

fect mosquitos and thus transmit the disease to others, just as in yellow fever, and that malaria may be as serious a disease as yellow fever.

I believe that we should at once institute a campaign against malaria. It offers the most brilliant results of any of the public health problems now confronting us.<sup>23</sup> A campaign of education should be begun with the medical profession, because physicians as a class, and particularly those residing in malarial regions, do not appreciate the seriousness of malaria, or the ease with which it may be eradicated. The public should be educated by means of popular addresses and literature on the subject should be placed in the hands of every one residing in malarial districts. Malaria, being both infectious and contagious, should be classed as among the reportable diseases, and the state and county boards of health should lead in the fight. Municipalities, counties and states should be called on to furnish money to purchase quinin to cure the indigent sufferers from malaria and to destroy the anophelines and their breeding-places. Philanthropists should be urged to aid in this fight against one of the

greatest enemies to mankind. Money spent in eradicating malaria will yield greater returns than any other philanthropy.

It is no idle dream to hope that the blot of malaria may be erased from the fair name of our Southland and from the Mississippi and Missouri valleys, where the disease is most prevalent. Our government has given us an example of what may be accomplished even in the tropics. Gorgas,<sup>24</sup> with the resources of our great country to aid him, when he applied the knowledge of the mosquito transmission of disease and eradicated yellow fever and malaria from Havana and the Canal Zone, made conquests which should be regarded as among the greatest in the history of the world, victories that mean more for the welfare of nations than have ever been achieved in war.

23. Thayer: The Prophylaxis of Malaria, Jour. Southern Med. Assn., November, 1909.

24. Ross: Albutt's System of Medicine, p. 285.

25. Harris, Seale: Some Problems in Medicine which Affect the Prosperity of the South, Jour. Southern Med. Assn., April, 1909.

26. Gorgas, W. C.: Malaria in the Tropics, The Journal A. M. A., May 12, 1906, p. 1416; Ann. Rep. Dept. of Sanitation, Isthmian Canal Commission, 1908, Government Printing Office, Washington.

## SOME UNDERLYING CAUSES OF THE EXISTENCE OF SOIL POLLUTION IN RURAL DISTRICTS.\*

By CH. WARDELL STILES, Ph.D.,

Professor of Zoology, U. S. Public Health and Marine-Hospital Service.

Recent investigations have shown that in our rural districts there is a great amount of soil pollution, and attention is turning to this insanitary condition in connection with the campaigns that are being carried on against certain diseases, especially typhoid fever and hookworm disease.

According to a recent summary of statistics of 4,825 farmhouses, tabulated for six states, 55 per cent have no privy of any kind; of 2,499

farmhouses tabulated as occupied by whites, 35.3 per cent are without a toilet, and of 2,326 farmhouses occupied by negroes, 76.8 per cent have no privy.

The average reader may perhaps consider that the foregoing statistics of the extent of soil pollution in the rural districts are somewhat exaggerated. To this it may be replied that the conditions described are from actual observations, and attention may be invited to

\*At the request of Dr. Charles P. Neil, Commissioner of Labor, an investigation into the prevalence of hookworm disease in the cotton mills was undertaken. Certain portions of the results obtained will be published in the reports to be submitted to Congress by the Bureau of Labor, while the more strictly medical discussions will be published elsewhere. The present article represents one in the series to be issued.

the further fact that no detailed account has been given of the actual condition of the privies which exist on those farms that are provided with them, nor has the point been emphasized that even when privies are present, frequently they are not used, especially by the male members of the family.

When such a widely spread custom (or lack of custom) exists, there must be some explanation for it, and in seeking to analyze the conditions the following points have come to my attention.

In the first place, while this pollution is greatest among the negroes, and among the tenant whites, it is by no means confined to them.

In a certain American college<sup>1</sup> there is an interesting chapter on the subject of soil pollution. It should be recalled that we are dealing here with college students, yet the President of the college told me it had been so difficult to induce certain of the boys from the country districts to use the regular water closets in the college buildings that he had been obliged to build a privy on the college campus in order to protect the campus from promiscuous fecal pollution. This privy was open in back and presented excellent opportunity for the spread of disease.

A certain United States official has recently been stationed at a certain college<sup>1</sup> for males. He informs me that one of the departments of this college has no toilet of any kind, and that the students practice soil pollution along the sides of the building.

A well known and very prominent educator<sup>1</sup> assures me from personal experience that there is a certain co-educational institution<sup>1</sup> for adults which had no toilet room in one of its buildings until a few years ago. Some time ago I had personal knowledge of one other case of this kind (also a co-educational institution), and I personally witnessed soil pollution back of the dormitory.

One of the best known educators<sup>1</sup> of the entire country recently stated to me that about 30 per cent of the country schools of his state<sup>1</sup>

had no privy. Personally I have seen a number of country schools and churches without privies.

A person who has made a special study of the schools in one state<sup>1</sup> assured me recently that in one section of that state it was the exception that country schoolhouses had a privy.

In two states<sup>1</sup>, in the hearings of Ex-President Roosevelt's Country Life Commission, testimony was given to the effect that, as a rule, in certain districts, neither the country churches nor country schools had toilet facilities of any sort. In another state,<sup>1</sup> one of the state officials described the sanitary conditions on the farms as "simply atrocious;" in still another state,<sup>1</sup> a member of the State Board of Health described them as "awful."

Among many prominent and educated lawyers and even among physicians, I have found a prejudice in favor of promiscuous defecation.

There are, it seems, several factors which explain at least a part of this widespread disregard of sanitary precaution.

1. *Hot Climate*—With the hot summer days, the ordinary surface privy becomes a place of foul odor and filled with flies, especially if not regularly and frequently cleaned. It is, therefore, a place which a person naturally wishes to avoid, hence he naturally seeks the open, with better air.

2. *Influence of the Negro, Mexican, and Indian*—The Negroes, Mexicans, and Indians are much nearer primitive man than is the white, and it need not therefore seem strange that these races are greater soil polluters than is the white. The servant class in the South is composed almost exclusively of negroes, and the influence exerted on the white children by the negro nurse is apparent in more ways than one. It is expecting almost too much of the average negress that she will of her own accord instill into the white children ideas of personal habits which are rather foreign to her own training. Many white children are actually trained by their negro nurses into the

<sup>1</sup>Names and localities are purposely suppressed.

habit of soil pollution, and the habit remains with them, to some extent, in later life.

3. *Influence of Hookworm Disease*—A person who has a severe infection of hookworm disease is not predisposed to making any unnecessary effort to find a privy when a more or less secluded spot may offer to him a safe retreat. While soil pollution favors hookworm disease, the converse is also true; hookworm disease favors soil pollution.

4. *Economy*—If one visits the hovels in which many of the rural tenants live, one is seriously impressed by their inferior condition. It is not very uncommon to find a family living in a one-room or two-room hovel, and in many instances the entire family, including brothers and sisters from 1 to 18 years of age, or older, eat and sleep in one and the same room. The same conditions of poverty that give rise to such economy would naturally result in economy in respect to building privies.

5. *Economy in Time and Work*—A poorly kept privy is not only an eyesore, but is an exceedingly unpleasant thing to have near a house. To avoid this unpleasantness, it is necessary to clean the privy regularly. This takes both time and work, and it is not a prominent characteristic among either the rural white tenants or the Negroes, Mexicans, and Indians, to devote any special amount of time to work which is not only disagreeable, but for which they see no necessity.

6. *Popular Beliefs*—There seems to be a more or less widespread idea among these country people that it is much better to scatter the night soil around than to collect it in one place. Two alleged advantages occur to their minds in support of this view, namely: (a) it is thought that the action of the sun is a powerful factor in destroying any injurious effects arising from night soil; and (b) it is thought that the night soil is valuable as fertilizer.

The first idea (a) is not without a certain amount of foundation; still, as a practical fact, people are prone to defecate in shaded places, hence the sun is not likely to exercise its disin-

fecting influence; further, the fact of the escape of thousands of hookworm embryos into the soil, whereby they avoid the action of the sun, is unknown to these people.

As for the second idea (b), without going into the question whether night soil is such a valuable fertilizer as is popularly supposed, the point may be raised that if the material is allowed to ferment sufficiently long or is boiled before being on the ground, the sanitary dangers involved are avoided.

7. *Popular Ignorance Regarding Sanitary Matters*—There is a widespread ignorance as to what constitute proper sanitary conditions, and this ignorance is especially marked among government employees, free delivery men (especially postoffice employees), and farmers. Thus in a recent inquiry the fact was developed that of 77,127 persons, 56,893 persons, or 73.7 per cent were unqualifiedly satisfied with their sanitary surroundings (despite a nationwide typhoid death rate of 46.5 deaths per 100,000 inhabitants, according to the twelfth census)!

8. *Low Rental of Farms*—Many of the tenant farms are not giving the returns which the landlords think they should, and the owners are not therefore inclined to expend more money for improvements than seems necessary to them. As their knowledge of the dangers of soil pollution is not much greater than the knowledge possessed by the tenants, the necessity for the building of sanitary privies is not apparent to the owner.

9. *Privacy*—As the popular conception of a privy is that it is a place for privacy, and as the chances for privacy are greater in sparsely populated areas, as away from the main roads, than in more densely populated localities, the popularly accepted reason for the existence of a privy is not self-evident to the inhabitants in the outlying districts.

From the foregoing it may be seen that soil pollution can, at least to some extent, be explained, and the very fact that there are certain definite reasons which tend to keep the

custom alive shows us the importance of conducting an intelligent campaign against this pernicious evil.

Soil pollution is in the nature of "*malum in*

*se*"; it is an "aggravated offense against the public welfare;" *ergo*, it should be made a "crime," and as such it should be punished by law.

---

## THE QUICK MACROSCOPIC TYPHOID AGGLUTINATION TEST, ITS APPLICATION AND ADVANTAGES.

By C. C. BASS, M.D.,  
New Orleans, La.

At the 1909 meeting of this association John A. Watkins demonstrated a quick macroscopic typhoid agglutination test which we had devised, whereby it was practical to make an agglutination test at the bedside of the patient, in less than two minutes, and without laboratory experience or equipment except a microscope slide or other piece of glass and a proper suspension of dead typhoid bacilli and having the same value and indications as the standard Widal's reaction. Since that time we have published, jointly (*Archives of Internal Medicine*, Dec., 1910), in detail, the principles involved permitting the improvement, such improvement as we have gained relative to the preparation of typhoid suspensions for this purpose, certain further slight simplifications in the technique of making the test, and the findings of a number of physicians who have kindly tried the test out for us with especial reference to its practicability for general practitioners. I desire to further call attention to the application and advantages of the test over all other methods of making typhoid agglutination tests, not only for general practitioners, but for laboratory workers as well.

It may be well to briefly recall the principles involved in agglutination tests and to repeat explanations already given as to the quantities employed in our test. Any agglutination reaction is produced by the action of the agglutinin in the serum tested on the bacteria employed, whereby they are sensitized and attracted to each other. For convenience in discussion we take as a unit of agglutinin that

quantity necessary to completely sensitize one million typhoid bacilli and as a unit of bacilli one million typhoid bacilli.

If we add to a series of tubes containing increasing quantities of salt solution (or water), from the smallest quantity upward, an equal number of bacilli units and agglutinin in units, and after a few minutes remove the bacilli from each by centrifuging, it is found on appropriate test that all the agglutinin has been removed and therefore taken up by the bacilli from the most concentrated mixtures. But an amount remains in the more dilute mixtures—which amount increases with the dilution. This shows that the more concentrated the mixture of bacteria and agglutinin, the more rapidly are the bacteria sensitized, and vice versa. Naturally we would expect this when we consider the fact that many of the agglutinin molecules must travel over geometrically increasing distances to reach and affect the bacteria as the dilution increases. We can conceive of a dilution being so great that sensitization could not occur in it at all, and this is easily demonstrable to be true by test tube experiment. Not only is sensitization delayed in geometric proportion to the dilution but clumping, or agglutination is also delayed in the same proportion.

This is also easily demonstrable. To two tubes add an equal quantity of bacilli units. To one, add one volume of diluting fluid (water or salt solution), and to the other twenty volumes. Now to the first tube add agglutinin units equal to the number of bacilli

units and to the second one add twenty times as many agglutinin units, so as to furnish agglutinin equally available to the bacilli and to assure sensitization of the bacilli in each. It will be observed that clumping is delayed by the dilution, even in the presence of twenty times as much agglutinin, and if we carry the dilution high enough agglutination is prevented entirely. It is therefore apparent that the more concentrated the agglutination mixture, the more rapidly will agglutination take place, and vice versa; and inasmuch as rapidity is very desirable for practical purposes, we have endeavored to use the most concentrated suspension of bacteria and serum that would be most practical for general use, and always to have the amount of serum used per bacillus to conform as nearly as possible to the amount used in the usual Widal's reaction.

It is not easy for general practitioners not trained in laboratory work to collect blood and obtain serum to test. As is generally well known, whole blood may be employed for agglutination tests in place of serum, provided the cells are dissolved. One volume of blood readily dissolves into a clear solution in four volumes of water, but less than four volumes of water per volume of blood cannot always be depended upon to give perfect and rapid solutions of the blood. We employ, therefore, blood diluted five times.

A 24-hour broth culture of typhoid bacilli with which the standard Widal's reaction is usually made contains a very variable number of bacilli ranging in estimates, I have made from 150 millions to 1,500 millions per cc. We estimate that a mixture of equal quantities of blood diluted five times, and a suspension of 10,000 million bacilli per cc. allows approximately the same amount of serum per bacillus as is applied to each bacillus in the standard Widal's reaction, viz, one fifty-billionth cc. of serum per bacillus.

Though there may be good reasons for varying the proportions of blood and bacilli from those generally employed in making a Widal's reaction, we have not ventured to do

so, and do not believe it would be warranted to change standards that have been employed and found satisfactory so many years, unless such change were justified by most extensive clinical trial.

The test fluid that we employ consists of ten thousand million dead typhoid bacilli in 1 7-10 per cent sodium chloride solution to which 1 per cent formalin is added to kill the bacilli and for preservative.

Any competent bacteriologist can make this bacterial suspension. The bacilli are washed off of the surface of large twenty-four-hour old agar slant cultures of typhoid bacilli, with 1 7-10 per cent salt solution. The number of bacilli per cc. is determined in the usual manner for standardizing bacterial suspensions and "vaccines" in general, and the whole appropriately diluted to contain ten thousand million per cc. Finally 1 per cent of commercial formalin is added.

This material does not seem to lose its serviceability from age. I have some now nearly five years old that is, so far as I can tell, as good as it was when first made. On account of these keeping qualities and the ease of preparation I see no reason why this reagent should not be sold in the stores as other reagents and drugs are.

The general rule for making the test is to dilute the blood five times by adding four volumes of water to one of blood. A good practical way to make this dilution is to let flow one drop of blood from the ear or finger into a tube or bottle containing four drops of water. Any specimen of blood, wet or dry, fresh or old, may be diluted with approximately four times as much water as the original volume of water appears to have been when fresh. One drop of this diluted blood is mixed with one drop of the test fluid on a microscopic slide. The slide is tilted from side to side or from end to end so as to mix and agitate the mixture and thereby hasten agglutination. A still better and more practical way of making the test is to make a smear on a slide of approximately one-fourth