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EDITORIAL

ECONOMY OF BED USAGE IN TUBERCULOSIS

During the last four decades, there have been several complete reversals of opinion regarding the relative needs for hospitalization of persons with minimal tuberculosis as compared to those with advanced disease. Who shall be chosen for hospitalization and who shall be given less systematic care are questions that must be answered if the present limited supply of beds is to realize maximum use. In some parts of the country, State laws actually require that only minimal cases be hospitalized, and these for too short a time. In other areas, only far-advanced infectious cases are given hospital care. Neither practice shows sound public health thinking, for neither considers the tuberculosis problem in its entirety.

This problem is approached currently from two quite different points of view, that of the private chest specialist, who is interested primarily in the individual patient, and that of the public health official, who is concerned with the health of the entire community. Although apparently irreconcilable, these points of view are easily made compatible if certain fundamental concepts are understood and accepted. For instance, both the chest specialist and the public health official must agree that a bed occupied by a person who could be supervised adequately as an ambulatory case is a bed lost to a patient whose disease could be arrested and prevented from spreading.

In any community, there are specific epidemiological data which must be analyzed and evaluated before a sound program of efficient bed utilization can be instituted and maintained. The morbidity and mortality rates are of great importance in determining the extent of the local problem. A knowledge of the quantity and availability of hospital beds, clinics, nursing, medical, social, and other professional services for the care and supervision of the tuberculous is equally important. The number and distribution of physicians trained in

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chest diseases constitute fundamental factors in the management of ambulatory cases and in economy of bed usage. In any effective program of treatment and supervision, it is necessary to have or to establish certified laboratories in which trustworthy tests for the detection of tubercle bacilli are performed.

Such critical studies provide the answers to certain questions that leaders in tuberculosis control in every community must answer before they can develop and operate an effective hospital program.

What is the fundamental purpose of hospitalization of the tuberculous—isolation or treatment?

Does the community, with a scarcity of beds, benefit more through the hospitalization of minimal inactive cases or of advanced infectious cases?

Should communities develop preventoria for children who are heavily exposed and certain to become infected, but do not yet have clinical disease?

The answer to the first question is unequivocal: The protection of the health of the community takes precedence over the health of any individual.

The answer to the second question inevitably follows: The positive sputum case must be hospitalized to prevent spread of the disease; the earlier the case is found, the better.

Study of family contacts has provided the answer to the third question: Hospitalize the infectious adult source and thereby remove the danger of infecting children in the home. It is easier and more economical to hospitalize one parent than three or more children.

There is a known shortage of over 50,000 beds for the tuberculous in the United States. This condition appreciably affects the quantity and quality of care that can be given. It is not uncommon for a large area to have only 200 beds and a register of more than 400 positive sputum advanced cases and twice that number with minimal disease.

Who will be chosen first for the available beds? How can the limited number of beds be used to greatest advantage?

It is suggested that the positive sputum cases be separated into two groups: The positive sputum case that has little hope of recovery and the positive sputum case with remediable disease. Hospitalize first the remediable positive sputum group. The irremediable positive sputum case could be isolated in the general hospital until the terminal episode. In this way both isolation and treatment are accomplished. In the event that such arrangements are impracticable, the hopeless case should be cared for in the home under the best possible isolation technique, supervised by a public health nurse.

Advanced positive sputum cases already in sanatoria but not benefiting from treatment should be discharged and replaced by positive

sputum cases that have chances for recovery. Such a practice protects the community and provides the opportunity to restore the health of the despairing ill. The minimal case with laboratory and other evidence of active disease should be given equal opportunity with the advanced remediable case, so that progression of disease can be prevented. Minimal cases that have, after careful and repeated search, no laboratory evidence of tubercle bacilli, can be supervised as ambulatory patients in the clinics and the offices of physicians trained in chest diseases. The utmost care must be exercised in the supervision of these ambulatory cases. They should be observed in the clinic and should have serial X-ray examinations at frequent intervals. The clinician must constantly watch for any indications of disease progression. Indeed, this type of patient must come for a check-up even when minor upper respiratory infections occur.

It may appear to be contradictory to find minimal cases and not to hospitalize all of them immediately. Yet experience shows that only a limited number of these cases break down. Careful X-ray laboratory study will facilitate the selection of those with early evidence of progressive disease. These can be hospitalized. It is wasteful to hospitalize all minimal cases when hospital facilities are grossly inadequate. If this is done, beds are occupied unnecessarily by people who are not sick, and the truly sick and infectious advanced cases continue to spread tuberculosis and to progress to hopeless advanced disease. It does not make sense to hospitalize minimal cases of all types when prolonged follow-up studies have demonstrated that only a limited number really needed sanatorium care. Even patients whose serial X-ray films show minor changes, in the absence of laboratory findings and symptoms, can be kept under control by continuous ambulatory medical supervision.

We must think of the community first and the individual next. Available beds should be used principally for the spreaders of tuberculosis whose lesions can be arrested, and for minimal cases with laboratory evidence of active disease. This does not preclude the hospitalization of a limited number of minimal cases when the question of activity is still in doubt. This is in accord with changing social views on illness. It is becoming more and more widely recognized that a tuberculous patient is not only an individual in a community but also a carrier of a disease in that community. We must choose carefully in terms of social welfare if limited resources are to be utilized and tuberculosis eventually eradicated.

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STANDARDIZATION OF TUBERCULIN

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INTRODUCTION

It is a well-known fact that two batches of tuberculin may differ in strength even if prepared in exactly the same manner—by the same man in the same laboratory, using the same strain of tubercle bacilli, the same culture medium, the same time for incubation, and the same method for preparation. The strength of the tuberculin prepared in different laboratories using different strains of tubercle bacilli, culture media, etc., will often vary considerably. This applies not only to old tuberculin (OT) but to purified tuberculin (PT) as well.

For the practical use of tuberculin in tests on man, it is of great importance to know fairly exactly the strength of the tuberculin employed, that is, the strength of the tuberculin in comparison with a recognized standard. Only when the strength of the tuberculin is known can the tuberculin test be used safely. When it is stated, for instance, that a dose of 0.0001 mg. PPD–S can be used without giving too many inconveniencing reactions, this holds true only for the particular batch of PPD–S tested. Another batch of PPD–S might be so strong that a dose of 0.0001 mg. would be too large.

The results of different tuberculin surveys can be compared only if the same dose of tuberculin of the same strength has been used or, within limits, if the comparative strength of the tuberculin employed is known. One of the reasons that tuberculin tests have been considered unreliable, especially for use in mass surveys, is that there has been too little attention paid to the facts that tuberculin may differ widely in strength and that the standardization most commonly employed has often been unsatisfactory. In using tuberculins that vary in strength, even if the doses are equal, almost any percentage of reactors can be obtained among the same population groups.

Extensive investigations made in the State Serum Institute in Copenhagen have shown that it is possible, with a relatively high degree of exactness, to compare the strength of two tuberculins. Following is a brief review of these studies and a detailed description of the method now used for standardization of tuberculin in Den-

mark. For further information the reader is referred to the publications listed under "References."

METHOD FOR STANDARDIZATION OF TUBERCULIN

The term "standardization," originally meaning "comparison of the strength of a certain batch with that of a recognized standard," is often used for the mere comparison of two batches. In the following, the word will be used in the latter sense.

Various methods have been used for the standardization of tuberculin. The oldest is the "shock" method. This method is based upon the fact, discovered by Robert Koch in 1891 (*1*), that tuberculin injected subcutaneously into a tuberculous guinea pig will kill the animal in 1 to 2 days. The method was worked out by Otto in 1905 (*2*), who tried to determine for each of the tuberculins the dose that would kill 50 percent of the animals injected. To obtain an exact comparison between two tuberculins, a great number of animals must be used; by using 100 animals, for instance, only a rough estimate can be obtained. This, of course, is one of the disadvantages of the method.

The intracutaneous tuberculin reaction in guinea pigs was worked out as a method for standardization by Römer and Joseph in 1909 (*3*). This method is based upon the experience that different doses of the same tuberculin will give reactions of different appearance and size in tuberculous guinea pigs.

Standardization by means of intracutaneous reactions in man was first tried by Löwenstein-Brill in 1919 (*4*). She tried to compare tuberculins by finding the lowest dose of each that would give a reaction when injected intracutaneously in tuberculin-sensitive persons. Because of the difficulty in distinguishing between small typical tuberculin reactions and merely traumatic and nonspecific reactions, she gave up this method.

In 1934 Johannes Holm published the first paper (*5*) on successful standardization of tuberculin by means of intracutaneous reactions in man. The method was based on the observation that different doses of the same tuberculin gave reactions of different sizes when injected intracutaneously in tuberculin reactors, which was the same principle Römer and Joseph used for guinea pigs. By using different doses, it was possible to obtain a sensitivity curve for each reactor, giving the size of reaction as ordinate and the dose employed as abscissa. By giving the same person three doses of each of the two tuberculins to be compared, a sensitivity curve for each tuberculin was obtained, and the distance between the two curves on the abscissa gave the difference in the strength of the two tuberculins. In 1938, this method was modified somewhat by K. A. Jensen and co-worker (*6*), who used only

two doses of each tuberculin and compared directly the size of the two pairs of reactions.

Another method of standardization by using the intracutaneous reaction in man has often been employed—for instance, by Seibert and Du Four (7). By this method, only one dose of each of the two tuberculins is given, one in each arm of the persons tested. The comparison is made between the percentage reacting to each of the two tuberculins. If only a small difference in the two percentages is obtained, the two doses employed are considered equal.

CHOICE OF METHOD FOR STANDARDIZATION

In selecting the method of standardization, it is necessary to consider the use to be made of the tuberculin. A tuberculin that is to be used for intracutaneous tests in man should be standardized by one of the intracutaneous methods for standardization in man. This should be done because the effect obtained by intracutaneous injection is not always parallel to that obtained by subcutaneous injection in guinea pigs. The two effects, to some degree, might be due to different components of the tuberculin. A standardization by means of the shock method in guinea pigs, therefore, does not permit one to draw exact conclusions as to the intracutaneous effect in guinea pigs. Furthermore, a standardization by means of intracutaneous injection in guinea pigs does not always give parallel results with standardization by the intracutaneous method in man.

In Denmark, the method used by Seibert and Du Four was found unreliable unless a great number of persons with different sensitivity were used. We have preferred, therefore, to base the standardization on the method in which several doses of each of the two tuberculins are given to the same person. The intracutaneous method on guinea pigs is used only as a preliminary method, to obtain a fairly good estimate.

STANDARDIZATION BY MEANS OF THE INTRACUTANEOUS METHOD ON TUBERCULOUS GUINEA PIGS

Only white guinea pigs weighing 400–500 gm. are used. The animals are inoculated intraperitoneally with an amount of moderately virulent tubercle bacilli sufficient to render them strongly tuberculin-positive in about 4 weeks. This is usually a dose of 0.001 mg. of our standard strain E5.

TECHNIQUE OF THE INTRACUTANEOUS INJECTION WITH GUINEA PIGS

It is of great importance in standardization that the injections of tuberculin be given as carefully as possible.

The injections are given with a long tuberculin syringe having a capacity of 1 cc., graduated to 0.01 cc., and with a shortened needle, No. 20, having an absolutely sharp, somewhat beveled point, made of stainless steel, and fitting precisely the nozzle of the syringe.

For the intracutaneous injection, a little fold of the skin is lifted between two fingers, and the point of the needle is introduced into the upper layer of the skin to such depth that the "eye" of the needle is just concealed. Care must be taken that exactly 0.1 cc. is injected, and that none of the liquid flows back along the piston; this may happen if too great a pressure is exerted at the point of injection. If a drop or two of the tuberculin solution flows out at the site of the injection, it is because the injection is not placed deeply enough in the skin. When the injection is given correctly, the result will be a well-defined papule with a diameter of about 10 mm.

Upon injection of several dilutions of the same tuberculin, the weakest solution is injected first, then the second weakest, and so on. Before each injection, the syringe and needle are flushed with the solution to be employed. If dilutions of several tuberculins are to be injected, a separate syringe must be used for each tuberculin. When the injections are finished, the syringe and needle must be flushed thoroughly several times with distilled water, as tuberculin has a tendency to adhere to the side of the syringe (*8*, *9*).

READING OF THE TUBERCULIN REACTIONS ON GUINEA PIGS

The tuberculin reactions are read after 24 and 48 hours. Distinction is made among 3 different degrees of reaction, recorded by means of the symbols +++, ++, and +, as first described by Römer and Joseph (*3*).

+++ ..... central extravasation of blood, surrounded by a porcelain-white zone, which is enclosed by a hyperemic border ("cockarde reaction").

++ ..... the same as the preceding without central extravasation of the blood.

\+ ..... nodular swelling and redness.

The diameters of each zone of the reaction are measured exactly in millimeters. In order that the reactions may stand out distinctly on the background of surrounding normal skin, and the individual zones be sharply defined, the skin of the animal must not be cold. It is preferable, therefore, to perform the measuring in daylight at a room temperature of about 20° C.

Additional comparison of the reactions is obtained by palpation. As the increase in the thickness of the skin does not feel alike to the right and left hand, the palpation is always performed with the fingers of the same hand.

PRELIMINARY TEST FOR SENSITIVENESS TO TUBERCULIN IN GUINEA PIGS

About 4 weeks after the animals have been infected, a preliminary test for sensitivity is made with an intracutaneous injection of 1/400 mg. purified tuberculin (PT). The abdomen is shaved gently so as not to injure or irritate the skin, and the injection is given in the middle of the abdomen. Here the skin is thin and flabby, giving a poorly defined tuberculin reaction, greatly elongated. On the back and upper part of the sides, the skin is thicker and firmer, giving considerably better tuberculin reactions. As both sides of the back are to be used for the standardization, the abdomen is always used for the preliminary test.

This test affords a rough classification of the infected guinea pigs in two groups: One, made up of animals with +++ reactions; the other, of animals with ++ and + reactions. For the standardization proper, the +++ reactors are injected with doses of 1/100, 1/200, 1/400, and 1/800 mg. of PT per 0.1 cc. The ++ and + reactors are injected with doses of 1/50, 1/100, 1/200, and 1/400 mg. per 0.1 cc.

PROCEDURE OF THE STANDARDIZATION WITH GUINEA PIGS

The standardization is performed 1 week after the preliminary test. The tuberculin doses are injected within the area extending from the spinal column to a little below the middle of the flank, and from the axillary fold to the pelvic bones. Throughout this area the tuberculin sensitivity is about the same. Care should be taken that the reactions or pairs of reactions to be compared are produced, as nearly as possible, on corresponding spots.

The smallest dose of each tuberculin is placed posteriorly, and the largest dose anteriorly. For more efficient utilization of the space, the four injections are placed in a zig-zag pattern. On one side of the animal, the four doses of the standard tuberculin are given, and the four corresponding doses of the other tuberculin are injected symmetrically on the other side.

An example of such a standardization of an unknown purified tuberculin on a tuberculous guinea pig is given in table 1. This example shows that the unknown purified tuberculin employed is equal to or somewhat weaker than the standard.

If, on standardization, the unknown tuberculin is found to be, for example, only about half as potent as the standard, the comparison is repeated with increased doses of the unknown tuberculin. This time, on the corresponding spot on the guinea pig, 1/100 mg. standard tuberculin is compared with 1/50 mg. of the unknown tuberculin; 1/200 mg. standard tuberculin is compared with 1/100 mg. unknown; and so on. For each standardization on tuberculous guinea pigs, four animals as a rule are used.

TABLE 1.—*Reactions on a tuberculous guinea pig injected with standard tuberculin in certain dilutions and with tuberculin of unknown strength in the same dilutions*

[Figures express diameter of reaction in millimeters]

Dose (in milligrams)	24 hours						48 hours						Standard compared to unknown by palpation
	Standard			Unknown			Standard			Unknown			
	Erythema	Induration	Necrosis	Erythema	Induration	Necrosis	Erythema	Induration	Necrosis	Erythema	Induration	Necrosis	
1/100	20	15	(?)	20	15	9	20	15	------	18	14	------	> Greater.
1/200	20	14	8	18	13	9	17	11	------	16	11	------	>> Greater.
1/400	15	(?)	------	17	(?)	------	13	------	------	12	------	------	≧ Greater or equal.
1/800	15	------	------	14	------	------	11	------	------	11	------	------	= Equal.

STANDARDIZATION BY MEANS OF THE INTRACUTANEOUS METHOD ON HUMAN TUBERCULIN REACTORS

The standardization on guinea pigs will give a rough estimate of the strength of the unknown tuberculin. The final and more accurate comparison of the two tuberculins must be carried out on human tuberculin reactors.

Results obtained in animal experiments are not always directly applicable to man. This holds true also for the assay of tuberculins. As a rule, however, the two classes of results agree fairly well, so that the standardization on humans merely gives a more exact expression for the rougher estimate on guinea pigs. Occasionally, it happens that a tuberculin on guinea pigs is found to be more potent than the standard, although on humans it proves to be weaker than the standard. As the practical use of the tuberculins is in the Mantoux test (intracutaneous) on man, it is reasonable that their assay on humans be the decisive determination of their potency.

Persons giving a distinct reaction of 15 mm. or more on the first Mantoux test, with 1/50,000 mg. of the State Serum Institute's standard preparation PT VII, are suitable reactors for standardization of tuberculin. Persons who react strongly may also be used if, in order to avoid too inconveniencing reactions, the doses are adjusted so that the total dose injected is less than 1/50,000 mg.

The best standardizations are obtained on persons showing a steep tuberculin sensitivity curve—that is, those giving a reaction of about 20 mm. to the largest dose, and only a weak reaction of about 5 mm., or no reaction at all, to the smallest dose, which is 8 times as small as the largest. Such persons can be found in extensive serial examinations, at which several persons have to be tested with 1/50,000 mg. Another injection, with a dose of 1/200,000 mg., is placed at the same time on the same arm. If the two reactions differ greatly, the

person concerned presents a steep tuberculin sensitivity curve, and will be suitable for tuberculin standardization. For the standardizations, men are used exclusively.

TECHNIQUE OF THE INTRACUTANEOUS INJECTION ON MAN

One syringe is used for each tuberculin, and the syringes are filled and washed as described in the section, "Technique of the Intracutaneous Injection with Guinea Pigs." Instead of steel needles, however, we use shortened, absolutely sharp, platinum-iridium needles, No. 20, which can stand flaming prior to each injection. The tuberculin injection, 0.1 cc., should be placed so superficially in the skin that the papule (about 10 mm. in diameter) shows a distinct "shagreen" or "peau d'orange."

Four different doses of each of the two tuberculins are injected intracutaneously on the middle third of the volar surface of the forearms for pairwise comparison of corresponding reactions. Two pairs of doses are placed on each arm. The reactions are read after 48 and 72 hours.

The dorsal aspect of the forearm gives but poorly defined reactions, which appear less distinctly against the surrounding normal skin than do the reactions on the volar surface. The volar surface, therefore, is selected as the more suitable for standardization of tuberculin. The skin area on the middle third of the forearm gives reactions of fairly uniform size to the same dose of tuberculin. Nearer the wrist the reactions are considerably smaller, and the same applies to reactions too near the elbow joint. Reactions on the lateral aspect of the forearm often make their appearance earlier and reach their maximal size before the reactions on the medial aspect. Therefore, the four doses of each tuberculin are placed so that two will be on the lateral aspect of one arm, and the other two will be on the medial aspect of the other arm.

On the volar surface of the left forearm, the smallest dose of the standard (1/400,000) is injected distally and medially; then the smallest dose of the unknown tuberculin (1/400,000) is injected distally and laterally. The next dose of the standard (1/200,000) is injected proximally and medially, and the corresponding dose of the unknown tuberculin (1/200,000) is placed proximally and laterally. On the volar surface of the right forearm, the second largest dose of the standard (1/100,000) is injected distally and laterally; the same dose of unknown tuberculin (1/100,000) distally and medially; and finally, the largest dose of the standard (1/50,000) is injected proximally and laterally; and the same dose of the unknown tuberculin (1/50,000) proximally and medially. It is advisable to place the injections in this sequence, because if three or more subjects are to be

injected with the same two tuberculins, an injection might otherwise be misplaced.

READING OF THE TUBERCULIN REACTIONS IN MAN

In man the tuberculin reactions and the individual zones within the reactions are not always sharply defined. As in guinea pigs, however, the reactions may be divided into three categories:

+++--------- central bulla or greyish-yellow zone, surrounded by a zone of infiltration, dark red to bluish-red, which again is enclosed by a lighter and more diffuse redness.

++---------- the same as the preceding without any bulla or central greyish zone.

+---------- redness with diffuse infiltration, or redness alone.

A more detailed description of the various forms of reaction has been given by Johannes Holm (*5*).

As on guinea pigs, the diameters of the various reaction zones on man are measured in millimeters. As the reactions are not always circular, it is often necessary to give the average of at least two diameters at a right angle; furthermore, as the borders of the reaction zones often are indistinct, these measurements may readily signify a somewhat subjective estimate. The measurements must be performed in daylight and at a room temperature of about 20° C. In addition to these measurements, corresponding reactions also are compared by palpation, as mentioned in the preceding section for guinea pigs.

PROCEDURE OF THE STANDARDIZATION ON MAN

An example of such a standardization on human subjects is given in table 2. In this example, the unknown tuberculin is seen to be as potent as the standard.

TABLE 2.—*Reactions on a tuberculin positive human subject injected with standard tuberculin in certain dilutions and with tuberculin of unknown strength in the same dilution* [1]

[Figures express diameter of reaction in millimeters]

Dose of tuberculin (in milligrams)	48 hours						72 hours						Standard compared to unknown by palpation
	Standard			Unknown			Standard			Unknown			
	Erythema	Induration	Yellow zone	Erythema	Induration	Yellow zone	Erythema	Induration	Yellow zone	Erythema	Induration	Yellow zone	
1/50,000	35	15	12	35	15	11	(?)	16	11	(?)	16	11	= Equal.
1/100,000	20	12	10	30	12	9	------	15	8	------	15	8	= Equal.
1/200,000	25	10	8	25	10	7	------	11	6	------	12	7	≧ Greater or equal.
1/400,000	15	9	7	20	9	6	------	9	5	------	10	6	≧ Greater or equal.

[1] Strength of unknown tuberculin equal to that of standard tuberculin.

If the reactions to the two tuberculins differ markedly in intensity, the standardization must be repeated with adjustment of the doses, so that the pairs of reactions that are to be compared will be of the same size.

The standardization of tuberculin by this method, therefore, is merely a pairwise comparison of the four pairs of reactions. As the size of a tuberculin reaction cannot be expressed by an exact numerical value, it is not safe to rely completely on a standardizing result calculated from curves plotted on the bases of the four different tuberculin doses and the corresponding measurements of reaction. The results of the palpation must also be taken into consideration.

ACCURACY OF THE STANDARDIZATION ON MAN

The accuracy with which these standardizations can be carried out on human reactors will depend largely on the training and experience of the examiner giving the injections, and reading and estimating the reactions. Indeed, in reading the results, a subjective estimate of the infiltration and entire appearance of the reactions, as well as the measurement of the diameter of the reactions, forms the basis for the evaluation of the outcome.

In practice, the method will produce excellent, reliable results when the standardization is carried out as outlined here: First, the relative potency of the unknown tuberculin is roughly estimated. For this preliminary comparison, the standardization is made on two or four persons. Then a comparison is made of the two tuberculins, with the doses adjusted so that the reactions to be compared will be of the same size. For this final standardization, a considerable number of persons are used, depending on the exactness desired.

The following experiment will give some impression of the degree of accuracy that can be obtained in standardizing tuberculins by means of intracutaneous reactions in man.

By our usual method of standardization, the following doses of the standard tuberculin (PT VII)—1/50,000 mg., 1/100,000 mg., 1/200,000 mg., and 1/400,000 mg.—were compared with different dilutions of the same tuberculin. The doses of tuberculin from these dilutions differed in varying degree from the standard. The doses of one series were 11 percent larger than the standard (1/45,000 mg., 1/90,000 mg., 1/180,000 mg., and 1/360,000 mg.); the doses of the other series, 25 percent, 43 percent, and 66 percent, larger than the standard. The doses of each series were compared with the standard doses by intracutaneous injections on two persons. The results of these standardizations are given in tables 3 and 4.

The reactions were found to be equally strong when the difference in doses was merely 11 percent. When the difference in doses was

TABLE 3.—*Estimation of strength of dose from comparative size of diameter of reactions (in millimeters), in which PT VII in dilutions of 1/50,000, 1/100,000, 1/200,000, and 1/400,000, and PT VII in higher known dilutions, were injected into each of eight human tuberculin reactors*

Dose in milligrams		48 hours						72 hours							
		Standard			Higher dose			Standard			Higher dose				
Standard PT VII	Higher dose	Erythema	Induration	Yellow zone	Erythema	Induration	Yellow zone	Erythema	Induration	Yellow zone	Erythema	Induration	Yellow zone	Standard compared to higher dose by palpation	Estimate of strength from reactions
1/50,000	1/45,000	18	11	.....	19	11	3	14	9	.....	15	8	.....	= equal	Individual 1: Dose 11 percent higher, equal to standard.
1/100,000	1/90,000	15	10	.....	15	10	.....	.....	11	.....	.....	10	.....	= equal	
1/200,000	1/180,000	13	9	.....	13	9	.....	13	.....	.....	12	5	.....	> greater	
1/400,000	1/360,000	11	.....	.....	12	.....	.....	11	.....	.....	12	.....	.....	= equal	
1/50,000	1/45,000	12	.....	.....	13	.....	.....	15	.....	.....	15	.....	.....	= equal	Individual 2: Dose 11 percent higher, equal to standard.
1/100,000	1/90,000	12	.....	.....	12	.....	.....	11	.....	.....	12	.....	.....	≦ smaller or equal	
1/200,000	1/180,000	10	.....	.....	10	.....	.....	11	.....	.....	11	.....	.....	= equal	
1/400,000	1/360,000	(?)	.....	.....	9	.....	.....	10 (?)	.....	.....	11	.....	.....	< smaller	
1/50,000	1/40,000	(?)	16	11	(?)	18	12	.....	15	8 (?)	.....	16	8 (?)	≦ smaller or equal	Individual 3: Dose 25 percent higher, stronger than or equal to standard.
1/100,000	1/80,000	(?)	16	10	(?)	16	10	.....	15	7	.....	15	8 (?)	≧ greater or equal	
1/200,000	1/160,000	13	8	.....	15	10	.....	13	.....	.....	15	7 (?)	.....	≦ smaller or equal	
1/400,000	1/320,000	10	5	.....	11	7	.....	11	.....	.....	12	.....	.....	< smaller	
1/50,000	1/40,000	25	12	.....	30	13	.....	18 (?)	13	.....	20 (?)	12	.....	≦ smaller or equal	Individual 4: Dose 25 percent higher, stronger than or equal to standard.
1/100,000	1/80,000	25 (?)	12	.....	30	12	.....	.....	12	.....	.....	12	.....	≧ greater or equal	
1/200,000	1/160,000	(?)	10	.....	30 (?)	10	.....	.....	11	.....	.....	12	.....	≧ greater or equal	
1/400,000	1/320,000	9	.....	.....	10	.....	.....	10	.....	.....	11	.....	.....	< smaller	
1/50,000	1/35,000	15	8	.....	17	11	.....	13	.....	.....	17	.....	.....	< smaller	Individual 5: Dose 43 percent higher, stronger than standard.
1/100,000	1/70,000	13	10	.....	16	10	.....	12	.....	.....	14	.....	.....	≦ smaller or equal	
1/200,000	1/140,000	13	.....	.....	15	8 (?)	.....	12	.....	.....	13	.....	.....	> greater	
1/400,000	1/280,000	10	.....	.....	12	.....	.....	6	.....	.....	10	.....	.....	< smaller	
1/50,000	1/35,000	15	8	.....	16	10	.....	.....	10	.....	.....	12	.....	< smaller	Individual 6: Dose 43 percent higher, stronger than standard.
1/100,000	1/70,000	8	.....	.....	14	8	.....	8	.....	.....	.....	10	.....	< smaller	
1/200,000	1/140,000	3	.....	.....	8	.....	.....	5	.....	.....	8	.....	.....	< smaller	
1/400,000	1/280,000	0	.....	.....	3	.....	.....	0	.....	.....	5	.....	.....	< smaller	
1/50,000	1/30,000	(?)	15	.....	(?)	16	.....	.....	13	.....	.....	15	.....	< smaller	Individual 7: Dose 66 percent higher, stronger than standard.
1/100,000	1/60,000	(?)	11	.....	(?)	12	.....	.....	12	.....	.....	13	.....	< smaller	
1/200,000	1/120,000	11	.....	.....	13	.....	.....	10	.....	.....	12	.....	.....	≦ smaller or equal	
1/400,000	1/240,000	10	.....	.....	11	.....	.....	6	.....	.....	8	.....	.....	= smaller or equal	
1/50,000	1/30,000	(?)	13	.....	(?)	12	.....	(?)	10	.....	(?)	13	.....	< smaller	Individual 8: Dose 66 percent higher, stronger than standard.
1/100,000	1/60,000	(?)	12	.....	(?)	12	.....	(?)	10	.....	(?)	10	.....	= equal	
1/200,000	1/120,000	11	.....	.....	11	.....	.....	9	.....	.....	11	.....	.....	< smaller	
1/400,000	1/240,000	10	.....	.....	11	.....	.....	7	.....	.....	10	.....	.....	< smaller	

TABLE 4.—*Summary of estimates of strength of dose from size of reactions on eight human tuberculin reactors injected with PT VII, in standard doses and with PT VII in higher known dilutions*

Dose stronger than standard by—	Comparative impression from reaction	Dose stronger than standard by—	Comparative impression from reaction
Percent		*Percent*	
11	Equal to standard.	43	Stronger than standard.
25	Stronger than or equal to standard.	66	Stronger than standard.

25 percent, there was a slight difference in the two series of reactions. With a difference in doses of 43 percent or more, there was a definite difference in the reactions.

There are some facts that it is important to know in order to obtain a good standardization; they should therefore be mentioned briefly.

The right and left arms of all persons do not react alike to the same dose of tuberculin. This will be seen from the following experiment.

One hundred and thirty-eight tuberculin reactors were given an intracutaneous test with 1/50,000 mg. of standard tuberculin, on the middle third of the volar surface of the right forearm, and with the same dose of the same tuberculin on precisely the corresponding spot on the left forearm. One hundred and forty-one other tuberculin reactors were given two equal doses of the same tuberculin, but on the volar surface of the *same* arm (right or left); these injections were both placed in the midline of the arm. The reactions were measured and compared after 72 hours, and the results are given in table 5.

TABLE 5.—*Comparison of size of reactions from same dose of tuberculin on right and left arms and on two different locations on the right arm only, on human tuberculin reactors*

Reaction	Number of persons	Percentage distribution		Reaction	Number of persons	Percentage distribution	
Reactions on right and left arms:				Reactions on right arm:			
Right larger than left by—				Proximal larger than distal by—			
5–9 mm	8	5.8	13.0	5–9 mm	0	0	1.4
3–4 mm	10	7.2		3–4 mm	2	1.4	
1–2 mm	28	20.3		1–2 mm	11	7.8	
Right equal to left	48	34.8		Proximal equal to distal	105	74.5	
Right smaller than left by—			74.7	Proximal smaller than distal by—			94.3
1–2 mm	27	19.6		1–2 mm	17	12.0	
3–4 mm	13	9.4	12.3	3–4 mm	6	4.3	4.3
5–9 mm	4	2.9		5–9 mm	0	0	
Total	138	100.0		Total	141	100.0	

On comparison of the results obtained in the two groups, it will be noticed that among 94.3 percent of the reactors who received the doses on the same arm, the two reactions were equal in size or showed a difference not exceeding 2 mm. In the remaining 5.7 percent, the difference did not exceed 4 mm.

In contrast, in the group that received an injection on either arm, the two reactions were equal or differed no more than 2 mm. in 74.7 percent of the reactors. In the remaining 25.3 percent, the difference in the diameter of the two reactions was very great, from 3 mm. to 9 mm.

Persons who have been employed several times for standardization of tuberculin are not as suitable for such tests as persons not previously employed. The reactions of the former are not so well defined as those of the latter, and they also reach their maximum earlier. Caretakers of the animals in the State Serum Institute were employed for the first standardizations, and many of them were used several times, as a rule, at intervals of 3 to 6 months.

Later, mainly students were employed. Through this change, we first realized that persons from the outside, who had not been employed previously for such studies, were considerably more suitable for tuberculin standardization than were the caretakers of the Institute. No doubt the explanation of this difference is to be found in the circumstance that the caretakers had been employed too many times. They reacted more rapidly to the tuberculin, so that their reactions soon reached a maximum and, after 72 hours, were regressing, subsiding markedly.

INTERNATIONAL STANDARD FOR TUBERCULIN

In 1928 the League of Nations Comité Hygiène established an international standard for old tuberculin. This standard has been kept in the State Serum Institute in Copenhagen, from which samples have been sent on request to any country that wished to compare its tuberculin with that of the international standard. In this way it has been possible to give the strength of any standardized old tuberculin in comparison to the same tuberculin all over the world.

Reactions following intracutaneous injections of purified tuberculins are not the same as those following intracutaneous injections of old tuberculin. A comparison of the two by means of a standardization, therefore, is not possible. This necessitated the establishment of an international standard for purified tuberculin as well as for old tuberculin.

In 1939 the League of Nations Comité Hygiène took the first steps for establishing such a standard, but the work was interrupted by the war. In Denmark, therefore, we established our own standard of purified tuberculin, selecting our preparation PT VII as such, standardizing all later-made batches against this standard. It is to be hoped that an internationally recognized standard of PT can be established before long.

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TUBERCULIN UNITS

As the strengths of different batches of tuberculin vary considerably, it is necessary to give the dose of a tuberculin in comparison to the standard. For this reason it is not practical to give the dose of a tuberculin by weight.

In Denmark, since 1939, we have given the doses in tuberculin units (T. U.):

1 T. U.=1/50,000 mg. of the Standard Purified Tuberculin (PT VII).
1 T. U.=1/100 mg. of the International Standard Old Tuberculin.

A great advantage of expressing the doses of tuberculin by units and not by weight is that units are easier for personnel to remember in practical testing. In Denmark we use two doses of tuberculin for the Mantoux test, the first doses being 1 or 3 T. U., the final doses always being 100 T. U.

The expression of doses in T. U.'s is only possible on the basis of a careful standardization of the tuberculin employed.

SUMMARY AND CONCLUSIONS

The necessity for standardization of tuberculins is stressed. Only by using well-standardized tuberculins is it possible to compare surveys made at different times in one place or in different places of the world.

For tuberculins used for intracutaneous tests in man, the standardization must be based upon methods employing intracutaneous reactions in human tuberculin reactors.

A detailed description is given of the method of standardization employed in the State Serum Institute in Copenhagen.

As purified tuberculins cannot be standardized directly against old tuberculin, an international standard for purified tuberculin must be established.

It is desirable that doses of standardized tuberculins be expressed in tuberculin units (T. U.'s).

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THE INHERENT EFFICIENCY OF THE X-RAY METHODS USED IN THE DETECTION OF TUBERCULOSIS [1]

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INTRODUCTION

It was not long after the introduction of mass radiography of the chest that sharp differences of opinion arose concerning the relative efficiency of the various types of film used in the detection of pulmonary disease. Some physicians were convinced that 4- by 5-inch films were superior to all others; some were sure that 35-mm. films were equally satisfactory; others favored the use of 14- by 17-inch sensitized paper; and still others preferred fluoroscopy. With the recent introduction of 70-mm. film, additional differences of opinion have already been expressed.

The efficiency with which a particular radiographic method achieves the detection of pulmonary disease is limited by two principal factors:

(1) All types of film may not record detail with sufficient clarity to reveal every pathologic lesion. Errors resulting from this failure to record detail may be termed *inherent errors* since they are governed by the film itself.

(2) The interpreter is not always able to recognize the presence of a lesion, even though it is clearly recorded by the film; that is, when abnormal pulmonary conditions are recorded on a series of films, some may be missed as a result of poor judgment, lack of concentration, or fatigue on the part of the reader. These errors of detection may be

[1] From the Tuberculosis Control Division, U. S. Public Health Service.

called *subjective errors*, since they are caused primarily by the failure of the interpreter.

Both types of error, inherent and subjective, are important in evaluating the efficiency of mass radiographic methods. The inherent error, however, has special significance for a comparison of the merits of a number of film types, for it is this error which is governed by the characteristics of the films. It is clear therefore that a knowledge of the inherent errors of the various mass radiographic films would be not only helpful but essential in resolving the problem of the comparative efficiency of the various types and sizes of films for tuberculosis case finding.

INHERENT ERROR AND RADIOGRAPHIC ABILITY TO RECORD DETAIL

The detail or clarity required of a particular type of film to detect chest pathology varies widely according to the nature of the lesions which must be revealed. Some lesions are large and require that the film have only a meager ability to record detail. Other lesions are so small that they are not recorded unless the film has exceptional qualities of reproduction. Other characteristics such as chemical composition and structure of the lesion affect the recording process. It follows, then, that in a random series of X-ray films of persons with chest pathology, there must exist a relation between radiographic detail and the percentage of lesions detected, such as that illustrated in figure 1. The shape of the curve will be governed by the type and extent of the pathology present in the persons studied, since the char-

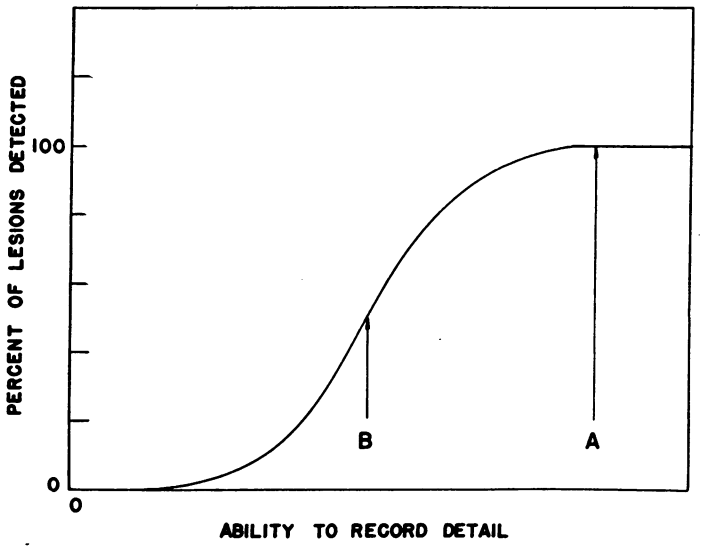

FIGURE 1.—Hypothetical relation between radiographic ability to record detail and the percentage of lesions detected.

acteristics of pulmonary lesions vary from one disease entity to another and from one stage to another within a given pathological group; that is, the shape of the curve would differ for silicosis, minimal tuberculosis, and far-advanced tuberculosis.

Now, if it were possible, by experimental methods on truly representative population groups, to derive curves similar to that shown in figure 1 for the three stages of tuberculosis, and if one were able to measure the abilities of radiographic films to record detail, the inherent efficiency of any film could be quickly evaluated for tuberculosis case finding. For example, if a film had an ability to record detail equal to "A" (fig. 1), its inherent efficiency would be 100 percent, since it would have had sufficient ability to record all of the lesions impressed upon it. On the other hand, if the film's ability to record detail were equal to "B," its inherent efficiency would be approximately 50 percent.

The ability of an X-ray film to record detail (*1*) may be evaluated quantitatively by radiographing on it a test object having a pattern that can be varied from a fine to a coarse configuration. Until recently, the test object most frequently used consisted of a mandril on which were wound wires of various size. The wires produce on the film a series of serrated patterns whose configurations vary with the sizes of the wires. When the pattern is coarse (i. e., one or two serrations per millimeter), little difficulty is encountered by most films in faithfully recording the pattern. As the pattern becomes finer, however, a limit is eventually reached beyond which the serrations can no longer be resolved by the film. The films which have poor ability to record detail reach the limit of resolution when the serrated pattern is still relatively coarse. The films that have excellent ability to record detail approach this limit only after the pattern has become very fine. By determining the maximum number of serrations per millimeter which the films are capable of resolving, one obtains a measure of the films' ability to record detail. Such a measure is customarily referred to as resolving power and is specified in terms of serrations per millimeter when the film is investigated with the wire-wound test object. More recently, it has become possible to measure resolving power by means of a linear type of test object (*2*). This has permitted the expression of X-ray-film resolving powers in terms of lines per millimeter, the same terms as used in photography.

To establish the relation between the radiographic ability to record detail (resolving power), and the percentage of tuberculous lesions that are detectable, it is necessary to collect a large group of persons with tuberculous pathology representative of that existing in the general population and to X-ray each of these persons with numerous

radiographic techniques that differ widely in their abilities to record detail. Strictly speaking, there does not exist a sufficient number of techniques to meet the latter requirement. However, the requirement can be fulfilled from a practical standpoint by using a very simple phenomenon of optical physiology. A brief discussion of this phenomenon follows.

The clarity with which the roentgen image of an anatomical structure can be perceived is determined by either (*a*) the ability of the radiographic film or (*b*) the ability of the observer's eye to record detail, whichever is poorer. Now the ability of the eye to record detail varies inversely, within certain limits, with the distance between the eye and the film viewed. That is, when a film on which is reproduced the series of linear patterns shown in figure 2 is observed at a number of viewing distances, the maximum number of lines per millimeter which the eye can resolve becomes progressively smaller as the viewing distance is lengthened. For example, at a viewing

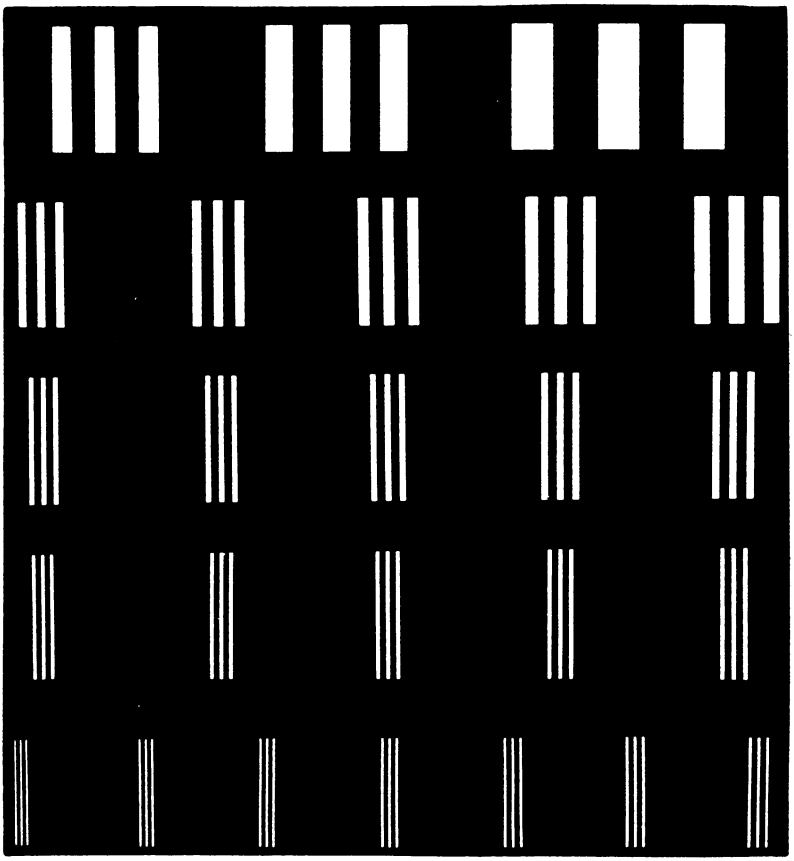

FIGURE 2.—Line drawing test—object with which the resolving power of the eye may be tested

distance of 1 meter, the maximum resolving power of the normal eye is approximately 2 lines per millimeter, whereas at 10 meters, the maximum resolving power of the eye falls to 0.2 lines per millimeter. Therefore, if a film having a resolving power of 10 lines per millimeter is viewed by an observer at a distance of 1 meter, the detail which can be seen is considerably less than that inherently recorded by the film. In fact, the detail perceived by the eye is the same as though the film had a resolving power of 2 lines per millimeter and was viewed under conditions in which the eye was not a limiting factor.

It is evident from the foregoing that the desired relation between radiographic detail and the percentage of tuberculous lesions detectable can be obtained if the following two conditions are met. First, the group of persons with tuberculous pathology is radiographed by films having sufficient inherent ability to detect all of the lesions that are present, and second, the films are read at a number of viewing distances. These distances must range from that at which the resolving power of the eye is equal to the resolving power of the films, to that at which the eye is unable to detect any of the lesions. In other words, by changing the viewing distance at which the films are observed, one achieves the same effect as though films of different resolving power were read at the usual viewing distance.

TECHNIQUE FOR MEASURING INHERENT EFFICIENCY OF VARIOUS RADIOGRAPHIC METHODS

A series of 50 roentgenograms of the chest (14- by 17-inch) which exhibited lesions characteristic of minimal tuberculosis (*3*) was collected. The films constituted a random sample taken from a group of several thousand roentgenograms of persons in whom disease had been discovered in mass radiographic surveys of apparently normal persons. The sizes of lesions varied from approximately 0.5 centimeter in diameter to a size sufficient to occupy one-third of one lung field. Thus, the sizes of the lesions were a random distribution of what is found in mass surveys of the adult population.

The 50 roentgenograms with abnormal findings were mixed with an equal number of negative films, and all the roentgenograms were then read at each of a number of viewing distances, from 100 to 1 meters. The reading was performed at night in an enclosed hallway, and the illumination was limited to that emanating from the view box on which the films were read. Visual acuity was thereby unaffected by the presence of extraneous sources of light. The view box contained fluorescent lamps of the standard type and had a surface brilliance of approximately 100 millilamberts.

The three readers started viewing the films at the maximum distance, each one calling out the presence or absence of an abnormal

shadow to the recorder. If there was any disagreement, the interpretation previously made at the normal viewing distance by an independent radiologist was stated, and a final decision was made on whether or not the lesion could be seen. Only in a few instances was it necessary to take the majority opinion of two of the three interpreters for the final decision.

This procedure was used because the purpose of the study was limited to a determination of whether or not a lesion could actually be seen at various distances. The study did not attempt to determine how easily a lesion could be seen or how often independent readers would be able to detect lesions without "before" or "after" knowledge of their presence. Independent readings by individual readers to determine the subjective errors were not done because another exhaustive study to answer that question is now in progress in the Tuberculosis Control Division.

When the series of readings was completed, the percentage of lesions detected at each viewing distance was calculated. The entire procedure was then repeated, using first, a series of 50 roentgenograms that exhibited lesions characteristic of moderately advanced tuberculosis (*3*), second, a series of 50 roentgenograms that exhibited lesions characteristic of far-advanced tuberculosis. The data for each of the series studied were then plotted as a function of the viewing distance, as shown in figure 3. At each viewing distance at which the films were read, the maximum resolving power of the readers' eyes

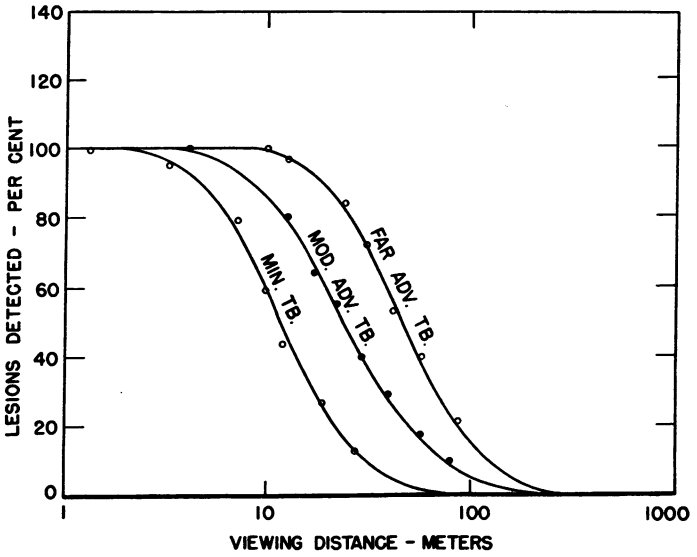

FIGURE 3.—Experimentally derived curves showing the percentage of minimal, moderately advanced, and far-advanced tuberculosis that can be detected at viewing distances ranging from 1 to 1,000 meters from 14- by 17-inch roentgenograms of the chest.

was measured by means of the resolving-power test object shown in figure 2. It became possible, therefore, to plot the data as a function of the maximum resolving power of the eye, as illustrated in figure 4.

It will be noted that the several curves are symmetrically sigmoid and that a higher level of maximum resolving power is required for the detection of a particular percentage of lesions when the lesions are minimal than when they are more advanced. This, of course, is to be expected. Furthermore, a high detection level is reached for all types of lesions at a maximum resolving power considerably below

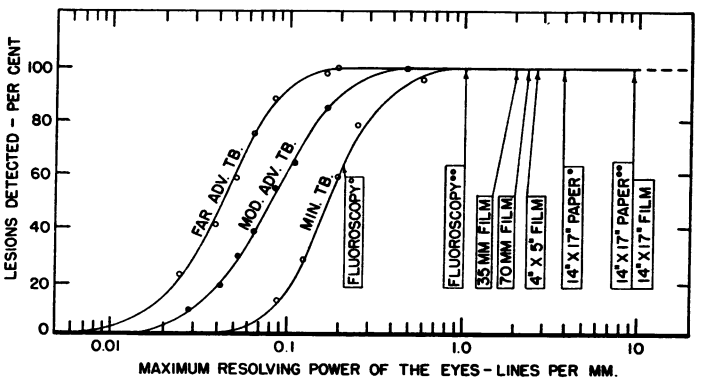

FIGURE 4.—Experimentally derived curves showing the relationships between the maximum resolving power of the eye and the percentages of minimal, moderately advanced, and far-advanced tuberculous lesions that can be detected by normal sight. The maximum resolving-power levels of 14- by 17-inch celluloid film, 14- by 17-inch sensitized paper, 4- by 5-inch, 70-millimeter and 35-millimeter photofluorographic film and fluoroscopy are shown at their respective positions. Two levels are indicated for 14- by 17-inch sensitized paper and fluoroscopy; those marked °° indicate the maximum resolving power for high-contrast patterns, whereas those marked ° indicate the effective maximum resolving power for low-contrast pattern.

the inherent resolving power of 14- by 17-inch roentgenograms.[5] Therefore, we may be reasonably certain that the curves are truly representative and are not distorted by the exclusion from the several series of test roentgenograms of significant lesions too small for detection by 14- by 17-inch films.

As previously stated, the inherent efficiency of any radiographic technique in tuberculosis case finding may be easily evaluated from the data presented in figure 4. Before proceeding to a discussion of the procedure by which the calculations may be made, it is necessary to point out that the resolving power of a radiographic film is a function of the contrast of the elements comprising the image of the test object with which the resolving-power measurements are made. Resolving power is relatively poor at low-contrast levels. When contrast is increased, resolving power also increases, quickly at first, then less rapidly until a contrast level is reached at which resolving power

[5] 14- by 17-inch roentgenographic films exposed with conventional Patterson Par Speed screens have a maximum resolving power of 10 lines per millimeter (2).

assumes a maximum value and beyond which it remains essentially constant. This relationship is illustrated graphically in figure 5. It will be noted that at high-contrast levels, the resolving power of a film is simply equal to the film's maximum resolving power and is unaffected by contrast. At low contrast, however, the resolving power is essentially proportional to the product of the maximum resolving power and contrast.[6]

How effective 4- by 5-inch, 70-millimeter, and 35-millimeter

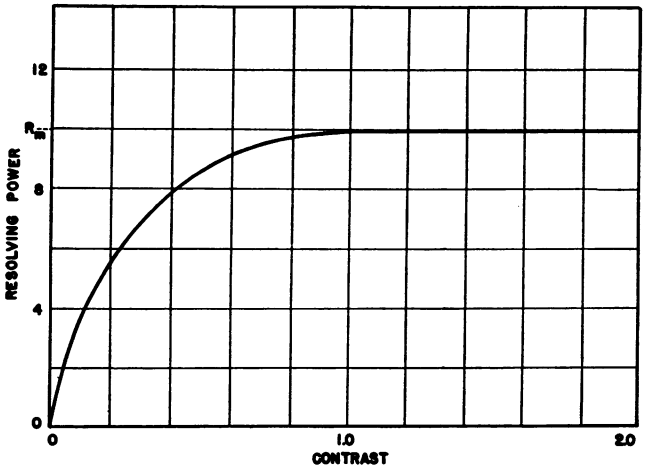

FIGURE 5.—Relationship between the resolving power of a radiographic film and the contrast exhibited in the image elements of the test pattern used to make the resolving-power measurements.

photofluorographic films are in the discovery of tuberculous pathology may be determined directly from figure 4, because it so happens that all three types of film, when exposed under normal photofluorographic conditions, record roentgen patterns with almost the same contrast as that of 14- by 17-inch films. Therefore, differences in the clarity with which these patterns are recorded by the several films are a consequence of differences in their maximum resolving-power values alone. Values of the maximum resolving power of 4- by 5-inch, 70-millimeter, and 35-millimeter photofluorographic films, determined by the Radiology Section of the Tuberculosis Control Division are, respectively, 2.75, 2.50, and 2.00 lines per millimeter. From an inspection of figure 4, it is evident that all three types of film have a sufficiently high maximum resolving power to detect the various types of tuberculous pathology represented

[6] Equation 1:
$R=aRmC$, where
Rm is the film's maximum resolving power,
C is contrast, and
a is a proportionality constant.

in the random series, with an accuracy equal to that of single 14- by 17-inch celluloid roentgenograms.

The place of 14- by 17-inch paper film in the scale of efficiency of detection may also be evaluated from figure 4. However, since paper film has an inherent contrast factor approximately 40 percent of that of 14- by 17-inch celluloid film, the calculation is not as direct as was the case with photofluorographic films. It has been shown in figure 5 that the clarity with which a high-contrast pattern is reproduced is simply proportional to the maximum resolving power of the film. Therefore, when one deals solely with roentgenographic patterns of high contrast, the influence of contrast on image quality and, as a result, on efficiency of detection need not be considered. Moderately and far advanced tuberculous lesions as seen on a roentgenographic film consistently exhibit high contrast. Accordingly, in order to determine the efficiency of detection of 14- by 17-inch paper film for such pathology, it is necessary only to measure the maximum resolving power of the film and find from figure 4 the efficiency at that level. The maximum resolving power of 14- by 17-inch paper film when exposed with conventional intensifying screens is 10 lines per millimeter. Therefore, paper films are easily capable of detecting all moderately and far-advanced tuberculosis lesions.

It has been shown in the equation (see footnote 6) that the clarity with which a low-contrast image is reproduced is not only proportional to the maximum resolving power of the film but also to the contrast of the image. Since the contrast of all roentgenographic images made on paper film is 40 percent less than that of the images appearing in 14- by 17-inch celluloid film, the clarity of paper film when recording low-contrast images is reduced. Indeed, it is clear from the equation that the clarity is reduced to the same extent as if the maximum resolving power of paper film were 40 percent that of celluloid film and as if the two films' respective contrasts were equal to one another. Such a resolving power is 4 lines per millimeter (i. e., 40 percent of 10 lines per millimeter).

Minimal tuberculous lesions usually are of low contrast and, therefore, the efficiency of detection of paper film for such pathology should be determined on the basis of a maximum-resolving-power level of four lines per millimeter. It is evident from figure 4 that paper film is inherently capable of detecting minimal tuberculosis.

Although fluoroscopy has not been used widely as a tuberculosis case-finding method, it may be of interest to some to determine the place of this procedure in the scale of efficiency of detection. The maximum resolving power of the Patterson type "B" fluoroscopic screen has been measured at 6 lines per millimeter. However, under normal fluoroscopic conditions, the eye cannot appreciate such clarity

of image reproduction. In chest fluoroscopy, the screen illumination has a value of approximately 2 microlamberts and, according to data published by Hecht (*4*), visual acuity at this level is approximately 7 percent of its value under normal lighting conditions (10 to 1,000 millilamberts). Usually, fluoroscopic screens are viewed at distances of 15 to 20 cm. Under normal lighting conditions, the maximum resolving power of the eye at these distances is approximately 14 lines per millimeter. Therefore, under fluoroscopic conditions, the resolving power is only 1.0 line per millimeter. By following the same line of reasoning as employed in the discussion of paper films, it is clear that moderately and far-advanced tuberculosis may be easily detected by fluoroscopy. In regard to fluoroscopy's efficiency of detection for low-contrast patterns (minimal tuberculosis), it may be shown experimentally that the contrast of fluorsocopic images is approximately two-thirds that of the images appearing in a 14- by 17-inch celluloid film.

Furthermore, there is evidence (*5*) that the proportionality constant, a, in equation 1 (see footnote 6) has a value considerably lower under fluoroscopic conditions (low illumination) than under radiographic conditions (high illumination). Indeed, its value at chest fluoroscopic levels is of the order of one-third that occurring under normal illumination. Therefore, the clarity with which low-contrast fluoroscopic images are reproduced is comparable to that of a radiographic image recorded by a film that has a maximum resolving power of 0.2 line per millimeter and a contrast equal to that of 14- by 17-inch celluloid film (i. e., one-third of two-thirds of 1.0 line per millimeter). It is clear from figure 4 that such a resolving power is less than that needed for the detection of all minimal tuberculous lesions (low-contrast patterns). In fact, a diagnostic error approaching 40 percent may be predicted in the detection of minimal tuberculosis by fluoroscopy. It must be pointed out at this time that this error is an inherent error of fluoroscopy and is caused by the inability of the eye to record sufficient detail to detect abnormal changes. Accordingly, it cannot be improved by more painstaking examinations or by more competent examiners.

To some chest specialists and radiologists, such a high diagnostic error in the fluoroscopy of minimal tuberculosis may seem incredible. However, one of us (I. L.) has recently completed a survey in which over 50 patients with minimal tuberculosis were examined fluoroscopically. The patients were studied in much the same manner as those whose films were used in the study described above. In no instance, however, did the fluoroscopist examine a patient previous to a period of dark adaptation of 30 minutes. The efficiency of detection obtained during this survey was 69 percent, a diagnostic error of 31 percent. This is in excellent agreement with the predicted value given above.

It is clear, therefore, that fluoroscopy is rather poor as a tuberculosis case-finding procedure from the standpoint of its efficiency in detecting minimal tuberculosis.

SUMMARY

1. A simple method of studying the inherent diagnostic error of all mass chest radiographic methods is described and experimental results are presented.

2. Fluoroscopy is found to be not wholly satisfactory in this study for detecting minimal tuberculous lesions.

3. By correlating the percentage of X-ray lesions detected with the maximum resolving power of the eye at various distances, it is shown that 35-millimeter, 70-millimeter, 4- by 5-inch celluloid, and 14- by 17-inch sensitized paper are all inherently capable of detecting random samples of minimal, moderately advanced, and far-advanced tuberculous lesions with a high degree of accuracy.

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(*3*) Diagnostic Standards and Classification of Tuberculosis. National Tuberculosis Association, New York (1940).

(*4*) Hecht, S.: Relation between visual acuity and illumination. J. Gen. Physiol., **11**: 255 (1928).

(*5*) Work done in Radiology Section, Tuberculosis Control Division, soon to be reported.

Review [1] of

THE IMMUNIZING VALUE OF THE BCG DRY GLUCOSE VACCINE.[2]

In February 1946, the American Review of Soviet Medicine published "The Immunizing Value of the BCG Dry Glucose Vaccine," [2] a report of experiments begun in 1937, by Leshchinskaya and Vakengut of the BCG laboratory, Central Institute of Experimental Medicine, Union of Soviet Socialist Republics.

The article begins with a brief discussion of the difficulties encountered by the Soviet Union in carrying out mass BCG vaccination against tuberculosis. The perishability of the vaccine precludes its use in some districts, and its production in those districts is impeded by the lack of qualified personnel. A general history of attempts to preserve the vaccine by drying is then presented.

A summary of reports (1941, 1942) is given, describing the results

[1] From the Office of the Chief, Tuberculosis Control Division, Bureau of State Services, U. S. Public Health Service.

[2] By Leshchinskaya, E. N. First published in Problemy tuberculeza No. 6, pp. 55–59 (1944).

of experiments by Leshchinskaya and Vakengut. The experiments led to the following conclusions:

1. BCG bacilli retain their vitality better in a 50-percent glucose solution than in such media as serum, saccharose, and gum arabic.

2. The death of the bacilli is most pronounced during the first months of drying (vacuum method), and later the number of colonies obtained upon inoculation remains constant for several months.

3. The dried vaccine may be stored at room temperature. (After 9 months, the seeding of 0.001 mg. of the culture still yielded growth of individual colonies.)

4. Refrigeration is the best method for storing.

5. Dry glucose vaccine emulsifies readily.

From these experiments, a standard sterile preparation was obtained in which the vitality of the bacilli was conserved for a considerable period. The immunizing ability of the dry glucose vaccine, following various periods of storage, remained to be checked.

The remainder of the article describes the checking experiment, which may be reported as follows:

Preparation of the vaccine.—A 14-day-old BCG culture of a Leningrad strain, grown on Sauton's medium, was used to prepare the vaccine on June 17, 1941. The culture was filtered, pressed between filter paper, weighed, and emulsified in a jar with beads. A small quantity of 50-percent glucose solution was added. For a final planting, the same solution was used—0.01 gm. of culture per cubic centimeter of emulsion. The preparation, in 5-cc. ampoules, was dried (variation of Flosdorf and Mudd method) after freezing at −18° C. The ampoules were sealed 24 hours later under a high vacuum.

Viability of the dry vaccine.—In September 1942, the first inoculations were made with the dry vaccine, which had been stored in summer at 20° C. to 25° C. and in winter at −25° C. to −30° C. A seeding of 0.001 mg. of culture on Petragnani medium yielded a growth that averaged 70 colonies per tube. In all cases, even 0.00001 mg. led to the growth of individual colonies. The growth of bacilli in dry BCG, after 16 months of storage, is approximately equal to the growth in liquid vaccine preserved for 2 months.

Tests were made on guinea pigs to determine the immunizing action of the dry vaccine after storage for 16 months. Twenty-two guinea pigs were used, divided into 3 groups:

(1) 12 guinea pigs inoculated with the dry BCG.
(2) 5 inoculated with fresh liquid BCG.
(3) 5 controls.

The guinea pigs weighed 200–300 gm. and gave a negative Mantoux reaction. Each BCG inoculation consisted of 1 mg. of culture. Six weeks after inoculation, the guinea pigs that had received BCG were

given the Mantoux test, and all were positive except one in the first group. Another in the first group gave a doubtful reaction.

Two months and ten days after inoculation, the 22 guinea pigs were infected with virulent tubercle bacillus culture (Vallea). The animals were observed for 4 months. (The article indicates that one animal in the first group and three in the second group died during the observation period.) One of the animals in the third group had died. At 4 months, eight guinea pigs in the first group, two in the second, and four in the third were killed, and the internal organs and lymphatic glands were examined according to the method of Weisfeiler. Diagnosis was confirmed by histologic examination in the Central Institute for Tuberculosis.

Effect of virulent culture (Vallea) upon vaccinated and control animals examined

Guinea pig No.	Group	Changes at site of injection	Glandular changes			Liver	Spleen	Lungs	Severity of pathology
			Inguinal glands		Other glands				
			Left	Right					
2	1	----------	++++	----------	++	++	----------	----------	Moderate.
3	1	----------	++++	+	----------	----------	----------	----------	Slight.
4	1	----------	++++	----------	----------	----------	----------	----------	Slight.
5	1	+	++	----------	----------	----------	----------	----------	Slight.
7	1	----------	+++	+	+	----------	----------	----------	Slight.
9	1	----------	+++	----------	+++	++	+++	++	Moderate.
10	1	----------	++++	----------	++	----------	----------	----------	Slight.
11	1	----------	++	----------	----------	++	++	----------	Moderate.
14	2	----------	++	----------	+	+	++	----------	Moderate.
15	2	----------	----------	----------	----------	----------	+	----------	Slight.
23	3	Large ulcer	++++	++++	++++	++++	++++	++++	Serious.
24	3	Two ulcers	++++	++++	++++	++++	++++	++++	Serious.
25	3	Large ulcer	++++	++++	++++	++++	++++	++++	Serious.
26	3	Scar	++++	----------	++++	++	++++	++++	Serious.

Symbols:

Evaluation of effect on glands:
+=Enlargement to 0.5 cm. in diameter.
++=Enlargement to 1.0 cm. in diameter.
+++=Enlargement to 1.5 cm. in diameter.
++++=Enlargement to over 1.5 cm. in diameter.

Evaluation of effect on organs:
+=Slight tubercle, suspicious of tuberculosis, or 1–2 tubercles on surface.
++=3–6 tubercles on surface.
+++=7–15 tubercles on surface.
++++=over 15 tubercles on surface.

The dry glucose vaccine, as tested by animal vaccination after preservation for 1½ years, differed very little from fresh liquid vaccine in its immunizing ability. The preparation, obtained as described, is sterile and may be recommended for practical use. Dry BCG vaccine will make it possible to centralize production, to increase vaccination, and to extend it to outlying areas of the Union of Soviet Socialist Republics.

CORRECTION

The article, "A Crystalline Antibacterial Substance from the Lichen *Ramalina Reticulata*," by Alfred Marshak, Public Health Reports, vol. 62, No. 1, Jan. 3, 1947, contained two errors in the captions of figures 2 and 4. The caption for figure 2, page 15, should read as follows: Inoculated with tubercle bacilli, treated with oil-Tween-80 only. Group III. The caption for figure 4, page 16, should read as follows: Not inoculated with tubercle bacilli, treated with oil-Tween-80 only. Group IV.

DEATHS DURING WEEK ENDED JAN. 11, 1947

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

	Week ended Jan. 11, 1947	Corresponding week, 1946
Data for 93 large cities of the United States:		
Total deaths	10,638	11,670
Median for 3 prior years	11,659	
Total deaths, first 2 weeks of year	20,847	23,598
Deaths under 1 year of age	861	611
Median for 3 prior years	661	
Deaths under 1 year of age, first 2 weeks of year	1,675	1,305
Data from industrial insurance companies:		
Policies in force	67,231,066	67,121,498
Number of death claims	11,563	13,283
Death claims per 1,000 policies in force, annual rate	9.0	10.3
Death claims per 1,000 policies, first 2 weeks of year, annual rate	8.4	10.3

INCIDENCE OF HOSPITALIZATION, AUGUST–DECEMBER, 1946

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

Item	December		November		October		September		August	
	1946	1945	1946	1945	1946	1945	1946	1945	1946	1945
1. Number of plans supplying data	82	81	82	78	80	78	83	79	80	81
2. Number of persons eligible for hospital care (in thousands)	23,903	18,915	21,898	18,841	21,113	18,676	22,800	18,581	20,532	18,500
3. Number of persons admitted for hospital care	212,009	145,954	200,835	162,954	203,329	172,938	201,093	157,675	194,170	176,672
4. Incidence per 1,000 persons, annual rate during current month (daily rate×365)	104.4	90.8	111.6	105.3	113.4	109.0	107.3	103.3	111.3	112.4
5. Incidence per 1,000 persons, annual rate for the 12 months ending with current month	111.2	106.7	110.2	106.4	109.7	106.2	109.2	105.5	109.1	105.5
6. Number of plans reporting on hospital days	33	27	31	29	30	26	30	29	28	31
7. Days of hospital care per case discharged during month [1]	8.22	8.98	8.07	8.70	8.23	8.38	7.93	7.86	7.93	7.61

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

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INCIDENCE OF DISEASE

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

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED JANUARY 18, 1947

Summary

The reported incidence of influenza declined during the week. A total of 4,129 cases was reported, as compared with 4,728 last week, 21,110 for the corresponding week last year, and a 5-year (1942–46) median of 4,387. Only 5 States reported currently more than 105 cases—Texas (1,788), South Carolina (713), Virginia (596), Arizona (259), and Oklahoma (114). Only 4 other States reported more than 46 cases. The total for the first 3 weeks of the year is 12,522 (less than for the corresponding period of any of the past 4 years), as compared with 101,786 for the same period last year and a 5-year median of 12,712.

Of the total of 69 cases of poliomyelitis (as compared with 91 last week, 51 for the corresponding week last year, and a 5-year median of 27), 21 occurred in California (last week 19) and 5 each in Illinois and Michigan. The total for the first 3 weeks of the year is 256, as compared with 105 for the 5-year median and 162 for the corresponding period last year. The last named figure was the largest number previously recorded for a corresponding period since 1928, when the number was 185.

Totals for the first 3 weeks of the year for certain other diseases are as follows (last year's figures in parentheses): Diphtheria 988 (1,320), dysentery, amebic, 77 (135), dysentery, bacillary 1,093 (1,164), dysentery, undefined 664 (436), infectious encephalitis 20 (22), measles 10,949 (13,573), meningococcus meningitis 266 (693), scarlet fever 6,844 (7,816), smallpox 13 (22), tularemia 154 (87), typhoid and paratyphoid fever 127 (129), endemic typhus fever 155 (191), undulant fever 250 (186), whooping cough 6,582 (5,504).

Deaths recorded for the week in 93 large cities of the United States totaled 9,960 as compared with 10,638 last week, 10,401 and 9,656, respectively, for the corresponding weeks of 1946 and 1945, and a 3-year (1944-46) median of 10,401. The total for the first 3 weeks of the year is 30,807, as compared with 33,999 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended Jan. 18, 1947, and comparison with corresponding week of 1946 and 5-year median

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

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median	Week ended—		Median	Week ended—		Median	Week ended—		Median
	Jan. 18, 1947	Jan. 19, 1946	1942–46	Jan. 18, 1947	Jan. 19, 1946	1942–46	Jan. 18, 1947	Jan. 19, 1946	1942–46	Jan. 18, 1947	Jan. 19, 1946	1942–46
NEW ENGLAND												
Maine	2	1	0	3	2	2	190	5	29	0	0	2
New Hampshire	0	0	0	2				7	7	0	0	0
Vermont	0	2	0	42	77		179	12	12	0	0	0
Massachusetts	10	6	3				431	209	284	4	10	8
Rhode Island	0	0	0		2	1	44		17	0	1	1
Connecticut	0	2	2	2	22	8	215	39	65	2	1	2
MIDDLE ATLANTIC												
New York	21	18	18	[1] 13	[1] 43	[1] 15	209	573	573	11	26	27
New Jersey	9	1	5	5	56	18	85	55	167	6	9	8
Pennsylvania	13	25	10	4	16	4	640	656	1, 107	3	18	12
EAST NORTH CENTRAL												
Ohio	9	30	8	7	35	29	330	18	82	2	13	9
Indiana	5	17	8	3	76	16	24	61	67	1	2	7
Illinois	0	4	8	2	22	22	35	438	177	2	13	13
Michigan [2]	15	18	15	1	18	5	46	430	[3] 176	0	5	5
Wisconsin	3	1	3	46	196	101	71	60	179	3	4	3
WEST NORTH CENTRAL												
Minnesota	6	8	3		3	2	30	7	16	2	3	3
Iowa	0	6	3	1		1	10	329	95	4	0	1
Missouri	1	8	8	4	33	12	2	113	80	4	9	9
North Dakota	0	6	2	34	28	28	1		14	0	2	1
South Dakota	0	0	0				16	33	33	0	0	0
Nebraska	0	2	1	13	61	51	14	13	13	1	2	2
Kansas	14	8	2	67	818	17	9	187	135	0	1	5
SOUTH ATLANTIC												
Delaware	0	0	1				2	4	6	0	0	1
Maryland [2]	15	26	7	5	26	26	158	33	33	2	2	4
District of Columbia	0	0	0		3	3	21	10	17	0	0	2
Virginia	10	23	8	596	1, 835	763	67	172	172	1	11	11
West Virginia	6	4	4	51	488	38		25	25	2	8	3
North Carolina	7	21	17			27	169	23	59	0	3	7
South Carolina	1	6	6	713	1, 811	775	46	53	53	1	1	1
Georgia	9	8	7	14	170	101	150	41	41	0	3	3
Florida	6	9	7	20	8	8	7	21	26	4	3	3
EAST SOUTH CENTRAL												
Kentucky	13	6	6	2	72	21	2	226	38	1	6	5
Tennessee	6	17	6	39	187	81	35	50	50	1	14	6
Alabama	5	4	6	50	2, 164	433	8	11	21	2	4	4
Mississippi [2]	5	8	6							1	3	3
WEST SOUTH CENTRAL												
Arkansas	9	15	10	105	490	186	58	38	52	4	8	1
Louisiana	6	11	7	35	2, 253	8	3	5	18	0	6	5
Oklahoma	0	3	8	114	461	138	6	20	20	0	3	3
Texas	26	39	58	1, 788	6, 437	2, 094	71	215	215	6	10	10
MOUNTAIN												
Montana	0	1	1	9	102	35	135	13	54	0	1	0
Idaho	0	2	0	30	105	2	7	69	22	0	1	1
Wyoming	2	0	0	6		61	7	10	10	1	1	1
Colorado	6	4	4	15	93	77	25	109	158	0	0	0
New Mexico	1	3	3	1	86	6	13		10	0	1	1
Arizona	4	4	2	259	356	103	43	4	14	0	0	0
Utah [2]	0	0	0	5	1, 976	105	8	52	38	1	2	2
Nevada	0	0	0					40	1	0	0	0
PACIFIC												
Washington	11	9	2			1	19	296	140	0	3	2
Oregon	4	6	1	14	136	53	25	35	72	2	7	4
California	22	35	20	9	343	112	73	670	387	9	20	20
Total	282	427	314	4, 129	21, 110	4, 357	3, 739	5, 490	8, 807	83	240	240
3 weeks	988	1, 320	1, 053	12, 522	101, 786	12, 712	10, 949	13, 573	25, 214	266	693	711
Seasonal low week [3]	(27th) July 5–11			(30th) July 26–Aug. 1			(35th) Aug. 30–Sept. 5			(37th) Sept. 13–19		
Total since low	8, 554	12, 964	10, 086	45, 497	464, 034	47, 888	33, 836	39, 697	63, 227	1, 237	2, 197	2, 197

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

Telegraphic morbidity reports from State health officers for the week ended Jan. 18, 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever [4]		
	Week ended—		Median	Week ended—		Median	Week ended—		Median	Week ended—		Median
	Jan. 18, 1947	Jan. 19, 1946	1942–46	Jan. 18, 1947	Jan. 19, 1946	1942–46	Jan. 18, 1947	Jan. 19, 1946	1942–46	Jan. 18, 1947	Jan. 19, 1946	1942–46
NEW ENGLAND												
Maine	0	0	0	35	19	26	0	0	0	0	0	0
New Hampshire	0	0	0	8	3	12	0	0	0	0	0	0
Vermont	1	1	0	7	13	7	0	0	0	1	0	0
Massachusetts	0	0	0	172	173	328	0	0	0	4	2	1
Rhode Island	0	0	0	14	11	15	0	0	0	0	0	0
Connecticut	0	2	0	59	34	63	0	0	0	1	1	0
MIDDLE ATLANTIC												
New York	4	4	2	290	297	372	0	0	0	6	0	2
New Jersey	1	3	1	104	87	109	0	0	0	1	3	0
Pennsylvania	2	1	0	147	137	285	0	0	0	1	1	4
EAST NORTH CENTRAL												
Ohio	1	0	0	287	228	311	1	1	1	1	2	2
Indiana	0	1	1	83	89	107	2	0	2	0	0	1
Illinois	5	1	1	126	159	242	0	0	1	0	1	1
Michigan [3]	5	0	0	133	145	169	0	0	0	1	1	1
Wisconsin	0	0	1	95	123	175	0	0	0	1	0	0
WEST NORTH CENTRAL												
Minnesota	2	0	0	40	52	95	0	0	0	0	0	0
Iowa	1	4	0	33	42	63	0	0	0	0	4	1
Missouri	1	1	1	38	41	86	1	0	0	2	0	0
North Dakota	1	0	0	6	9	36	0	0	0	1	0	0
South Dakota	0	0	0	4	15	31	1	0	0	0	0	0
Nebraska	1	0	0	32	55	49	0	0	0	2	0	0
Kansas	3	1	0	77	71	79	0	0	1	0	0	0
SOUTH ATLANTIC												
Delaware	0	0	0	25	1	12	0	0	0	0	0	
Maryland [3]	1	0	0	48	56	68	0	0	0	1	2	
District of Columbia	0	0	0	12	12	28	0	0	0	0	0	0
Virginia	0	1	0	44	72	52	0	0	0	1	0	1
West Virginia	2	0	0	23	34	64	0	0	0	0	0	0
North Carolina	0	0	1	36	33	53	0	0	0	0	4	0
South Carolina	0	0	0	3	10	10	0	0	0	0	0	1
Georgia	0	0	0	18	7	17	0	0	0	0	2	2
Florida	2	1	0	8	5	5	0	0	0	1	1	1
EAST SOUTH CENTRAL												
Kentucky	0	0	0	44	35	56	0	0	0	0	1	1
Tennessee	3	0	0	30	50	78	0	0	0	2	1	1
Alabama	0	0	1	8	9	17	0	0	0	1	0	0
Mississippi [3]	4	2	0	8	13	13	0	0	1	2	1	0
WEST SOUTH CENTRAL												
Arkansas	1	2	0	4	14	11	0	1	0	0	0	0
Louisiana	0	6	2	5	11	11	0	1	0	4	4	4
Oklahoma	1	0	0	1	25	25	0	1	0	1	3	2
Texas	2	3	3	40	103	103	0	0	1	5	3	6
MOUNTAIN												
Montana	1	2	0	11	2	15	0	0	0	1	2	0
Idaho	1	0	0	13	10	15	0	8	1	0	2	1
Wyoming	0	0	0	6	6	7	0	0	0	0	0	0
Colorado	0	0	0	53	51	51	0	1	0	0	0	1
New Mexico	0	1	0	7	17	10	0	0	0	0	1	1
Arizona	0	0	0	14	2	8	0	0	0	0	4	2
Utah [3]	1	1	1	28	43	45	0	0	0	0	0	0
Nevada	0	0	0	0	0	0	0	0	0	0	0	0
PACIFIC												
Washington	1	2	2	30	57	57	0	0	0	0	0	0
Oregon	0	1	0	13	24	24	0	0	0	0	0	1
California	21	10	3	106	206	206	0	0	0	5	2	2
Total	69	51	27	2,428	2,711	3,981	5	13	13	46	48	57
3 weeks	256	162	105	6,844	7,816	10,749	13	22	37	127	129	155
Seasonal low week [3]	(11th) Mar. 15–21			(32d) Aug. 9–15			(35th) Aug. 30–Sept. 5			(11th) Mar. 15–21		
Total since low	[5]25,030	13,499	12,189	33,530	46,387	49,470	67	98	154	3,655	4,380	5,135

[1] Period ended earlier than Saturday.
[2] Dates between which the approximate low week ends. The specific date will vary from year to year.
[4] Including paratyphoid fever reported separately, as follows: Vermont 1; Massachusetts 3 (salmonella infection); New York 1; Ohio 1; California 2.
[5] Corrections: Virginia, delayed report, 2 cases, October and November onset; Nebraska, 6 December cases; Maine, diagnosis changed, 1 December case.

Telegraphic morbidity reports from State health officers for the week ended Jan. 18 1947, and comparison with corresponding week of 1946 and 5-year median—Con.

Division and State	Whooping cough			Week ended Jan. 18, 1947							
	Week ended—		Median 1942–46	Dysentery			Encephalitis, infectious	Rocky Mt. spotted fever	Tularemia	Typhus fever, endemic	Undulant fever
	Jan. 18, 1947	Jan. 19, 1946		Amebic	Bacillary	Unspecified					
NEW ENGLAND											
Maine	14	16	41								
New Hampshire	1	12	5				1				
Vermont	30	12	34								4
Massachusetts	226	111	111		1						2
Rhode Island	45	69	27								
Connecticut	59	42	47								1
MIDDLE ATLANTIC											
New York	251	258	258	4	5		2		1		3
New Jersey	139	164	144	1							2
Pennsylvania	225	141	220				1		1		3
EAST NORTH CENTRAL											
Ohio	101	92	134								
Indiana	36	24	16				3		2		4
Illinois	133	82	100	2	1				10		20
Michigan [2]	219	129	129	1					1		3
Wisconsin	135	71	98								2
WEST NORTH CENTRAL											
Minnesota	9	10	35	2							1
Iowa	7	7	22								14
Missouri	17	6	6								
North Dakota			3								
South Dakota	3	1	2								2
Nebraska	2	5	6								
Kansas	19	14	29						2		3
SOUTH ATLANTIC											
Delaware											
Maryland [2]	96	12	41						2		1
District of Columbia	1	10	10						1		
Virginia	39	70	70			23			3	1	
West Virginia		14	59						1		
North Carolina	23	58	135						4	5	
South Carolina	39	53	53	6	24				4		
Georgia	7	6	15	1					4	17	3
Florida	25	14	20							5	1
EAST SOUTH CENTRAL											
Kentucky	48	11	33						4		
Tennessee	28	20	20	1	1	1			5		1
Alabama	50	7	13							3	
Mississippi [2]									2	1	
WEST SOUTH CENTRAL											
Arkansas	5	3	15						8	4	
Louisiana	7		1						1	3	
Oklahoma	11	6	10	1					4		
Texas	252	146	146	2	309	5				16	11
MOUNTAIN											
Montana	3	2	16								1
Idaho	1	4	4			1					
Wyoming	1		5								
Colorado	1	32	32								4
New Mexico	3	12	12								
Arizona	20	14	19			37					
Utah [2]		15	15								1
Nevada		7	1				1				
PACIFIC											
Washington	32	61	47								3
Oregon	10	10	10								3
California	112	123	222	1	3					1	4
Total	2,485	1,976	2,418	22	344	67	8	0	60	56	97
Same week, 1946	1,976			67	309	173	8	0	35	49	78
Median, 1942–46	2,418			27	177	40	7	0	32	51	[3] 77
3 weeks: 1947	6,582			77	1,093	664	20	1	154	155	250
1946	5,504			135	1,164	436	22	0	87	191	186
Median, 1942–46	6,526			81	810	159	22	0	87	191	[3] 193

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

WEEKLY REPORTS FROM CITIES [1]

City reports for week ended Jan. 11, 1947

This table lists the reports from 85 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	2	0	----	0	54	0	2	0	3	0	0	3
New Hampshire:												
Concord	0	0	----	0	----	0	0	0	0	0	0	----
Massachusetts:												
Boston	6	0	----	0	16	4	8	0	29	0	1	37
Fall River	0	0	----	0	1	0	0	1	3	0	0	6
Springfield	0	0	----	0	3	0	1	0	5	0	0	16
Worcester	0	0	----	0	5	0	8	0	6	0	0	26
Rhode Island:												
Providence	2	0	1	0	22	0	5	0	4	0	0	8
Connecticut:												
Bridgeport	0	0	----	0	----	0	0	0	3	0	0	----
Hartford	0	0	----	0	1	0	2	0	5	0	0	----
New Haven	0	0	----	0	31	0	1	0	3	0	0	5
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	----	2	----	0	7	0	10	0	0	3
New York	27	0	17	4	63	2	99	1	74	0	2	79
Rochester	0	0	----	0	7	0	6	0	14	0	0	1
Syracuse	0	0	----	0	----	0	4	0	5	0	0	24
New Jersey:												
Camden	0	0	----	0	----	0	0	0	4	0	0	4
Newark	0	0	4	0	6	2	5	0	13	0	0	20
Trenton	2	0	1	0	30	0	6	0	2	0	0	2
Pennsylvania:												
Philadelphia	0	0	3	1	24	1	17	0	22	0	0	58
Pittsburgh	0	0	1	1	222	0	8	0	8	0	0	12
Reading	0	0	----	0	3	0	2	0	1	0	0	5
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	0	0	----	0	2	0	2	0	11	0	0	4
Cleveland	0	0	5	1	220	1	7	0	31	0	0	15
Columbus	2	0	----	0	1	0	1	0	7	0	0	4
Indiana:												
Indianapolis	0	1	----	0	----	1	8	0	6	0	0	24
South Bend	0	0	----	0	----	0	0	0	2	0	0	----
Terre Haute	0	0	----	0	----	0	2	0	2	0	0	----
Illinois:												
Chicago	0	0	2	1	9	3	34	0	41	0	0	61
Michigan:												
Detroit	3	1	1	1	4	0	10	0	46	0	0	105
Flint	0	0	----	0	----	0	9	0	1	0	0	4
Grand Rapids	0	0	----	0	----	0	3	0	6	0	0	17
Wisconsin:												
Kenosha	0	0	----	0	----	0	0	0	3	0	0	----
Milwaukee	0	0	1	1	6	2	9	0	15	0	0	71
Racine	0	0	----	0	----	0	0	0	9	0	0	4
Superior	2	0	----	0	----	0	0	0	1	0	0	----
WEST NORTH CENTRAL												
Minnesota:												
Duluth	0	0	----	0	----	0	0	1	4	0	0	----
Minneapolis	4	0	----	1	4	0	4	0	5	0	0	4
St. Paul	1	0	----	0	1	0	4	0	5	0	0	----
Missouri:												
Kansas City	0	0	----	0	4	0	11	0	4	0	0	5
St. Joseph	0	0	----	0	----	0	0	0	2	0	0	3
St. Louis	2	0	4	0	1	3	17	0	7	0	0	3

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

City reports for week ended Jan. 11, 1947—Continued

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
Nebraska:												
Omaha	0	0	------	0	------	0	4	0	3	0	0	2
Kansas:												
Topeka	0	0	------	0	------	0	0	0	1	0	0	------
Wichita	0	0	------	0	1	0	4	1	4	0	0	2
SOUTH ATLANTIC												
Delaware:												
Wilmington	0	0	------	0	------	0	1	0	2	0	0	5
Maryland:												
Baltimore	10	0	2	1	10	2	8	0	17	0	0	56
Cumberland	0	0	------	0	------	0	0	0	0	0	0	------
Frederick	0	0	------	0	------	0	1	0	0	0	0	------
District of Columbia:												
Washington	0	0	3	1	19	0	6	0	16	0	0	9
Virginia:												
Lynchburg	0	0	------	0	------	0	2	0	2	0	0	------
Richmond	2	0	1	1	41	1	3	0	1	0	0	1
Roanoke	0	0	------	0	------	0	0	0	4	0	0	------
West Virginia:												
Charleston	0	0	------	0	------	0	0	0	0	0	0	------
Wheeling	0	0	------	0	------	0	1	0	1	0	0	2
North Carolina:												
Raleigh	0	0	------	0	5	0	3	0	1	0	0	1
Wilmington	1	0	------	0	3	0	0	0	0	0	0	------
Winston-Salem	0	0	------	0	51	0	3	0	0	0	0	5
South Carolina:												
Charleston	2	0	20	0	2	1	1	0	1	0	0	0
Georgia:												
Atlanta	0	0	5	0	30	0	1	0	7	0	0	2
Brunswick	0	0	------	0	4	0	0	0	0	0	0	------
Savannah	1	0	4	0	51	0	0	0	1	0	0	------
Florida:												
Tampa	2	0	------	0	------	1	2	0	4	0	0	------
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	6	0	------	1	------	2	16	1	6	0	0	13
Nashville	0	0	------	0	------	0	3	0	2	0	0	------
Alabama:												
Birmingham	0	0	1	0	7	0	7	0	1	0	0	1
Mobile	2	0	1	0	------	0	4	0	4	0	0	------
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0	------	0	------	0	0	0	0	0	0	------
Louisiana:												
New Orleans	2	0	2	0	4	1	14	0	3	0	0	5
Shreveport	0	0	------	0	------	0	6	1	1	0	0	------
Texas:												
Dallas	2	0	------	0	------	0	4	0	2	0	0	------
Galveston	0	0	------	0	------	0	1	0	1	0	0	------
Houston	0	0	------	0	------	0	5	3	6	0	1	------
San Antonio	1	0	------	0	2	0	8	0	3	0	0	------
MOUNTAIN												
Montana:												
Billings	0	0	------	0	------	0	1	0	0	0	0	------
Great Falls	0	0	------	0	95	0	0	0	0	0	0	------
Helena	0	0	------	0	10	0	1	0	0	0	0	------
Missoula	0	0	------	0	------	0	0	0	0	0	0	1
Colorado:												
Denver	6	0	6	0	2	0	8	1	25	0	0	7
Pueblo	0	0	------	0	------	0	1	0	0	0	0	------
Utah:												
Salt Lake City	0	0	------	0	2	0	3	0	5	0	0	------

City reports for week ended Jan. 11, 1947—Continued

Division, State, and City	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle	0	0	------	0	3	0	5	0	4	0	0	3
Spokane	1	0	------	0	15	0	4	1	3	0	0	------
Tacoma	0	0	------	0	1	0	0	0	2	0	0	------
California:												
Los Angeles	8	0	1	0	6	3	8	6	22	0	0	9
Sacramento	0	0	------	0	2	0	0	0	0	0	0	1
San Francisco	3	0	3	0	5	3	12	1	11	0	0	1
Total	102	2	89	17	1,111	33	453	18	588	0	4	[1]759
Corresponding week, 1946	80	------	697	103	2,049	------	709	------	806	0	13	643
Average 1942–46	74	------	1,116	[2]138	[3]1,874	------	[2]680	------	1,109	0	10	741

[2] 3-year average, 1944–46.
[3] 5-year median, 1942–46.

Dysentery, amebic.—Cases: Boston 1; Chicago 3; Memphis 1.
Dysentery, bacillary.—Cases: Chicago 2; Detroit 5.
Dysentery, unspecified.—Cases: Worcester 1; Cincinnati 1; Baltimore 1; San Antonio 5.
Leprosy.—Cases: Los Angeles 1.
Tularemia.—Cases: Washington, D. C., 1; Richmond 1.
Typhus fever, endemic.—Cases: Mobile 1; New Orleans 3; Dallas 1; Los Angeles 1.

Rates (annual basis) per 100,000 population, by geographic groups, for the 85 cities in the preceding table (estimated population, 1943, 34,143,300

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
			Case rates	Death rates								
New England	26.3	0.0	2.6	0.0	349	10.5	70.9	2.6	160	0.0	2.6	265
Middle Atlantic	13.4	0.0	12.0	3.7	164	2.3	71.3	0.5	71	0.0	0.9	96
East North Central	4.4	1.2	5.6	2.5	150	4.4	52.8	0.0	113	0.0	0.0	192
West North Central	14.1	0.0	8.0	2.0	22	6.0	88.5	4.0	70	0.0	0.0	38
South Atlantic	29.4	0.0	57.2	4.9	353	8.2	52.3	0.0	93	0.0	0.0	132
East South Central	47.2	0.0	11.8	5.9	41	11.8	177.1	5.9	77	0.0	0.0	83
West South Central	14.3	0.0	5.7	0.0	17	2.9	109.0	11.5	46	0.0	2.9	14
Mountain	49.6	0.0	49.6	0.0	900	0.0	115.6	8.3	248	0.0	0.0	66
Pacific	19.0	0.0	6.3	0.0	51	9.5	45.9	12.7	66	0.0	0.0	22
Total	15.6	0.3	13.6	2.6	170	5.0	69.4	2.8	90	0.0	0.6	116

TERRITORIES AND POSSESSIONS

Panama Canal Zone

Notifiable diseases—November 1946.—During the month of November 1946, certain notifiable diseases were reported in the Panama Canal Zone and terminal cities as follows:

Disease	Residence [1]									
	Panama City		Colon		Canal Zone		Outside the Zone and terminal cities		Total	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Chickenpox	2		2		7		2		13	
Diphtheria	8		7		1		6		22	
Dysentery:										
Amebic					1		4		5	
Bacillary	2		1		3				6	
Malaria [2]	6		2		18		28	1	54	1
Measles	24	1	17	1	32		10		83	2
Meningitis, meningococcus							1		1	
Mumps	2				6		1		9	
Pneumonia		11		6	21	6		5	[3] 21	28
Poliomyelitis					1				1	
Tuberculosis		20		10	2	2		4	[3] 2	36
Typhoid fever	1						1		2	
Whooping cough					2				[3] 2	

[1] If place of infection is known, cases are so listed instead of by residence.
[2] 7 recurrent cases.
[3] In the Canal Zone only.

Virgin Islands of the United States

Notifiable diseases—October–December 1946.—During the months of October, November, and December 1946, cases of certain notifiable diseases were reported in the Virgin Islands as follows:

Disease	October	November	December	Disease	October	November	December
Chickenpox			2	Mumps	1		
Dysentery, amebic			1	Paratyphoid fever			1
Filariasis	5		1	Syphilis	6	11	15
Gonorrhea	25	23	14	Tuberculosis		4	1
Hookworm disease	11	4	3	Yaws		1	
Lymphogranuloma inguinale	1						

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended December 28,1946.—During the week ended December 28, 1946, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		4	1	85	253	18	31	41	81	514
Diphtheria		2		20	5	5				32
Dysentery, amebic					2					2
Encephalitis, infectious							1			1
German measles					3			4	8	15
Influenza		1			5	1				7
Measles		145	3	41	27	62	374	217	73	942
Meningitis, meningococcus							2			2
Mumps				6	204	13	70	24	117	434
Poliomyelitis		2		3	3					8
Scarlet fever		6	3	40	91	11		2	7	160
Tuberculosis (all forms)		14	6	72	42	19	5	9		167
Typhoid and paratyphoid fever				3					3	6
Undulant fever					2			1		3
Venereal diseases:										
Gonorrhea		7	5	47	59	17	18	19	83	255
Syphilis		8	2	30	39	3	4	1	51	138
Whooping cough			1	8	47	3	6	1	21	87

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

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

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

Smallpox

China—Hong Kong.—For the week ended January 4, 1947, 73 cases of smallpox were reported in Hong Kong, China.

Yellow Fever

French Equatorial Africa—Ubangi Shari Department—Carnot.—Diagnosis has not been confirmed in the death from suspected yellow fever on December 21, 1946, in Carnot, Ubangi Shari Department, French Equatorial Africa, as published on page 148 of the PUBLIC HEALTH REPORTS for January 24, 1947.