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Survival of Tubercle Bacilli in Various Sewage Treatment Processes

I. Development of a Method for the Quantitative Recovery of Mycobacteria From Sewage

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Although there have been many studies of the survival of *Mycobacterium tuberculosis* outside the animal host, only a very few have dealt with the presence and survival of the organism in tuberculosis sanatoria wastes and surface waters (*1–9*). Most of the latter, however, have been concerned largely with demonstrating the presence or absence of presumably tuberculous organisms in sanatorium wastes, rather than with the numbers actually present or surviving. In consequence, no conclusions can be drawn from these studies regarding the extent or significance of tuberculous contamination of sanatorium sewage.

In approaching this problem, the authors first found it necessary to devise a satisfactory method for the isolation and enumeration of tubercle bacilli in highly contaminated substrates—one which would completely suppress the large numbers of contaminating micro-organisms and leave unchanged the number of tubercle bacilli. The purpose of this paper is to report the development of such a method, and to present preliminary findings derived through the use of the method. Future reports will attempt to evaluate the significance of these findings through comparative studies of sewage from tuberculosis sanatoria and other sources in addition to bacteriological typing and virulence tests.

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Development of the Method

In the past, the results of quantitative studies have been greatly influenced by the use of an acid or alkaline pretreatment. Rhines (*9*) infected various substrates with tubercle bacilli and utilized a pretreatment of 2 percent NaOH for 10 minutes, followed by cultivation on glycerol agar containing crystal violet. Although tubercle bacilli are relatively resistant, it seems probable that many would be destroyed in such procedures. As a matter of fact, Rhines himself showed that the concentration of NaOH he had utilized was bactericidal, and stated further that the crystal violet incorporated with the glycerol agar also reduced the number of tubercle bacilli. The authors therefore felt that this method was unsuitable for the present study.

There were three means by which the desired end could be accomplished: (1) the use of a selective medium; (2) the use of a selective pretreatment procedure; and (3) a combination of pretreatment and cultivation on a selective medium. Each of these methods was approached in turn and systematically studied.

Selective Medium

In his classical review on the tubercle bacillus and tuberculosis, Calmette (*10*) lists some 20 media for cultivation of the tuberculous organism. Since his work, the number of media has doubled, but the majority of them are not only complex organic preparations, but nonspecific as well.

Although Dubos' (*11*) medium is not selective, it is one which is relatively simple to prepare and which provides fairly rapid growth from small inocula. Moreover, when solidified with agar, this particular medium is transparent, so that colony study and differentiation are facilitated.

Dubos' agar medium was therefore chosen as a starting point in developing the method for this study, and attempts were made to render it selective. *Mycobacterium tuberculosis avium* was utilized as the test organism because of its close physiological resemblance to the human pathogen and because it could be more readily handled with the facilities available.

The addition of dyes (malachite green and methylene blue) to the medium revealed that the concentrations required to inhibit sewage organisms were bacteriostatic as well for the tubercle bacilli. Sulfadiazine was also found to inhibit growth of the test organism.

Since certain antibiotics have been shown to be selective in their action, their possible use suggested itself. A number of these antibiotics, however, while they are active against gram-negative and/or gram-positive organisms, and not against the tubercle bacillus, are toxic or insoluble, and so are not readily available or applicable.

Penicillin, active against gram-positive organisms, is water soluble and relatively inactive against tubercle bacilli. Grisein (*12*) is active against both gram-positive and gram-negative organisms, water soluble, and also inactive against tubercle bacilli. A combination of these two antibiotics therefore appeared to be a logical method for inhibiting growth of sewage organisms while at the same time permitting quantitative growth of tuberculous organisms.

A systematic laboratory study was made to determine the effect of these agents upon the test organisms. Varying concentrations of each antibiotic were incorporated with Dubos' basal medium prepared and utilized as follows:

KH_2PO_4	1.0 gm.
$Na_2HPO_4.12\ H_2O$	6.3 gm.

Heat in 100 ml. distilled water to dissolve

Add:

Distilled water	850 ml.
Enzymatic Digest of Casein	1.0 gm.
Ferric Ammonium Citrate	0.05 gm.
$ZnSO_4$	0.0001 gm.
$MgSO_4$	0.01 gm.
$CaCl_2$	0.0005 gm.
$CuSO_4$	0.0001 gm.
Agar	15.0 gm.

Dilute to 1 liter; autoclave; adjust to final pH of 6.5; and, when working with the pathogen, add 0.5 gm. bovine albumin aseptically.

To make this medium selective, freshly prepared aqueous solutions of antibiotics were added to the petri dishes in amounts required to obtain desired final concentration after addition of the agar. Liquefied agar was poured into the plates and thoroughly mixed with the antibiotics by swirling. The plates were then allowed to solidify and were incubated overnight to eliminate some of the water of condensation and to allow contamination to grow out.

The inoculum was then placed upon the surface of the solidified plate. Dilution blanks were prepared by mixing 1 part basal medium with 3 parts distilled water, liquefied, and cooled to 45° C. Dilutions were then run, and a 1 ml. inoculum was placed on the surface of the agar. The plate was immediately rotated to obtain equal distribution of the inoculum, allowed to solidify, and incubated at 37° C. for one week, after which plate counts were made.

The results obtained may be summarized as follows:

1. At a maximum concentration of 5 units/ml., penicillin yields a 40–56 percent inhibition of the organisms normally present in sewage without inhibiting the growth of *M. tuberculosis avium.*

2. At a maximum concentration of 50 units/ml., grisein yields a 22 percent inhibition of sewage organisms without inhibiting the avian tubercle bacillus.

The effects of combining both penicillin and grisein with the basal medium at the given maximum concentrations are presented in table 1.

It appears that the addition to Dubos' agar medium of 5 units of penicillin and 50 units of grisein per ml. suppresses 74 to 82 percent of the organisms usually present in raw sewage, without inhibiting the growth of *M. tuberculosis avium.*

Table 1. *Effect of penicillin and grisein mixtures on* M. tuberculosis avium *and normal sewage organisms*

Penicillin concentration [1] (units/ml.)	Replication	Recovery of *M. tuberculosis avium*		Reduction of sewage organisms	
		Range	Mean	Range	Mean
		Percent			
40	1	18	18		
25	1	34	34		
7	1	68	68		
5	2	83-90	86	74-82	78
3	1	86	86	74	74

[1] All media contained 50 units of grisein per ml.

Pretreatment

The value of subjecting the study samples to an acid or alkaline pretreatment procedure was explored. Typical results (table 2) show that exposure to alkali is a drastic pretreatment means.

Table 2. *Effect of exposure to NaOH on* M. tuberculosis avium

Length of exposure (minutes)	Percent kill of *M. tuberculosis avium*		
	N/4 NaOH	N/10 NaOH	N/100 NaOH
10	99+	93	90
30		96	93
60			95

Of the other pretreatment methods which suggested themselves, the utilization of heat seemed the most practical. Tests were made with temperatures between those used for incubation and those required for pasteurization for varying lengths of time. Typical results (table 3) indicated that the use of heat at 50° C. for a period of 1 hour had no

Table 3. *Effect of exposure to 50° C. on* M. tuberculosis avium *and sewage organisms (representative results)*

Length of exposure (minutes)	*M. tuberculosis avium* per ml.	Sewage organisms per ml.
Start	830,000	150,000
20	780,000	40,000
40	890,000	23,500
60	840,000	11,700

effect on the number of tubercle bacilli present in a sample, but destroyed 92 percent of the sewage organisms.

Combined Method

Based on the results obtained from the separate use of the selective culture medium and of the preheat treatment for 60 minutes at 50° C., and assuming that these results are reliable, it is possible to predict that the combined use of these two methods should result in a higher suppression of sewage organisms than by heat or antibiotics alone. At the same time, the method allows successful quantitative recovery of tubercle bacilli originally present in the sewage material.

To test this, a quantity of raw sewage was filtered, inoculated with an enumerated suspension of *M. tuberculosis avium*, and the proposed combination method was applied. Counts for normal sewage organisms were made following 48 hours of incubation at 37° C., and all colonies developed within that time were marked. Since plates inoculated with a pure culture of *M. tuberculosis avium* showed no growth following 48 hours of incubation, all plates were rechecked following 7 days of incubation to obtain the *M. tuberculosis avium* count. (This differential time of incubation was subsequently utilized as an integral part of the method.)

Application of the method to artificial mixtures of sewage and *M. tuberculosis avium* revealed that preheating for 30 minutes instead of 60 minutes at 50° C. yielded better recovery of the tubercle bacilli present. Since previous work had shown that 50° C. for 60 minutes is not effective, it appears that prolonged heating may make the organism more susceptible to antibiotic action. In subsequent work, therefore, a 30-minute exposure to 50° C. was utilized as the pretreatment procedure.

The results of combining the 30-minute pretreatment with heat and cultivation on media containing 50 units of grisein and various concentrations of penicillin ranging from 2 to 7 units/ml. are given in table 4. Quantitative recovery of *M. tuberculosis avium* was

Table 4. *Effect of antibiotics and pretreatment with heat on* M. tuberculosis avium *and normal sewage organisms*

Penicillin concentration [1] (units/ml.)	Replication	Recovery of *M. tuberculosis avium*		Reduction of sewage organisms	
		Range	Mean	Range	Mean
		Percent			
2	1	92	99	94	94
3	5	88-110	98	83-93	87
4	5	88-104	96	88-93	88
5	4	89-101	96	89-97	93
7	3	63-81	72	92-98	95

[1] All media contained 50 units of grisein per ml.

obtained on media containing 2 to 5 units of penicillin/ml. while the average inhibition of the sewage organisms varied from 87 to 94 percent. A concentration of seven units of penicillin/ml. was found to inhibit the growth of *M. tuberculosis avium* somewhat, with the recovery averaging 72 percent while the inhibition of sewage organism was increased only slightly.

Application of the Method

Laboratory Studies of Sewage Treatment Processes

Sewage was inoculated with avian tubercle bacilli and subjected to various treatment processes in the laboratory. The number of tubercle bacilli present in the sewage before and after treatment was determined by the developed method.

Results obtained in these laboratory studies are as follows:

1. Quiescent sedimentation for 6 hours showed no significant change in the number of tubercle bacilli present.

2. Chemical coagulation with ferric chloride at a pH of 5.0, followed by flocculation and sedimentation, removed more than 99 percent of the tubercle bacilli present in the sewage.

3. Continuous application of sewage to sand filters removed 99 percent of all tubercle bacilli originally present, and appeared to be far more efficient than intermittent flooding.

4. Aeration for 24 hours at a rate of 22 cu. ft./gal./day had little effect on the number of tubercle bacilli.

5. The effectiveness of chlorination was determined by correlating the free chlorine residual with the number of tubercle bacilli surviving. A free chlorine residual of 0.9 ppm was found necessary to reduce the number of tuberculous organisms to less than 5 per ml. This is equivalent to a 2–5 ppm residual by ortho-tolidine, and is much higher than that normally maintained for disinfection of ordinary municipal sewage.

Preliminary Study of Sanatorium Sewage Treatment Plant

As a preliminary field trial, the developed method was also used to detect the presence of mycobacteria in the different units of a tuberculosis sanatorium sewage treatment plant and in the stream receiving the plant effluent. The treatment processes utilized by the plant under study are sedimentation, trickling filters, secondary settling, digestion, and chlorination. Plates were prepared from samples obtained from the plant and receiving stream and incubated for 7 days, at which time the contaminants on the plates were marked. The plates were then incubated a month longer, after which the colonies of mycobacteria were picked and subcultured in Dubos' liquid medium. A slide was prepared from each culture, stained, and studied microscopically.

By utilizing the developed procedure, it was possible to isolate acid-fast bacilli, similar in morphology and staining characteristics to *M. tuberculosis*, from the raw sanatorium waste, the effluent of the sanatorium treatment plant, the ripe sludge, fresh solids, and from the stream receiving the plant effluent. The concentration of these acid-fast bacilli was found to be as follows:

	Per ml.
Raw sewage	1, 500
Plant effluent	10
Receiving stream	±10
Settled raw sludge	100, 000
Digested sludge	10, 000

The significance of these findings will be evaluated in future reports which will deal with virulence and typing of the acid-fast rods discovered in these preliminary trials, and with comparative findings from nonsanatorium sewage.

Discussion

Preliminary results indicate that the developed method, that is, pretreatment utilizing heat at 50° C. for 30 minutes and cultivation on Dubos' medium modified by the addition of penicillin and grisein, is effective for the quantitative recovery of tubercle bacilli from highly contaminated materials. It is felt that the method is particularly well adapted to laboratory survival studies of a quantitative nature, and one which, within limits, is suitable for the primary isolation of the tuberculous organism from contaminated material.

It would appear, therefore, that the method could be readily adapted to diagnostic work. Recent studies (*13*, *14*) indicate the importance of cultural methods in the diagnosis of tuberculosis and have made clear that a majority of erroneous negative diagnoses are due to the effects of alkali pretreatment and of the particular kinds of selective media used. Utilization of the method developed in this study would eliminate pretreatment with NaOH, yield positive cultures from small inocula, and prevent loss of the acid-fast staining characteristic. Dubos' medium, as utilized in this procedure, provides rapid growth from small inocula, and is more easily prepared than some commonly used, complex organic media. Moreover, the transparent property of this medium facilitates identification of typical tubercle bacilli colonies (*15*). The use of antibiotics to render the medium selective appears to be superior to that of dyes, in that the latter inhibit growth of tuberculous organisms at the concentrations usually employed.

Although the developed method appears sound, there are four possible complications which may cause error in recovery results:

1. Even after 48 hours' incubation at 37° C., when contaminant

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colonies are marked, more contaminants may grow out to cause error in the differential count.

2. Organisms present in the sewage may produce a penicillinase or grisein-destroying substance which would eliminate the action of the antibiotics, thus allowing the contaminants to grow out and cause error.

3. With prolonged incubation, some sewage organisms may develop resistance to the antibiotics and grow out to cause error.

4. Prolonged exposure to 37° C. may in itself destroy antibiotic action.

The extent to which these factors might cause error in final results was explored by inoculating some plates containing the modified medium with raw sewage and incubating them for a prolonged period at 37° C. Results obtained from daily counts (table 5) show that there was no significant increase in the number of contaminant colonies after 48 hours. Where contaminant colonies do develop after 48 hours, they are so few that an experienced observer can readily differentiate between them and tuberculosis colonies. Moreover, the greater the number of tuberculosis colonies counted later, the more insignificant this possible error.

Table 5. *Effect of prolonged incubation on the inhibition of sewage organisms by modified Dubos' medium (representative results)*

Days of incubation	Number of colonies		Days of incubation	Number of colonies	
	Plate 1	Plate 2		Plate 1	Plate 2
1	27	27	6	31	35
2	30	32	7	32	35
3	30	32	14	32	35
4	31	33	35	32	35
5	31	35			

Summary and Conclusions

A satisfactory quantitative method for the enumeration of tubercle bacilli in sewage materials is described. This method, which employs a pretreatment procedure and cultivation on a selective medium, suppressed 87 to 94 percent of sewage organisms and permitted successful quantitative recovery of tuberculous organisms present in a given sample.

The laboratory application of the developed method to the problems of this study reveals that the sewage treatment processes best suited for the removal of tuberculous organisms are (1) chemical coagulation with ferric chloride, followed by settling; (2) continuous filtration through sand at a rate of 240,000 gal./acre/day; and (3) chlorination to an 0.9 ppm free chlorine residual. Used in combination, the effectiveness of these methods is, of course, enhanced. Except for chlorination, the efficiency of each of the treatment processes in the removal of *M. tuberculosis avium* was more or less equal to that for sewage organisms. In chlorination, however, residuals of less than 0.9 ppm appear to be ineffective against tuberculous organisms.

A preliminary survey was made for mycobacteria in a sanatorium sewage treatment plant which utilizes sedimentation, trickling filtration, and chlorination. Acid-fast rods were found in the raw sewage and in diminished numbers in the plant effluent and the stream receiving the effluent. They were also found in the fresh solids and digested sludge in greater numbers than in the raw sewage. In general, these findings correspond to those obtained in laboratory treatment tests. The results of these field studies will be further refined and evaluated in future work, which will include typing and virulence testing of the recovered acid-fast organisms.

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REFERENCES

(*1*) Brown, L., Petroff, S. A., and Heise, F. H.: The occurrence of living tubercle bacilli in river water contaminated by sewage from a health resort. Am. J. Pub. Health **9:** 1148 (1916).

(*2*) Conroy, J. M., Conroy, B. B., and Laird, A.: The destruction of tubercle bacilli in sewage by chlorine. Am. Rev. Tuberc. **6:** 63 (1922).

(*3*) Cummins, S. L., and Acland, C. M.: Living tubercle bacilli in septic tank effluent. Tubercle **10:** 310 (1929).

(*4*) Jensen, K. A., and Jensen, K. B.: Occurrence of tubercle bacilli in sewage and experiments on sterilization of tubercle bacilli-containing sewage with chlorine. Acta Tuberc. Scandinav. **16:** 217 (1942).

(*5*) Kraus, E.: Untersuchungen uber die Verbreitung von Tuberkelbazillen aus den Abwassern einer Lungenheilstatte. Arch. Hyg. **128:** 112 (1942).

(*6*) Gaustad, V.: Tuberculosis primary infection in three children occurring in connection with fall into highly contaminated river water. Pub. Health Engr. Abst. **29:** No. 2, 14 (1949).

(*7*) Briscoe, C. F.: Fate of tubercle bacilli outside the animal body. Agricultural Experiment Station Bulletin No. 161, University of Illinois, 1912, pp. 279–375.

(*8*) Stenhouse, R., Williams, R., and Hoy, W.: The viability of B. *tuberculosis* on pasture land, in stored feces and liquid manure. J. Hyg. **412:** 30 (1930).

(*9*) Rhines, C.: Persistence of avain tubercle bacilli in soil and relationship of soil microorganisms to the tubercle bacilli. Rutgers University Thesis, 1935.

(*10*) Calmette, A.: Tubercle bacillus infection and tuberculosis in man and animals. Baltimore, Williams and Wilkins Co., 1923.

(*11*) Dubos, R. J., and Middlebrook, G.: Media for tubercle bacilli. Am. Rev. Tuberc. **56:** 334 (1947).

(*12*) Reynolds, D. M., and Waksman, S. A.: Grisein, an antibiotic produced by certain strains of *Streptomyces griseus.* J. Bact. **55:** 739 (1948).

(*13*) Freiman, D. G., and Pinner, M.: Routine examination of sputum for acid fast bacilli. Am. Rev. Tuberc. **59:** 449 (1949).

(*14*) Spendlove, G., Cummings, M., and Patnode, R.: Demonstration of tubercle bacilli in sputum smears. Pub. Health Rep. **64:** 574 (1949).

(*15*) Middlebrook, G., Dubos, R. J., and Pierce, C.: Virulence and morphological characteristics of mammalian tubercle bacilli. J. Exper. Med. **86:** 175 (1947).

Role of the Nurse in Research

When a new drug or other product gives promise of benefiting human beings, the modern procedure is to give it every possible test and trial both in the laboratory and in clinical application. Whether these tests begin in the laboratory or not, the final analysis must always rest upon a clinical evaluation among human beings.

The role of the nurse in such investigations is logical and necessary since she is trained both in administering medications and treatments and in close personal observation of patients. Her usefulness in research, however, depends upon her training in the nursing technique itself and her understanding of the significance of the technique in collecting data. Her value in research, and the opportunities it offers her, increase with her training and experience in that field.

Certainly an intense and constant interest in the problem she is helping to solve and an intellectual curiosity about the outcome of the whole project is essential to the research nurse's success. If she is to have a continuing interest in a research problem, she must know specifically what it is about; she must have a general picture of the methods to be used in the investigation and an idea of why these particular methods were selected. With this knowledge, she can help constructively in planning the programs on the basis of her practical observations in the field. Her knowledge, experience, and ingenuity can be called upon in planning not only the technical nursing procedures, but the handling of materials and equipment and the general logistics of the whole program.

In carrying out field research responsibilities a nurse who has had training and experience in public health is at a great advantage, particularly when the investigation requires administrative contacts with institutions and communities, and public speaking to orient and organize personnel who are cooperating in various localities. Moreover, a nurse with some knowledge of statistical procedures will have an appreciation of the necessity for complete and careful performance and uniform recording of procedures and observations. She will have an awareness of the many subtle biases that may creep into a study.

To illustrate these statements, we can consider the investigation of BCG vaccination against tuberculosis in the Public Health Service for the past several years. The duties of the nurses in this study have been many and varied, and have involved considerable responsibility.

In the BCG study the nurses have taken a large part in formulating

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From the Field Studies Branch, Division of Tuberculosis, Public Health Service. Speech given by S. A. Nurse Officer Patricia B. Geiser at the Metropolitan Washington Tuberculosis Conference, March 22, 1950.

procedures for the standardized care of equipment, the performance of skin tests, methods of inoculation, and in general for the innumerable small but important matters that may spell the success or the failure of a field project. During part of this program, BCG vaccine was flown from Copenhagen, Denmark, to various small towns in America. The vaccine must be used within a few days after its manufacture, and so it was necessary for the nurses to receive it at the airport. They had to keep track of possible changes in airplane schedules that were not known to the shipper in Copenhagen and to arrange with airline officials for the refrigeration and proper delivery of the vaccine so that it could reach a given point at a given time. Nothing is more embarrassing than to have one or two thousand people standing in line ready to be vaccinated, while the vaccine to be used has been placed on the wrong airplane and has not arrived. When the vaccine does arrive, if too long a time has elapsed since it was made, it must be discarded and the program canceled. If this happens, the public's interest is lost and the whole program is jeopardized.

The nurses in the BCG research program have been concerned purely with the collection of data and not with the drawing of conclusions. This means not that the nurses are incapable of drawing conclusions, but that they must constantly guard against doing it, because such conclusions would constitute a bias in their work. In other words, they cannot accurately measure the effect of a procedure if they have already reached the conclusion that that procedure is either good or bad. Training themselves to avoid prejudice in these matters is perhaps the most difficult phase of their work. It is only human to bring a certain prejudice to any observation.

Nurses engaged in research work must be entirely honest in their reporting. Honesty in this sense means complete objectivity and adherence to the standards set, regardless of personal opinion. Every effort must be made to make sure that the words and terms used in descriptions have the same meaning to all persons concerned. This is easy when we are simply measuring in terms of millimeters or centimeters, but it is extremely difficult when we are talking in such terms as "firm," "elevated," "clearly defined," and "well circumscribed." It is the nurse's responsibility to be sure that what she thinks is "clearly defined," is exactly the same as what the other nurses regard as "clearly defined." Even the slightest variation in such interpretations can grossly distort the statistical findings. I am, of course, referring to the reading of tuberculin tests. As you know, reactions must not only be measured in size but must be described with qualitative adjectives which indicate the quality of induration.

A great deal of correspondence becomes essential in a program of this sort. It is important that such correspondence be explicit in its meaning and in the dates stated, and that it be carefully timed.

A hospital official, for instance, must be given sufficient advance notice if we ask him to arrange a schedule for the testing or vaccinating of patients or employees. In an institution that operates a 24-hour service, schedules must be arranged in such a manner that employees coming on duty can be processed at the same time as those going off duty, and care must be taken to avoid scheduling programs on holidays. Otherwise an entire shift might be missed.

One of the most important requirements of a nurse on field duty in a research project that covers extensive territory is a thorough understanding of the geography and transportation facilities of the area. Otherwise, she will find herself unable to get from one city to another and to be on hand at the time she is expected. She must therefore have a good knowledge of air, rail, and bus transportation.

The intricacies of the Federal, State, and local civil service employment regulations must be well understood, because a nurse is often called upon to hire and train clerks in the field for temporary duty.

The research nurse is often alone in carrying out her work, in a location far removed from the central organization and its medical officers, and she must be prepared to answer questions tactfully and competently. There is nearly always some limit to the amount of information which she is free to give on any research problem, and she must learn to restrict her replies to questions without giving offense.

One of our BCG programs is concerned with the tuberculin testing and vaccinating of student nurses and medical students in a certain area in New England. The investigation calls for X-ray of all participants and, within a period of 6 weeks, the tuberculin testing of all participants with negative X-rays. Tuberculin tests are read 72 hours after administration, and the participants who are found eligible are vaccinated. For research purposes, several varieties of tuberculin may be used in different tests, different dosages may be given, and the tests may be read at different periods, i. e., 48 hours after testing, as well as the usual 72. At the same time the vaccination itself may have several variables. We may use different vaccines from different producers, at different periods after manufacture, in various doses, and may administer the vaccination by several different techniques. All these factors must be accurately recorded for each person vaccinated. The nurse returns 3 days after vaccination to observe the reaction, and again in 30 days for a similar observation. After 50 days, she returns once more to test both the vaccinated and the unvaccinated to determine how many converted from negative to positive in their tuberculin tests. This procedure may be followed up again at other periods such as 6 months or 1 year after vaccination. And at each of these visits the new arrivals at the institution begin the process all over again.

The problems presented in another environment may be entirely different from those just described. In the program among American Indians which took us through the most remote areas of the West, we were confronted by a variety of unique and challenging situations arising from the cultural background of the people. For instance, in one reservation we found it impossible to obtain the names of deceased parents, since the Indians refused to allow the names of dead persons to be used. We were obliged to consider carefully the various tribal customs in each area as well as to train the Indian nurses in the technical conduct of the program.

In the midst of the multitude of problems arising from such situations as mentioned, the nurse must continue to maintain strict scientific accuracy in her work so that the records of her observations present data that will be useful to the statistical analyst. The accurate recording of the many variations in the procedure is done on mark-sensing IBM cards. Since the nurse is called upon to instruct the clerks who are making these records, it is necessary that the nurse herself be aware of the techniques of coding the data on the IBM cards.

The IBM cards are sent to the central office and provide the data for the eventual statistical evaluation of the study. Since statistical analysis loses its purpose if the accuracy of the data is doubtful, it is extremely important for a nurse to make sure that the data being collected are as accurate as is humanly possible. Absolute accuracy in procedures involving human observations is of course impossible to achieve, but one must aim toward it in gathering data.

It is apparent that the duties of a nurse engaged in medical research involve many problems other than those directly associated with usual nursing responsibilities. Some important qualifications are:

1. A real interest in, and an intense curiosity about, the problem being investigated, as well as an understanding of the basic nature of the specific problem. Without these it is not humanly possible for her to maintain a high quality of production in detailed work.

2. The physical stamina for what may at times be a rigorous life.

3. Ability to perform the work involved, to deal with people effectively, to arrange schedules, to understand transportation, and so forth.

4. Adaptability, ingenuity, and common sense in planning and carrying out the programs. It is here in particular that the public health nurse is at an advantage.

5. Willingness to maintain constantly a strict adherence to the rules or standards which have been set for the performance of the procedure.

6. Ability to travel, to work, and to live in strange surroundings, contentedly, in spite of considerable isolation at times.

7. Ability to establish necessary contacts with local people and to represent her organization in such a way as to insure herself, or any

other representatives of her organization, a welcome in the future.

This is a brief outline of what nursing participation in research may involve, and in general it may sound a little severe. Indeed it is severe from the standpoint of the demands it makes upon the time and energies of a nurse. It is never a 9 to 5 job. It means living out of suitcases, waiting in railway stations and airports, meeting airplanes in the middle of the night, dashing in and out of hotels and telegraph offices. Often pie and coffee must substitute for a meal, and the sleep is not too regular. It means, above all, securing the cooperation of many different people each of whom must be separately and individually introduced to the nature of the project.

But the compensations of this kind of work should not be overlooked. The nurse is respected wherever she goes; she is well informed on a subject that is likely to be a mystery to most people but which is always interesting. She meets many people, some in high office, and while she must use tact in her dealings with them, she need never be subservient. In the course of her traveling she learns much that will stand her in good stead throughout her life. No matter how small a part she may play in a large undertaking, it is a dignified part and she has the advantage of knowing that her work is fundamental to the success of the project. No matter how routine the procedures may be, the scene is continually changing and her life is never monotonous. The nurse becomes in each locality a sort of special person, an authority on a fascinating subject, medical research.

Protecting Photofluorographic Personnel From Excessive Radiation

By Willard W. Van Allen*

In photofluorography, radiation hazards are present to a considerably greater extent than in other roentgenographic diagnostic procedures. This is due both to the higher energy requirements of the photofluorographic techniques, and to the characteristics of the equipment itself.

The quantity of radiation required for a photofluorographic exposure is several times that used for a conventional radiograph. Also, it is not unusual for a single photofluorographic machine to produce over 500 exposures per day, and to operate at this rate for many consecutive days. With this combination of a great number of exposures and high radiation requirements for each exposure, the amount of secondary radiation in the vicinity of the equipment is, of course, far greater than that encountered in large-film work.

Furthermore, most photofluorographic equipment is portable, semiportable, or mounted in mobile trucks, and operating space is usually limited. Consequently, it is not always possible to employ the same protective measures which apply readily to permanent installations. Protective screens, for example, are limited in size, especially in mobile installations, by the requirement of movability and by the necessity for providing space for the movement of people to and from the X-ray equipment. Obviously, these considerations cannot be interpreted as an excuse for inadequate protective measures. They do, however, introduce the necessity for more careful design and placement of protective barriers, more thorough attention to radiation fields actually present, and full cooperation on the part of both supervisors and operating personnel to assure completely safe operating conditions.

The Electronics Laboratory has undertaken two programs in an effort to find the most effective procedures for the protection of photofluorographic personnel. These are (1) the continuous monitoring of the amount of radiation actually received by its personnel each week, and (2) the study of radiation fields surrounding photofluorographic installations used by Public Health Service teams. These programs are still in progress, and a more extensive and detailed report will be published later.

Radiation Monitoring

In spite of the fact that ideal protective devices are difficult or

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impossible to realize, radiation exposure can very definitely be kept within safe limits. Complete cooperation by all concerned is the means by which this can be achieved.

Unfortunately, it is possible for technicians, through carelessness, ignorance or both, to circumvent even the most carefully designed protective devices. Consequently, the Electronics Laboratory has instituted a system of continuous monitoring of the exposure received by all personnel working in photofluorographic installations. Each employee is given a plastic badge containing a dental film packet, and required to wear the badge for 1 week while on duty. At the end of each week the badges are returned to the laboratory for processing under standard conditions. The radiation received is then determined from the density of the developed image.

The results of the first 5 weeks of monitoring during a recent survey are summarized in the table and indicate the amounts of radiation actually received by operating personnel. What is more important, however, these results show what improvement can be made in only a short time through the conscientious observation of safety rules by supervisors and operating personnel alike.

Percent of operating personnel receiving more than the indicated amount of radiation

[Milliroentgens per week]

Period	25	50	75	100	150	200	300
	Percent						
First week	90	50	45	36	30	25	20
Second week	80	52	40	36	16	4	0
Third week	68	44	32	16	8	8	8
Fourth week	74	36	31	5	5	5	0
Fifth week	50	12	4	4	0	0	0

At the start of the check, 20 percent of the technicians received radiation in excess of 300 milliroentgens per week, which is generally considered the limit of allowable radiation. As a result of follow-up procedures, however, the percentage of personnel receiving high dosage rates dropped from week to week, until during the fifth week, no one received more than half this amount. Similarly, although 50 percent received more than 50 milliroentgens per week during the first week, only 12 percent received more than this amount during the fifth week. In other words, the majority of technicians succeeded in reducing their radiation dosage to less than one-sixth the accepted limit of 300 milliroentgens per week.

Radiation Fields

The study of radiation fields serves to show where radiation hazards exist and ways of avoiding excessive exposure. Figure 1 shows, by

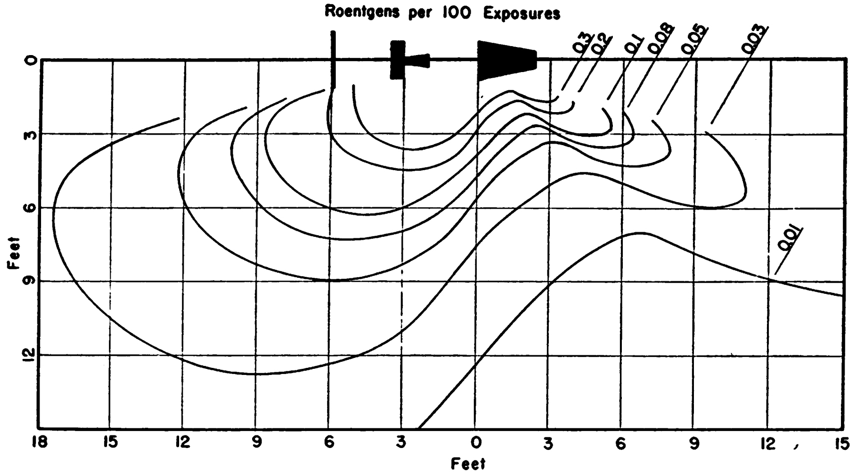

Figure 1. Fields of secondary radiation surrounding a typical photofluorographic installation in an unconfined area.

means of isodose curves, the field of secondary radiation surrounding a typical photofluorographic installation in a large room with no confining walls. These measurements were made in a unit set up in the train concourse of the North Station in Boston, and are probably representative of most installations in large rooms.

The scattered radiation originated in a presdwood phantom 12.5 cm. thick and 40 cm. square. For this purpose, such a phantom is roughly equivalent to a human subject of somewhat more than average size. At 85 KVP and 200 MA, exposures were approximately 25 milliampere-seconds. The isodose curves are labeled to show roentgens per 100 exposures under these conditions.

The general pattern of the field on the tube side of the photofluorographic hood was found to vary little from one installation to another. On the other hand, the shape of the isodose curves on the side of the screen opposite the tube showed wide variations with different units. This was clearly due to differences in accuracy of tube alignment and in efficiency of coning.

In some installations, for example, the radiation field patterns behind the hood showed a region of higher intensity on one side of the central axis than on the other. In others, the pattern is symmetrical on both sides—sometimes showing the bulge on both sides, sometimes not—depending on the effectiveness of coning of the primary beam. While the general shape of the field patterns encountered in different installations is roughly as shown in figure 1, it should be remembered that the fields as a whole vary with differences in exposure, the size of the subject, type of screen and film used, and in phototimer density setting.

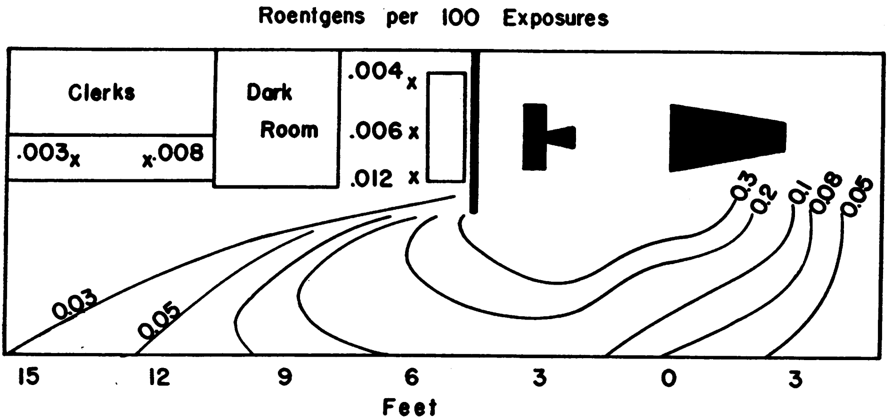

Figure 2. Fields of secondary radiation in a mobile (bus) photofluorographic installation.

Figure 2 shows the radiation field pattern under the same exposure conditions as used in figure 1, but with the photofluorographic machine installed in a mobile bus unit. This, therefore, represents the other extreme, where space is limited and walls and ceiling are near the source of radiation.

In addition to the field pattern outside the protective barriers, figure 2 includes isolated measurements of radiation at five points behind the protective screens, three at the control stand position, and two at the clerk's desk.

A study of the radiation fields in the two diagrams provides the answers to many questions about safe operating practice. It is obvious that operating personnel must stand behind the protective screens during exposure.

Unfortunately, an operator can stand just outside the protective screen and still reach the exposure switch in most cases. In this position, the operator would attain the maximum allowable dosage of 300 milliroentgens per week in from 100 to 150 exposures of the order described above. This represents only a fraction of a single day's work in most cases. On the other hand, if the operator positions himself squarely behind the protective screen, he may expect to make some 5,000 exposures per week before exceeding the 300-milliroentgen limit.

Similarly, other personnel employed at a particular unit must also be provided with suitable protection. This is especially important in mobile units where two or more technicians are on duty, and protective barriers are frequently limited to a single screen behind the tube. In a mobile bus unit, no position in the aisle can be considered completely safe for exposures totaling more than a fraction of a typical week's work.

Incidence of Disease

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

UNITED STATES

Reports From States For Week Ended June 17, 1950

The total number of reported cases of poliomyelitis in the United States increased from 207 (corrected figure) last week to 236 for the current week. For the corresponding weeks of last year, 243 and 278 cases, respectively, were reported. The largest increase was shown in Texas, from 61 cases last week to 96 cases for the current week. Only 2 other States reported a total of 10 or more cases for the current week. These were California (19) and South Carolina (10).

The cumulative total number of cases for the current "disease" year or the total since the seasonal low week (March 18, 1950) is 1,326 which may be compared with 1,381 for the corresponding period last year. Corresponding cumulative totals show Texas with 471 cases and California with 182 cases which may be compared with 464 and 139 cases, respectively, last year.

Comparative Data for Cases of Specified Reportable Diseases: United States

[Numbers after diseases are International List numbers, 1948 revision]

Disease	Total for week ended—		5-year median 1945–49	Seasonal low week	Cumulative total since seasonal low week		5-year median 1944–45 through 1948–49	Cumulative total for calendar year—		5-year median 1945–49
	June 17, 1950	June 18, 1949			1949–50	1948–49		1950	1949	
Anthrax (062)	-------	2	(1)	(1)	(1)	(1)	(1)	19	30	(1)
Diphtheria (055)	80	94	162	27th	7,237	8,648	13,437	2,966	3,534	5,871
Acute infectious encephalitis (082)	22	13	10	(1)	(1)	(1)	(1)	317	246	208
Influenza (480–483)	766	562	590	30th	273,379	109,372	178,747	242,849	73,102	135,189
Measles (085)	12,802	14,073	14,073	35th	266,501	602,580	524,160	247,371	550,187	489,214
Meningococcal meningitis (057.0)	75	55	61	37th	3,048	2,741	2,975	2,135	1,897	2,003
Pneumonia (490–493)	975	1,003	-------	(1)	(1)	(1)	-------	53,220	48,155	-------
Acute poliomyelitis (080)	236	278	183	11th	[2] 1,326	1,381	908	[2] 2,460	2,296	1,375
Rocky Mountain spotted fever (104)	28	25	25	(1)	(1)	(1)	(1)	128	180	132
Scarlet fever (050)	729	875	1,334	32d	53,638	77,499	83,689	37,199	54,955	57,003
Smallpox (084)	1	-------	-------	35th	44	49	190	24	39	136
Tularemia (059)	30	28	23	(1)	(1)	(1)	(1)	476	591	474
Typhoid and paratyphoid fever (040, 041) [3]	61	68	82	11th	730	709	811	1,240	1,197	1,283
Whooping cough (056)	2,743	1,294	2,106	39th	85,779	35,019	79,018	64,243	24,986	47,752

[1] Not computed.
[2] Additions: Arkansas, weeks ended Apr. 15, June 3, and June 10, 1 case each.
[3] Including cases reported as salmonellosis.

The total number of reported cases of influenza for the current week was 766 which may be compared with 1,015 last week and 562 for the corresponding period last year. The 5-year (1945–49) median was 590. The cumulative total number of cases of influenza reported this calendar year is 242,849 which may be compared with the 5-year median of 135,189.

Reported cases of infectious encephalitis numbered 22 for the current week as compared with 12 the preceding week and 13 for the corresponding week of last year. The 5-year median was 10 cases. The cumulative total number of cases reported for this calendar year was 317. The corresponding cumulative 5-year median was 208; the highest year since 1944 was 1949 when a corresponding total of 246 cases was reported.

The total number of cases of tularemia reported for the current week was 30 which may be compared with 12 the previous week and 28 for the corresponding week last year. The 5-year median was 23 cases. The cumulative total reported for this year is 476 cases of tularemia.

One case of smallpox was reported in Arizona which may be compared with 1 case reported in Kansas last week. No cases were reported for the corresponding weeks of 1947–49. Total number of cases of smallpox reported this year was 24 which may be compared with 39 reported for the corresponding period last year and 244 for 1946, the high year since 1944.

Of 42 States reporting on rabies in animals, 23 and the District of Columbia reported no cases. The remaining 18 States reported 113 cases with the largest numbers in New York (20), Indiana (17), and Georgia (13).

Deaths During Week Ended June 17, 1950

	Week ended June 17, 1950	*Corresponding week, 1949*
Data for 94 large cities of the United States:		
Total deaths	8, 791	8, 851
Median for 3 prior years	8, 632	----------
Total deaths, first 24 weeks of year	231, 300	228, 920
Deaths under 1 year of age	629	652
Median for 3 prior years	652	----------
Deaths under 1 year of age, first 24 weeks of year	14, 944	15, 584
Data from industrial insurance companies:		
Policies in force	69, 748, 806	70, 361, 365
Number of death claims	12, 310	12, 379
Death claims per 1,000 policies in force, annual rate	9. 2	9. 2
Death claims per 1,000 policies, first 24 weeks of year, annual rate	9. 8	9. 6

Reported Cases of Selected Communicable Diseases: United States, Week Ended June 17, 1950

[Numbers under diseases are International List numbers, 1948 revision]

Area	Diphtheria (055)	Encephalitis, infectious (082)	Influenza (480–483)	Measles (085)	Meningitis, meningococcal (057.0)	Pneumonia (490–493)	Poliomyelitis (080)
United States	80	22	766	12,802	75	975	236
New England	1	1	—	1,394	1	47	2
Maine	—	—	—	129	—	8	—
New Hampshire	—	—	—	4	—	1	1
Vermont	—	—	—	2	—	—	—
Massachusetts	1	1	—	868	1	—	—
Rhode Island	—	—	—	1	—	10	1
Connecticut	—	—	—	390	—	28	—
Middle Atlantic	6	12	2	3,959	10	242	14
New York	3	11	[1] 1	1,475	6	158	9
New Jersey	2	1	1	1,608	1	38	2
Pennsylvania	1	—	—	876	3	46	3
East North Central	7	1	17	4,031	17	156	19
Ohio	3	—	1	663	10	26	2
Indiana	—	—	—	196	2	4	2
Illinois	1	—	—	1,366	1	80	3
Michigan	1	1	3	758	2	41	7
Wisconsin	2	—	13	1,048	2	5	5
West North Central	3	2	13	465	6	34	17
Minnesota	—	1	6	114	3	6	1
Iowa	1	1	—	127	—	1	3
Missouri	—	—	—	95	2	8	9
North Dakota	—	—	1	—	1	9	—
South Dakota	—	—	—	24	—	—	1
Nebraska	—	—	6	70	—	5	2
Kansas	2	—	—	35	—	5	1
South Atlantic	23	—	170	550	9	97	25
Delaware	—	—	—	19	1	—	—
Maryland	1	—	1	88	1	22	—
District of Columbia	—	—	2	28	—	9	1
Virginia	5	—	139	103	2	38	1
West Virginia	2	—	16	116	1	15	3
North Carolina	4	—	—	76	2	—	2
South Carolina	6	—	4	17	—	2	10
Georgia	5	—	7	23	1	6	3
Florida	—	—	1	80	1	5	5
East South Central	10	—	20	292	7	52	19
Kentucky	2	—	1	124	1	14	6
Tennessee	—	—	5	116	5	—	—
Alabama	4	—	12	32	1	24	
Mississippi	4	—	2	20	—	14	9
West South Central	18	3	489	507	15	275	111
Arkansas	1	—	16	33	—	8	4
Louisiana	2	—	1	11	1	35	2
Oklahoma	1	—	32	12	1	16	9
Texas	14	3	440	451	13	216	96
Mountain	5	2	49	782	1	36	7
Montana	2	—	2	16	—	—	—
Idaho	—	—	8	75	—	—	2
Wyoming	—	—	—	13	—	3	—
Colorado	—	1	18	367	1	13	1
New Mexico	2	—	—	23	—	11	1
Arizona	1	1	21	11	—	6	3
Utah	—	—	—	277	—	3	—
Nevada	—	—	—	—	—	—	—
Pacific	7	1	6	822	9	36	22
Washington	—	—	—	77	2	1	1
Oregon	—	—	3	20	—	16	2
California	7	1	3	725	7	19	19
Alaska	—	—	—	—	—	1	—
Hawaii	—	—	1	1	—	—	—

[1] New York City only.

Reported Cases of Selected Communicable Diseases: United States, Week Ended June 17, 1950—Continued

[Numbers after diseases are International List numbers, 1948 revision]

Area	Rocky Mountain spotted fever (104)	Scarlet fever (050)	Smallpox (084)	Tularemia (059)	Typhoid and paratyphoid fever [1] (040, 041)	Whooping cough (056)	Rabies in animals
United States	28	729	1	30	61	2,743	113
New England		**112**				**354**	
Maine		3				62	
New Hampshire						3	
Vermont						23	
Massachusetts		91				100	
Rhode Island		4				58	
Connecticut		14				108	
Middle Atlantic	**4**	**154**			**7**	**340**	**22**
New York	2	[2] 89			4	102	20
New Jersey	1	24				132	
Pennsylvania	1	41			3	106	2
East North Central	**1**	**202**			**10**	**449**	**27**
Ohio		77			4	154	8
Indiana		6			1	8	17
Illinois	1	26			1	48	1
Michigan		59			2	134	1
Wisconsin		34			2	105	
West North Central		**25**		**2**		**136**	
Minnesota		2				29	
Iowa		8				19	
Missouri		1		1		35	
North Dakota						3	
South Dakota							
Nebraska		8				2	
Kansas		6		1		48	
South Atlantic	**16**	**47**		**1**	**13**	**354**	**27**
Delaware	1	2				3	
Maryland	5	13			2	41	
District of Columbia		3					
Virginia	4	10				84	2
West Virginia	2				1	62	1
North Carolina	3	11			4	112	
South Carolina	1	2			4	20	10
Georgia		5		1	2	18	13
Florida		1				14	1
East South Central	**1**	**29**		**4**	**6**	**137**	**25**
Kentucky		7			3	10	9
Tennessee	1	16			2	76	6
Alabama		6		2	1	45	9
Mississippi				2		6	1
West South Central		**26**		**20**	**18**	**546**	**8**
Arkansas		5		11	3	77	5
Louisiana		3		1	1	2	
Oklahoma		5			3	33	3
Texas		13		8	11	434	
Mountain	**5**	**24**	**1**	**2**	**1**	**137**	
Montana	1	1				15	
Idaho		2				12	
Wyoming		2		2			
Colorado	3	11				14	
New Mexico						35	
Arizona		5	1		1	45	
Utah	1	3				16	
Nevada							
Pacific	**1**	**110**		**1**	**6**	**290**	**4**
Washington		18			1	65	
Oregon		3				44	
California	1	89		1	5	181	4
Alaska							
Hawaii						4	

[1] Including cases reported as salmonellosis.
[2] Including cases reported as streptococcal sore throat.

FOREIGN REPORTS

CANADA

Reported Cases of Certain Diseases—Week Ended June 3, 1950

Disease	New-found-land	Prince Edward Island	Nova Scotia	New Bruns-wick	Que-bec	On-tario	Mani-toba	Sas-katch-ewan	Al-berta	Brit-ish Co-lum-bia	Total
Brucellosis					2	2					4
Chickenpox	1		11	1	170	321	16	8	77	122	727
Diphtheria					5						5
Dysentery, bacillary					7						7
German measles			21		21	1,440	7	120	121	334	2,064
Influenza			14							1	15
Measles	1		1	1	708	1,068	98	32	52	179	2,140
Meningitis, meningococcal						2					2
Mumps			90	2	175	428	8	122	97	172	1,094
Poliomyelitis						1					1
Scarlet fever	1			2	46	36	3	9	44	8	149
Tuberculosis (all forms)	9		3	20	184	8	31	8		29	292
Typhoid and paratyphoid fever			2	4	4			1		9	20
Venereal diseases:											
Gonorrhea	10		10	10	67	36	12	17	50	47	259
Syphilis	2		9	9	53	22	1	6	2	12	116
Whooping cough			2	2	96	42	4	1	1	51	199

FINLAND

Reported Cases of Certain Diseases—April 1950

Disease	Cases	Disease	Cases
Diphtheria	54	Scarlet fever	751
Dysentery	28	Typhoid fever	13
Meningitis, meningococcal	4	Venereal diseases:	
Paratyphoid fever	73	Gonorrhea	428
Poliomyelitis	15	Syphilis	28

NORWAY

Reported Cases of Certain Diseases—March 1950

Disease	Cases	Disease	Cases
Diphtheria	12	Pneumonia (all forms)	3,438
Dysentery, unspecified	3	Poliomyelitis	4
Erysipelas	305	Rheumatic fever	127
Gastroenteritis	2,312	Scabies	937
Hepatitis, infectious	69	Scarlet fever	139
Impetigo contagiosa	1,527	Tuberculosis (all forms)	372
Influenza	3,856	Typhoid fever	1
Measles	1,167	Venereal diseases:	
Meningitis, meningococcal	9	Gonorrhea	204
Mumps	187	Syphilis	64
Paratyphoid fever	1	Whooping cough	3,675

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

The following reports include only items of unusual incidence or special interest and the occurrence of these diseases, except yellow fever, in localities which had not recently reported cases. All reports of yellow fever are published currently. A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday in each month.

Cholera

India. The total number of cases of cholera reported in the port city of Calcutta during the period January 1–May 27, 1950, was 6,509, with 3,094 deaths. The peak incidence was reported for the week ended April 22, when 777 cases with 480 deaths were recorded. For the week ended June 3, 316 cases, 132 deaths, were reported.

Pakistan. During the week ended May 20, 1950, 11 cases of cholera with 5 deaths, were reported in Dacca. For the week ended June 3, 1950, 14 cases, 7 deaths, were reported in Chittagong.

Plague

Belgian Congo. Plague has been reported in Belgian Congo as follows: In Costermansville Province, on May 26, 1950, one fatal case at Malonga, a village northwest of Lubero; in Stanleyville Province, on May 27, 1950, one case at Djaji, on June 3, one fatal case at Wasa. Both of these villages are located northeast of Blukwa.

Union of South Africa. During the week ended May 13, 1950, one case of plague was reported in Luckhoff Municipal Area, Orange Free State.

Smallpox

Indonesia (Java). Smallpox has been reported in Surabaya as follows: Week ended May 13, 1950, 149 cases, 32 deaths; week ended May 27, 191 cases, 62 deaths.

Republic of Korea. Smallpox has been reported in the port of Ryusu as follows: Weeks ended April 8, 1950, 13 cases; April 15, 12 cases; April 29, 8 cases; May 6, 25 cases; May 13, 2 cases

Typhus Fever

Afghanistan. During the month of April 1950, 405 cases of typhus fever were reported in Afghanistan.

Egypt. During the week ended May 20, 1950, 12 cases of typhus fever were reported in Egypt, including 1 in Cairo. For the week ended May 27, 9 cases were reported, 5 of which occurred in Cairo.

Republic of Korea. During the week ended April 8, 1950, 9 cases of typhus fever were reported in Inchon.

Yellow Fever

Peru. Reports of yellow fever have been received as follows: In Cuzco Department, on February 15, 1950, one death, and on February 23, one death, both at Quincemil; in Huanuco Department, on April 25, one case at Tingo Maria, Rupa-Rupa District.