present, not to interfere with precipitation, the less liability there is of molybdic acid depositing. Just here I would add that the deposit from the official molybdic solution, at least, is not molybdic acid alone but a mixture of molybdic acid and ammonium molybdate. I found one deposit to contain 1.21 per cent. NH_3.

The volumetric method as it has given me best results is as follows: Make solution as per the official nitric and hydrochloric acid method for total phosphoric acid, redissolve two grams substance in thirty cc. strong nitric acid and five to ten cc. hydrochloric acid, measure out twenty cc. for total or forty cc. for insoluble. corresponding to two-tenths and four-tenths gram substance respectively, into a four-ounce beaker. add ammonia till precipitate just begins to form, and dilute to seventy-five cc. If much of the nitric acid was driven off in making the solution add ten to fifteen grams ammoninm nitrate, otherwise this is not necessary. Digest in water-bath at 60° C., and after filtering the molybdate[1] used in the official method. precipitate in the usual way, allow to stand four or five minutes from the time the molybdate is added, filter as quickly as possible upon either a filter made by putting a platinum cone or disk, well filled with holes. into a three-inch funnel and covering with coarse asbestos, or upon the Hirsch funnel, or preferably upon a porcelain disk (the disk to be covered with filter paper) with rubber rim in three-inch glass funnel, using the pump in all cases. Wash the precipitate three to five times by decantation, using fifty to seventy-five cc. water each time and agitating thoroughly, then onto the filter and till no longer acid, titrate with potassium hydroxide and back with nitric acid.

N. C. EXPERIMENT STATION,
RALEIGH, N. C.

THE QUALITY OF WATER SUPPLIES.[2]

BY WM. P. MASON.

A PAPER of some length, bearing the title "The Quality of Water Supplies," has just been presented before the American Society of Civil Engineers, at their Niagara meeting, which contains considerable matter provoking comment. The

[1] This solution is made by dissolving 100 grams molybdic acid in 417 cc. 0.96 sp. gr. ammonia, and pouring this into 1,250 cc. 1.20 sp. gr. nitric acid.

[2] Read at the Brooklyn meeting August 16, 1894.

author appears to be a believer in the power of water to spread disease; but some of the statements and quotations advanced by him would certainly go far to unsettle the public mind and cause lack of faith in the teachings of some able masters.

He says: "While water is held to be a carrier of disease germs, the writer is not aware that any investigator has ever claimed to have seen these germs in water, even under the highest powers of the microscope; and the evidence that water is such a carrier of pathogenic bacteria is obtained by inoculation from water samples, of nutrient media in test-tubes or on culture plates. The typhoid bacillus in water has never been seen with the microscope without previous cultivation of the germ in nutrient media. Nor has it ever been demonstrated, so far as the writer is aware, that the presence of bacilli in water can be proven, excepting by delicate and difficult bacteriological processes."

That single individuals of the Eberth bacillus should escape direct detection is hardly to be considered surprising, in view of the enormous volume of water in which they are suspended. However difficult the processes of modern bacteriology may be for a tyro, it is hardly just to consider them unreliable in the hands of Koch, Pasteur, or Eberth; and if any one of these men, or of many other who might be named, should state that he had secured pure cultures of a specific germ, under circumstances which excluded the possibility of extraneous contamination, we should be exceedingly liable to believe him.

Again: "It is well understood that the infective element of typhoid fever can be present in water, and the chemical test be powerless to disclose it."

True enough! but it does not complete the story. The contaminated waters were pronounced pure. It must be remembered that the polluting material, as weighed, being very largely water, the pollution appeared greater than it really was. During an investigation following a serious outbreak of typhoid fever in the Tees Valley, England, the medical officer of the Local Government Board, London, caused preparation to be made of samples of pure water, to which small quantities (fifty and twenty-five parts per million) of typhoid dejecta had been added, and these samples were then submitted to prominent water analysts for examination. No results upon which an adverse report could be based were obtained. Fifty parts per million of the typhoid dejecta corresponded to only four parts per million of total dry residue. As a natural result of these experiments, the purely chemical methods of water examination received very severe criticism, and the advocates of the exclusively bacteriological processes were correspondingly elated, for here were known instances of fatal contamination, which the chemists had failed to diagnose. Let this, however, be said in defense: In cases as they occur in practice, a serious addition of typhoid dejecta has much that is associated with it. of a comparatively inoffensive character, but which reacts with the chemical reagents, and tells the tale of sewage contamination, although the analyst can not venture to state the exact nature of the source whence the pollution is derived.

Not long since, the writer claimed that the river water furnishing a large Eastern city was contaminated with up-stream sewage, the opinion having been based not alone upon an analysis of the water at the intake, for the river was large and the consequent dilution great, but upon the difference between that analysis and one of the water taken from above the sewage inflow. The difference was small, but it was noticeable, and there was no other sufficient explanation of its existence than the one given. Later on, typhoid fever broke out in the upper valley, and epidemics developed not only in the city in question, but in all the neighboring towns using the river water for supply. Closely related cities and towns. which received their water from other sources, were not affected. Space does not permit of giving details, showing how clearly the case stood against the river water, but it is interesting to note that typhoid germs were most carefully sought for and were not found. That they were nevertheless present, there can be but little doubt.

Chemical analysis in this instance did certainly not detect the presence of typhoid, but what it did do, was to warn the people, months before the typhoid appeared, that they were drinking diluted sewage, and that they must beware of the time when that sewage came from pathogenic sources.

The paper in question goes on to say:

"The popular impression that the Koch or Finkler and Prior comma bacillus is the cause of cholera is fallacious, or, at least, not proven. The same remark applies to the typhoid bacillus of Eberth. The proof is still wanting that this will cause typhoid." This last is a quotation from Sternberg's Manual of Bacteriology, but it is very misleading because it is incomplete. What Sternberg really says is this: "Recent researches support the view that the bacillus described by Eberth, in 1880, bears an etiological relation to typhoid fever; and pathologists are disposed to accept this bacillus as the veritable germ of typhoid fever, notwithstanding the fact that the final proof that such is the case is still wanting. This final proof would consist in the production of man, or in one of the lower animals, of the specific morbid phenomena which characterize the disease in question, by the introduction of pure cultures of the bacillus into the body of a hearty individual. Evidently it is impracticable to make the test upon man, and thus far we have no satisfactory evidence that any one of the lower animals is subject to the disease, as it manifests itself in man." Now that is a very different statement, and conveys a meaning greatly unlike the one suggested by the partial quotation referred to.

The paper says: Absolutely healthy persons have been known to reject the Eberth bacillus in their excrement, showing such, probably, to be in the intestines at all times." This is an error. To use the words of Sternberg, from whom the paper so often quotes: "No competent bacteriologist, so far as I know, has claimed to find the Eberth bacillus in the feces of healthy individuals."

As to the doubt thrown upon the correctness of the view that Koch's comma bacillus is the cause of cholera, the work of Sternberg will hardly endorse it. In this connection Sternberg says: "The etiological relation of this spirillum to Asiatic cholera is now generally admitted by bacteriologists," and also, "the most satisfactory evidence that this spirillum is able to produce cholera in man, is afforded by an accidental infection which occurred in Berlin in the case of a young man who was one of the attendants at the Imperial Board of Health when cholera cultures were being made for the instruction of students."

As to the statement in the paper that "fatal cases of typhoid have been attended with none of the Eberth bacillus in the feces, or in the intestines, the seat of the disease," it is to be noted that Gaffky's investigations show it to be by no means a serious objection. He considers the technical difficulties surrounding a hunt for the bacillus in some few instances so considerable as to readily account for a small percentage of negative results, and he cites instances where he found the "germ" after an amount of patient search extending far beyond the point where the average observer would have ceased work and placed a negative report upon record.

Finally, the paper has much to say upon the imperfections of modern filters and the danger of using water therefrom. It goes without saying that pure water is better than purified water, but then the former is often unattainable, and we have to do with the latter or go without.

The paper lays especial stress upon the fact that even when the filtration is so successfully accomplished as to leave in the filtrate only one or two bacteria per cubic centimeter, yet "a person may imbibe from 250 to 500 bacteria in drinking a single glass of water, some of which may be pathogenic and produce typhoid fever, or some less dangerous disease." Such a degree of excellence in filtration as the obtaining of a filtrate with only one or two bacteria per cubic centimeter is indeed rarely attained, yet the public have a right to look with confidence upon a plant which does not pretend to accomplish half that amount of purification.

Consider for a moment what the Altona filters did for that city during the Hamburg cholera epidemic of 1892. The Altona water was taken from the Elbe river at a point below the outfalls of sewers carrying the cholera-infected sewage of 800,000 people. Yet Altona had but very little cholera (except imported cases), while Hamburg was scourged by it. The cities are practically one, a stranger being unable to tell the dividing line.

Take the numbers showing the efficiency of the Altona filters during one month of 1892:

The bacteria in the raw Elbe water per cubic centimeter varied from 9,370 to 44,140, with an average of 28,667. The average number in the filtered water was ninety. This meant a removal of 99.69 per cent. of germs of all kinds, 0.31 per cent. still remaining. The filtrate was by no means sterilized, but the city was protected from a cholera epidemic under circumstances trying in the extreme. As to the efficiency of sand filtration for water purification, the following figures are given for results found at the Lawrence experiment station, the filters having been operated with water containing known quantities of bacteria:

Rate in gallons per acre daily, 1,500,000; kind of bacteria added, B. typhi. abdom.; per cent. removed, 99.93; rate in gallons per acre daily, 3,000,000; kind of bacteria added, B. prodigiosus; per cent. removed, 99.95.

This reduction of the number of germs in a given volume of water is possibly equivalent to a dilution of the unfiltered water with a very large volume of a pure supply; and in this connection the writer of the paper says: "Dilution may reduce the chances of any single individual imbibing a fatal germ, but the germ itself will be just as dangerous when it is imbibed."

This is, doubtless, true if the individual be especially susceptible, for it has been experimentally shown that a single germ may produce fatal results when injected into an animal very prone to the special disease, but it has been also shown that when the animal is not very susceptible, the "dose" of bacteria has to be enormously increased to produce any result. We incline to believe that some similar reason may account for the apparent immunity of that fraction of a community, which has been equally exposed but which escapes contagion.

What the paper says regarding the unsatisfactory results observed where household filters are in use, is, unfortunately, very true, but the fault is more commonly with the attendant than with the filter. The common belief is that a filter, once established, is good for all time, and I could tell tales of what I have seen, in otherwise well-organized establishments, that would stagger belief. I do not approve of general household filtration, as I believe purification can be better and more cheaply done on the large scale by the municipal authorities, but I can not think that the Pasteur filter should be swept aside like the worthless contrivance the paper calls it. My experience is that, with proper care, it is efficient. Extended tests were made with it for the Connecticut Board of Health in 1892, which show that it may be depended upon, if the procelain cylinder be cleaned and sterilized once a week.

Freundenreich has obtained similar results, and has also shown that the length of time during which the filter is efficient depends upon the temperature.

RENSSELAER POLYTECHNIC INSTITUTE,
August, 1894.

THE PROTEIDS OF COTTONSEED.[1]

BY THOMAS B. OSBORNE AND CLARK G. VOORHEES.

THE only reference to the proteids of cottonseed which we can find was made by Ritthausen in 1881 (*J. prakt. Chem.*, **23**, 485), who stated that he had been unable to obtain crystals of proteid matter from this seed and also that he would soon publish his complete investigations of the proteid bodies of this as well as of several other seeds which he named. Papers on the proteids of the other seeds mentioned by him were subsequently published, but we have not found anything relating to those of cottonseed. Since so long a time has elapsed, we feel warranted in assuming that Ritthausen has abandoned his intention of reporting the results of his investigation. The importance which cottonseed-meal has assumed as a cattle-food of late years, makes it desirable to understand its chemical composition, especially as regards the nitrogen compounds which it contains so abundantly. Our results are not as satisfactory as we hoped for when we undertook this work but we have decided to publish them as they stand and shall endeavor to make them more complete in the future. The difficulties encountered are due to the presence of substances which render filtration of the extracts extremely slow and to the large amount of coloring matters taken up from the seed together with the proteids, which could be separated only with difficulty and large loss of substance. The material used in our investigation consisted partly of seed

[1] First printed in the Report for 1893 of the Connecticut Agricultural Experiment Station.