12	74
Syracuse	0	------	0	0	2	3	0	1	0	21	54
New Jersey:											
Camden	0	1	1	24	4	18	0	1	0	1	30
Newark	0	5	0	236	6	40	0	10	0	17	123
Trenton	0	1	0	50	2	57	0	3	0	0	36
Pennsylvania:											
Philadelphia	2	3	2	1,589	29	106	0	19	0	54	534
Pittsburgh	0	------	0	406	11	15	0	8	0	51	180
Reading	0	------	0	195	2	0	0	0	0	6	25
Scranton	0	------	------	1	------	2	0	------	0	2	------
Ohio:											
Cincinnati	0	4	2	681	4	16	0	8	0	2	141
Cleveland	1	8	2	2,760	13	37	0	9	0	77	200
Columbus	0	2	2	145	4	17	0	1	1	14	95
Toledo	0	------	0	79	4	6	0	3	0	14	72
Indiana:											
Anderson	0	------	0	6	1	1	0	0	0	1	4
Fort Wayne	0	------	0	68	5	1	0	1	0	0	36
Indianapolis	5	------	1	406	9	19	0	4	0	9	99
Muncie	0	------	0	33	0	15	0	1	0	0	7
South Bend	0	------	0	26	4	0	0	0	0	0	26
Terre Haute	0	------	0	4	1	0	0	0	0	0	29
Illinois:											
Alton	0	------	0	1	1	3	0	0	0	0	10
Chicago	7	7	3	1,818	22	189	0	32	2	41	675
Elgin	0	------	0	289	1	0	0	0	0	0	11
Springfield	0	------	0	3	1	11	0	0	0	2	31
Michigan:											
Detroit	3	3	0	1,211	12	155	0	15	0	137	240
Flint	0	------	0	168	3	4	0	0	0	15	32
Grand Rapids	0	------	0	568	0	7	0	1	0	6	37
Wisconsin:											
Kenosha	0	------	0	148	1	0	0	0	0	2	7
Madison	0	------	0	61	1	7	0	0	0	2	9
Milwaukee	0	1	0	196	6	36	0	5	0	23	104
Racine	0	------	0	5	0	6	0	0	0	6	19
Superior	0	------	0	0	0	1	0	0	0	0	11

[1] Figures for Barre estimated: report not received.

City reports for week ended March 29, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Minnesota:											
Duluth	0	------	0	1	3	0	0	0	0	22	29
Minneapolis	0	1	1	4	5	13	0	2	0	40	127
St. Paul	0	------	0	2	6	10	0	2	0	12	56
Iowa:											
Cedar Rapids	0	------	--------	0	-------	1	0	-------	0	0	--------
Davenport	0	------	--------	4	-------	3	0	-------	0	0	--------
Des Moines	3	------	--------	2	-------	6	0	-------	0	3	25
Sioux City	0	------	--------	0	-------	3	0	-------	0	2	--------
Waterloo	0	------	--------	23	-------	3	0	-------	0	2	--------
Missouri:											
Kansas City	0	------	3	33	3	12	0	0	0	33	73
St. Joseph	0	------	0	20	5	0	0	0	0	1	30
St. Louis	1	------	0	152	21	68	0	13	1	22	218
North Dakota:											
Fargo	0	------	0	0	1	0	0	0	0	19	12
Grand Forks	0	------	--------	0	-------	0	0	-------	0	0	--------
Minot	0	------	--------	0	-------	0	0	-------	0	4	6
South Dakota:											
Aberdeen	0	------	--------	0	-------	2	0	-------	0	2	--------
Nebraska:											
Lincoln	0	------	--------	3	-------	6	0	-------	0	0	--------
Omaha	0	------	0	1	3	1	0	1	0	0	46
Kansas:											
Lawrence	0	------	0	22	2	0	0	0	0	5	9
Topeka	0	------	0	184	3	3	0	1	0	7	22
Wichita	0	------	0	0	6	0	0	0	0	11	27
Delaware:											
Wilmington	0	------	0	95	4	2	0	0	0	0	26
Maryland:											
Baltimore	0	12	0	90	19	24	0	10	0	57	249
Cumberland	0	------	0	1	0	1	0	0	0	0	13
Frederick	0	------	0	0	1	2	0	0	0	2	4
Dist. of Col.:											
Washington	2	3	1	276	20	14	0	7	2	6	166
Virginia:											
Lynchburg	0	------	1	9	2	2	0	0	0	0	11
Norfolk	1	19	0	399	2	1	0	2	1	2	21
Richmond	0	------	0	52	4	2	0	3	0	0	59
Roanoke	2	------	0	116	1	0	0	0	0	2	16
West Virginia:											
Charleston	0	------	0	23	5	0	0	1	0	1	41
Wheeling	0	------	0	9	0	2	0	0	0	9	16
North Carolina:											
Gastonia	0	------	--------	33	-------	0	0	-------	0	11	--------
Raleigh	0	------	0	340	0	1	0	0	0	23	11
Wilmington	0	------	0	1	2	0	0	2	0	3	15
Winston-Salem	0	2	0	23	3	0	0	0	0	9	22
South Carolina:											
Charleston	0	23	0	42	4	0	0	0	1	1	22
Florence	0	19	0	10	2	0	0	0	0	2	12
Georgia:											
Atlanta	0	7	1	104	7	1	0	4	0	1	86
Brunswick	0	------	0	13	0	0	0	0	0	0	4
Savannah	0	19	2	24	4	1	0	1	0	0	47
Florida:											
Miami	0	7	1	32	0	1	0	2	1	0	44
Tampa	0	1	1	0	1	0	0	0	0	2	25
Kentucky:											
Ashland	0	------	0	0	1	1	0	0	0	0	8
Covington	0	------	0	44	0	2	0	1	0	0	15
Lexington	0	------	0	7	4	0	0	0	0	0	15
Tennessee:											
Knoxville	0	------	0	77	0	13	0	1	0	5	25
Memphis	0	6	0	67	0	4	0	3	0	4	63
Nashville	0	------	1	90	1	10	0	2	0	0	45
Alabama:											
Birmingham	0	8	2	111	7	2	0	3	1	4	678
Mobile	0	6	1	12	0	0	0	0	0	1	20
Montgomery	0	2	--------	15	-------	1	0	-------	0	0	--------
Arkansas:											
Fort Smith	0	------	--------	13	-------	0	0	-------	2	0	--------
Little Rock	1	10	1	13	2	2	0	0	0	10	38
Louisiana:											
Lake Charles	0	------	0	0	0	0	0	0	0	0	2
New Orleans	1	4	2	22	12	1	0	11	0	3	136
Shreveport	0	------	0	2	1	0	0	7	0	0	52

City reports for week ended March 29, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Oklahoma:											
Oklahoma City	1	0	----	0	2	4	0	2	0	0	51
Tulsa	0	0	----	14	1	2	0	0	0	8	16
Texas:											
Dallas	0	----	0	35	7	0	0	1	0	2	63
Fort Worth	0	----	2	97	2	4	0	0	0	7	48
Galveston	0	----	0	0	1	0	0	1	0	0	17
Houston	3	2	0	1	10	3	0	2	0	0	106
San Antonio	0	4	1	1	9	0	0	5	0	1	57
Montana:											
Billings	0	----	0	0	0	0	0	0	0	0	6
Great Falls	0	----	0	1	0	4	0	0	0	0	5
Helena	0	----	0	2	0	4	0	0	0	0	2
Missoula	0	----	0	0	1	0	0	0	0	0	7
Idaho:											
Boise	0	----	0	4	0	1	0	0	0	0	8
Colorado:											
Colorado Springs	0	----	0	3	0	3	0	1	0	5	12
Denver	5	24	0	181	3	4	0	5	0	44	67
Pueblo	0	----	1	2	2	0	0	0	0	8	6
New Mexico:											
Albuquerque	0	----	0	16	0	0	0	5	0	4	12
Utah:											
Salt Lake City	0	----	0	8	4	5	0	0	0	22	37
Washington:											
Seattle	0	----	0	0	0	0	0	2	0	12	76
Spokane	0	----	0	10	0	3	0	0	0	0	35
Tacoma	0	----	0	3	2	0	0	0	0	9	32
Oregon:											
Portland	0	2	0	21	7	2	0	2	0	1	90
Salem	0	----	----	0	----	0	0	----	0	0	----
California:											
Los Angeles	2	23	1	43	6	33	0	16	0	44	356
Sacramento	0	2	0	9	0	6	0	2	1	14	37
San Francisco	1	116	----	6	10	7	0	7	0	47	162

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Massachusetts:				Maryland:			
Springfield	1	0	0	Frederick	1	0	0
New York:				North Carolina:			
New York	2	2	0	Wilmington	1	0	0
Pennsylvania:				Alabama:			
Philadelphia	1	1	0	Birmingham	1	0	0
Michigan:				Louisiana:			
Flint	1	0	0	Shreveport	0	3	0
Missouri:				California:			
St. Louis	1	0	0	Los Angeles	0	1	1

Encephalitis, epidemic or lethargic.—Cases: Newark, 1; Chicago, 1; Florence, 1. Deaths: Boston, 1.
Pellagra.—Cases: Philadelphia, 1; Columbus, 1; Wichita, 1; Charleston, South Carolina, 1; Tampa, 1; Knoxville, 1; Mobile, 1; New Orleans, 1.
Typhus fever.—Cases: Montgomery, 1.
Rabies in man.—Deaths: St. Louis, 1.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended March 8, 1941.—During the week ended March 8, 1941, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis	1	13	2	5	16	1		1	7	46
Chickenpox		17	1	185	294	16	27	18	74	632
Diphtheria	2	15	3	29	2					51
Dysentery				15	1					16
Influenza		13			9	5			31	58
Measles		392	197	395	1,200	125	246	263	1,141	3,959
Mumps				272	271	38	23	31	40	675
Pneumonia		19			12	2	5		7	45
Scarlet fever		23	7	125	248	4	6	22	30	465
Tuberculosis		13	7	79	54	4	8	1		166
Typhoid and paratyphoid fever				16	1	1	2			20
Whooping cough				132	148	1	10	1	25	317

Vital statistics—Third quarter 1940.—The Bureau of Statistics of Canada has published the following preliminary statistics for the third quarter of 1940. The rates are computed on an annual basis. There were 22.0 live births per 1,000 population during the third quarter of 1940 as compared with 20.8 for the third quarter of 1939. The death rate was 8.7 per 1,000 population for the third quarter of 1940 and 8.5 for the same quarter of 1939. The infant mortality rate was 46 per 1,000 live births in this quarter as compared with 53 for the corresponding quarter of 1939. The maternal death rate was 3.4 per 1,000 live births for the third quarter of 1940, and 3.6 for the same quarter of 1939.

The accompanying tables give the numbers of births, deaths, and marriages, by Provinces, for the third quarter of 1940, and deaths by causes in Canada for the third quarter of 1940 and the corresponding quarter of 1939.

Number of births, deaths, and marriages, third quarter, 1940

Province	Live births	Deaths (exclusive of still-births)	Deaths under 1 year of age	Maternal deaths	Marriages
Canada [1]	63,242	25,155	2,883	218	44,606
Prince Edward Island	525	210	21	1	233
Nova Scotia	3,189	1,277	143	7	2,171
New Brunswick	2,944	1,039	197	11	1,794
Quebec	21,257	7,536	1,246	86	14,386
Ontario	17,899	8,798	635	64	14,518
Manitoba	4,043	1,536	176	12	3,073
Saskatchewan	5,261	1,425	187	15	2,070
Alberta	4,415	1,379	166	16	2,873
British Columbia	3,709	1,955	112	6	3,488

[1] Exclusive of Yukon and the Northwest Territories.

Deaths, by cause, third quarter, 1940

Cause of death	Canada [1] (third quarter)		Province								
	1939	1940	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
All causes	24,161	25,155	210	1,277	1,039	7,536	8,798	1,536	1,425	1,379	1,955
Automobile accidents	531	627	3	32	22	171	272	31	22	32	42
Cancer	3,102	3,314	25	186	139	870	1,220	217	164	181	312
Cerebral hemorrhage, cerebral embolism and thrombosis	435	529	12	52	38	118	193	34	25	26	31
Diarrhea and enteritis	1,023	637	9	9	84	349	83	27	36	23	17
Diphtheria	68	38		1	2	18	4		11	2	
Diseases of the arteries	2,326	2,505	18	109	73	489	1,235	157	112	116	196
Diseases of the heart	3,984	4,525	35	223	152	1,066	1,909	271	241	230	398
Homicides	39	50	1	3		12	17	4	2	5	6
Influenza	188	194	1	14	7	67	52	12	11	16	14
Measles	28	21		1		8	5	2	3	1	1
Nephritis	1,383	1,527	12	60	39	766	397	53	72	47	81
Pneumonia	800	888	9	40	34	249	322	74	48	45	67
Poliomyelitis	24	16				6	6	2	1		1
Puerperal causes	213	218	1	7	11	86	64	12	15	16	6
Scarlet fever	17	15				6	5	2	1	1	
Suicides	258	245		7	6	38	74	16	36	37	31
Tuberculosis	1,406	1,426	11	98	60	612	252	96	58	85	154
Typhoid fever	48	62			5	35	10	2	4	2	4
Other violent deaths	1,434	1,425	10	70	50	383	511	74	98	96	133
Other specified causes		6,621	59	345	282	2,073	2,144	432	439	392	455
Unspecified or ill-defined causes		120	3	12	18	41	10	9	11	10	6
Whooping cough	112	152	1	8	17	73	13	9	15	16	

[1] Exclusive of Yukon and the Northwest Territories.

FINLAND

Notifiable diseases—4 weeks ended January 31, 1941.—During the 4 weeks ended January 31, 1941, cases of certain notifiable diseases were reported in Finland as follows:

Disease	Cases	Disease	Cases
Diphtheria	260	Poliomyelitis	12
Dysentery	3	Scarlet fever	478
Influenza	7,514	Typhoid fever	81
Paratyphoid fever	187	Undulant fever	3

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

NOTE.—A cumulative table giving current information regarding the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS of March 28, 1941, pages 674-678. A similar table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Smallpox

Syria.—During the week ended March 1, 1941, 1 case of smallpox was reported in the interior of Syria.

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