

The Wassermann has been supplemented by the use of Noguchi's Luetin, a skin test for syphilis. A report on these studies would consume a considerable time and would be chiefly of interest to the serologist. These numerous tests should be mentioned, however, because of their great aid in securing correct diagnosis in doubtful cases and as a means of controlling treatment.

Leaving the subject of syphilis rather abruptly, I will mention very briefly the work done in the study of typhoid immunity produced by the use of vaccines made from the typhoid bacillus. As another paper on the program calls for a discussion of the same subject, I shall touch upon this but briefly.

The occurrence of typhoid among the insane is always a source of worry to those who bear the responsibility for the care of these unfortunates. The appearance of typhoid in institutions for the insane is not infrequent, and is in part the natural result of drawing patients from a large district where the disease is sometimes only too common. Among other means of infection we were convinced there were typhoid carriers among the inmates. In the fall of 1912 we started the work of vaccinating the entire institution against typhoid, and at the same time began the study of blood changes produced by the vaccine.

At that time it was most practical to vaccinate a few hundred patients at a time, thus constantly decreasing the number unvaccinated, but for a considerable period leaving some who had not received treatment. During this period 18 cases of typhoid occurred, but not a single one of the 18 was among those who had been vaccinated. The first vaccinations were done in the fall of 1912, and since then over 2,200 patients and employes have received this protection, but up to the present no typhoid has occurred among them. And yet among the comparatively small population of unprotected, who were living under the same conditions as those vaccinated, 18 cases occurred. Typhoid carriers were located and isolated. The studies of blood changes were undertaken in collaboration with the workers in the State Board of Health laboratories, and consisted in the examination of over 1,000 blood specimens. It was demonstrated that in 94 per cent of the cases vaccinated there was evidence of immunity from typhoid as judged by the Widal reactions being present in the blood.

Typhoid fever has a sister disease, para-typhoid, which acts very much like typhoid, but is caused by a different bacteria. The immunity against typhoid did not always provide immunity against para-typhoid, which would of course have been desirable. This caused us to change our former procedure slightly. Strains of the typhoid bacillus and also para-typhoid bacillus were secured from patients at our institution and a vaccine made containing both organisms. This is now being used in place of the typhoid vaccine in the belief that protection will be afforded against both diseases in this manner.

At the present time we are dependent upon our own laboratories for the manufacture of vaccines, making of blood examinations, locating of typhoid carriers, etc.

I wish to thank the chairman of the program committee and also the other members for the kind invitation to present a paper at this gathering.

EXPERIENCES WITH TYPHOID COVERING A PERIOD OF TWO YEARS.

E. H. Trowbridge, M. D., Assistant Superintendent, School for Feeble-Minded and Colony for Epileptics.

For convenience of discussion, the following history of our experience with typhoid fever, is divided into three parts, the first part covering the time from the appearance of typhoid in the early spring of 1911 till the administration of the typhoid prophylactic was completed; the second part covering our first epidemic, and the third part, from the subsidence of this epidemic to the present time.

Typhoid fever appearing in our institutions is of serious import because of the existence of the following conditions:

1. Actual contact is frequent, due to close association and grouping; of the inmates on grades or wards.
2. Hand-to-mouth infection is likely, as mentally deficient people are not always of cleanly habits.
3. Food contamination occurs readily as the major portion of its preparation, and serving is performed by the inmates
 - 1. Milk contamination is apt to occur, as the milking, care of cows, etc., is performed generally by the inmates.
 5. Water contamination is possible, depending upon its source, and the method of sewage disposal.
 6. Contamination by means of the house-fly is apt to occur during fly season.

As soon as a clinical diagnosis of typhoid fever was made on a male patient admitted to the hospital in February, 1914, investigation was started immediately for the source of infection. House-fly infection was readily dismissed, due to the season. The water supply and sewage disposal were investigated. Tests made on the water supply samples gave negative findings and sewage contamination found impossible. A thorough examination of our milk supply was then made without positive results.

Other cases appearing on the same and adjacent grades, the conclusion was reached that we were dealing with a carrier or carriers. To detect the carrier, blood specimens were taken for Widal's of all on the grades where clinical cases had developed. Other cases appearing a little later in other buildings (and there being no communication except possibly through food contamination in the general kitchen), the decision was reached to have Widal's made on everyone in the institution, those having to do in any way with the preparation of the food being taken first. A total of 1,601 Widal's were made, with the result that 26 or 1.62 per cent, have a positive reaction and 8 or .19 per cent an atypical reaction, the balance being negative. Repetition of the Widal's on the 8 atypical gave 2 positive and 6 negative results.

A thorough investigation of the personal history, before and since admission to the institution, of those showing a positive Widal threw but little light upon the situation, except in that of four cases, which gave a history of being treated for enteritis during the past few years.

Eight cases out of 28 giving a positive Widal developed clinical typhoid, and these, with the other cases, were immediately isolated and the regular precautionary measures for the prevention of spread of infection instituted. Specimens of urine and feces for isolation-tests were taken and made as rapidly as possible, with the result that we found 6 cases passing typhoid bacilli in their excreta. Of this number the bacilli were isolated from the feces in 4 individuals and from the urine in 2. In one other case a paratyphoid organism was isolated from the feces.

In the meantime inoculation of all other individuals with the typhoid prophylactic was being rapidly carried on. The usual method of administration was used except that we gave 10 minims at the first injection instead of .5 c. c. and 1 c. c. at the second and third injections. The arm was painted thoroughly with iodine and the needle sterilized from time to time in carbolic acid. In this manner 1,520 individuals were inoculated without infection developing.

Inoculation with the prophylactic was begun on May 30th and brought to a successful conclusion on June 25, 1914. No marked serious after-effects were noted. In the majority of cases we found that a marked local reaction developed in from four to six hours, lasting from two to three days. In quite a few cases constitutional symptoms, grippe-like in nature, with slight temperature rise, appeared within forty-eight hours, subsiding in from two days to a week.

Widals were made ten days or later following the third inoculation in 1,390 cases. Of this number 477 or 34.3 per cent gave a positive reaction, 265 or 19 per cent an atypical, and 648 or 46.6 per cent a negative reaction. To determine at what point during treatment the Widal reaction became positive, Widals were made on 127 individuals at ten-day intervals following each inoculation, with the following result:

	First Inoculation	Second Inoculation	Third Inoculation
Number giving positive reaction	12—9.4%	67—52.7%	37—29.1%
Number giving atypical reaction	9—7%	15—11.8%	22—17.1%
Number giving negative reaction	106—83.5%	45—35%	(35—53.5%)

In reviewing these results it is noted that the positive and atypical reactions begin appearing following the first inoculation, increase following the second, and the positive decrease about 50 per cent following the third. Why this variation should occur is not definitely known. In a recent paper by Dr. Buringame on their experience with the prophylactic at Fergus Falls, this variation in the Widal reaction is clearly shown.

At the completion of the prophylactic treatment the patients having shown a positive Widal and the known carriers, were returned to their respective grades. This was the latter part of June, and the institution was free from typhoid until about the middle of September, when several patients were admitted to the hospital with symptoms somewhat resembling those of typhoid fever. As these patients had been previously inoculated, a diagnosis of typhoid fever was not justifiable without a more thorough investigation.

The State Board of Health, upon request, kindly lent us their assistance. Blood cultures taken from twelve individuals resulted in the finding of the bacillus typhosis in one instance. This same patient had given a positive

Widal reaction following the use of the prophylactic and also after the onset of the disease. At necropsy typhoid ulceration was found in the ileum, thus verifying the nature of the infection.

Specimen of the feces and urine were collected and examined, the bacillus typhosis was isolated in two cases and the bacillus paratyphosis in three. Widals were made at intervals during the course of the epidemic. Of the 46 patients examined, 39 gave positive Widals, 1 gave an atypical, 2 gave agglutinations with the bacillus paratyphosis, and 3 remained negative although manifesting clinical signs of typhoid fever.

The typhoid occurring in separate buildings, scattered over a wide area, made it possible to dismiss the previous carriers as a source of infection and to focus attention on the food, milk and water supply. No carriers were found among those concerned with the preparation and distribution of the food, and water contamination was quickly dismissed as in the previous outbreak.

Investigation of the conditions existing at the dairy disclosed the fact that the dairyman had an ambulatory case of typhoid. The dairyman's wife was ill at the time; her symptoms were of an indefinite nature and a subsequent Widal was found to be positive. Neither the dairyman nor his wife had previously received the prophylactic treatment. A milker, one of the inmates, had been removed to the hospital a few days previous to the investigation at the dairy, and after a prolonged prodromal stage developed clinical typhoid fever. He had returned recently from a short vacation in an adjacent town where he no doubt contracted the disease. The daily association of the dairyman and his wife with this milker indicate that he was the original source of infection.

Precautionary measures were immediately instituted. The dairyman and his wife relieved from duty, and all the milk was sterilized during the following four weeks. Milk formed part of the diet of every individual who contracted the disease. After the inoculation period of twenty-one days had passed, new cases ceased to develop, showing conclusively that the milk supply was the source of the epidemic.

A total of 57 cases in this epidemic were diagnosed as clinical typhoid. Of this number 46 were inmates and the remainder employes. Only one of the employes had received the prophylactic and three of the inmates were uninoculated.

It is worthy of note that many of the classical symptoms of typhoid, such as enlargement of the spleen, rose spots, epistaxis, and abdominal tenderness, were absent in most cases. However, the course of the disease did not appear to be appreciably shortened. The mortality among the vaccinated was 9.1 per cent or less than one-half of that occurring among the unvaccinated which was 23 per cent.

The cause of an epidemic of this nature so shortly after the completion of vaccination with the antityphoid vaccine is a subject for further discussion. Various reports submitted by recent investigators who have had vast experience in the use of the prophylactic, show that it is not an uncommon occurrence for typhoid fever to develop among a certain proportion of vaccinated individuals.

QUARTERLY

The use of the vaccine by the Germans in 1914 in the Herero campaign in Southern West Africa resulted in a diminution of the occurrence of cases among the vaccinated to about one-half as compared with the unvaccinated. The mortality among unvaccinated was about four times as great as among the vaccinated.

Figures computed by Col. R. H. Fieth covering the first six months of the year 1911 relative to vaccinated soldiers in India, show that the case incidence for typhoid was approximately five times greater among the unvaccinated than among the vaccinated.

In a recent article published by Sinnhuber at Berlin, he gives the history of preventive vaccination against camp diseases in the present war, and relates that of 144 typhoid cases in his service among the soldiers 55 of the men had been vaccinated against typhoid, and 2 of them died: in one the disease was of a peculiarly malignant type.

In a recent article Frederick F. Russel, U. S. A., gives the remarkable results obtained by the use of the vaccine in the United States Army during the past six years. The death rate has fallen from .28 per thousand ill 1909 to zero in 1913. No doubt these "extraordinary results were in part due to the fact that camp sanitation was greatly improved and the chance of infection reduced to a minimum.

In the epidemic under consideration about one-half as many cases occurred in the vaccinated as in the unvaccinated, and the mortality among the vaccinated was less than one-half that among the unvaccinated. No doubt the proportion of cases among the vaccinated individuals would have been greatly reduced were it not for the fact that the milk which was the source of infection was saturated from day to day with typhoid bacilli.

The following is from a letter of Mai. Frederick F. Russel referring to a recent article published in the Journal of the American Medical Association giving a history of this epidemic: "You have, it seems to me, indicated the most interesting point in your conclusion number six. We know, of course, that the prophylactic prevents infection from the average dose of infectious material, but I have always doubted if it would protect against an excessive dose, such as occurs in milkborne epidemics.

"In the army we are practically free from infections from that source; soldiers use very little milk and that is either canned or from dairies under our own supervision."

The following deductions were reached after a careful study of this epidemic:

1. Typhoid fever may be contracted by individuals who have received the prophylactic and who subsequently show a positive Widal.
2. The course of the disease is not appreciably shortened in vaccinated individuals.
3. The mortality is markedly reduced among protected persons.
4. Protected persons having typhoid fever fail to give many of the classical symptoms of the disease.
5. The development of paratyphoid is not prevented by the use of the typhoid prophylactic.
6. The degree of immunity conferred by the prophylactic in some cases fails to prevent the development of typhoid when the individual has been subjected to repeated exposure.

7. The Widal reaction as a criterion of the presence of immunity is of uncertain value.

The institution again remained free from typhoid until the middle of June this year, when three inmates were admitted to the hospital within a few days of each other with clinical symptoms of typhoid. Within a short period of time we had nine cases develop the disease. Of this number eight had had the prophylactic a year ago. Seven of them had given negative Widal reactions and one a positive following its use. As the State Board of Health, due to lack of funds, was unable to prepare Widal's of isolation tests, none were made on these cases. Three of them died and, one coming to necropsy, typhoid or paratyphoid ulceration of the ileum was found.

As these cases all came from two adjacent grades where inter-communication is more or less common, we immediately traced its origin to that of a previous known paratyphoid carrier found in our original epidemic. The removal and isolation of this individual and all other known carriers immediately stopped the occurrence of new cases, showing" definitely that these were contact or carrier cases.

The occurrence of typhoid from carriers in this case no doubt gives evidence that the immunity-giving power of the prophylactic in a certain proportion of individuals is beginning to wane in a little more than a year's time from its administration. Further, an individual once proven a typhoid carrier is always to be reckoned with as a menace and probable danger to his associates. This is shown clearly by our experience, by the example of the well known "Typhoid Mary," and by the history of the typhoid carrier H. O., a sailor, so ably reported by Dr. Wilbur A. Sawyer, who has been in touch with him since 1907. Dr. Sawyer's summary in his last report on this case is worth repeating:

1. "Although frequent examinations of the feces of the typhoid carrier H. O. gave negative results for four months after he had been treated with autogenous typhoid vaccine, he infected three persons when subsequently released from quarantine on parole. The total number of persons infected by this carrier is thirty, including five who died.
2. In a further attempt to cure this carrier, the gall-bladder and its ducts were removed surgically, but the typhoid bacillus was found in the feces several times after the operation. Examination of the gall-bladder showed that it was normal and that its contents were free from typhoid bacilli.
3. After fifty-one successive examinations of feces during a period of fourteen months, all with negative results, the typhoid bacillus was isolated from the stomach contents containing bile.
4. Certain typhoid carriers are unusually dangerous and must be controlled by quarantine or other adequate supervision."

In closing, I will say that we as institution physicians owe all the protection that it is possible to give to these unfortunates in our care. If we wish to erase typhoid from the list of ever present and often fatal diseases with which we have to contend, I would suggest that the typhoid prophylactic be given as a general routine upon the admittance of all new patients, repeated every two years, and all known carriers isolated