If, then, tuberculosis is not inherited, the question of prevention resolves itself principally into the avoidance of tubercular meat and milk and the destruction of the discharges, especially the sputum of tubercular individuals. As to the first means of communication, those measures of prevention alone answer the requirements which embrace the governmental inspection of dairy cows and of animals slaughtered for food, and the rigid exclusion and destruction of all those found to be tubercular.

For the removal of the second means of communication, i.e., the sputum of tubercular individuals, the problem is simple when the patients are confined to their rooms or houses. Then, wooden or pasteboard cups, with covers, should always be at hand for the reception of the sputum. These cups are supported in simple racks, and at least once daily, or more frequently if necessary, should be removed from the racks and thrown with their contents into the fire. A cheap and efficient cup answering this purpose is now on the market, and is supplied by the druggists.

The disposition of the expectoration of persons who are not confined to their rooms or homes is a far more difficult problem. The expectoration certainly should not be discharged on the street, and the only practicable means for its collection seems to be in handkerchiefs, which, when soiled, should at the earliest possible moment be soaked in a solution of five per cent carbolic acid, and then boiled and washed. Handkerchiefs thus soiled are exceedingly dangerous factors in distributing tubercle bacilli; for, when the sputum becomes dry, it is easily separated in flakes from the cloth, and then soon becomes pulverized and suspended as dust.

It becomes evident from what has been said that the means which will most certainly prevent the spread of this disease from one individual to another are those of scrupulous cleanliness regarding the sputum. These means lie largely within the power of the affected individual. It is furthermore to be remembered that consumption is not always, as was formerly supposed, a fatal disease, but that it is in very many cases a distinctly curable affection.

An individual who is well on the road to recovery may, if he does not with the greatest care destroy his sputum, diminish greatly his chances of recovery by self-inoculation.

While the greatest danger of the spread of this disease from the sick to the well is in private houses and in hospitals, yet, if this danger is thoroughly appreciated, it is, for the most part, quite under control through the immediate destruction of the sputum and the enforcement of habits of cleanliness. But in places of public assembly, such as churches and theatres, particularly the latter, conditions are different, and the safety would seem to depend largely upon a dilution and partial removal of the floating and possibly dangerous dust by means of adequate ventilation.

Rooms in private houses and hospital wards that are occupied by phthisical patients should from time to time be thoroughly cleaned and disinfected, and this should always be done after they are vacated before they are again occupied by other individuals. Steamship companies should be obliged to furnish separate apartments for consumptive persons, so that no person in the exigencies of travel need be forced to share his room with one who might be a source of active danger to him.

Drs. Prudden, Biggs, and Loomis desire especially to emphasize the following facts: (1) that tuberculosis is a distinctly preventable disease; (2) that it is not directly inherited; and (3) that it is acquired by the direct transmission of the tubercle bacilli from the sick to the healthy, usually by means of the dried and pulverized sputum floating as dust in the air.

The measures, then, which are suggested for the prevention of the spread of tuberculosis are (1) the security of the public against tubercular meat and milk, attained by a system of rigid official inspection of cattle; (2) the dissemination among the people of the knowledge that every tubercular person may be a source of actual danger to his associates if the discharges from the lungs are not immediately destroyed or rendered harmless; and (3) the careful disinfection of rooms and hospital wards that are occupied or have been occupied by phthisical patients.

THE annual meeting of the American Climatological Society will be held in Boston, June 24 and 25; Dr. V. L. Bowditch of Boston, president.

SIXTH ANNUAL REPORT OF THE SUPERINTENDENT OF HEALTH OF PROVIDENCE.

IN this report, Dr. Charles V. Chapin, the superintendent of health, records many important facts and observations. The number of deaths reported was 2,608. The population of the city being 121,500, this gives a death-rate of 21.48 per thousand. From consumption there were 359 deaths, an increase of 46 over 1887: 10.39 per cent of all deaths were from diarrhœal diseases. Malarial fever first appeared in Providence in 1880, when one death was reported from that cause. Since that time 92 deaths have occurred from that cause: 9 in 1885, 11 in 1886, 28 in 1887, and 39 in 1888. The disease is confined almost entirely to certain well-defined districts of the city, which are particularly exposed to those influences which have been conclusively shown to be the chief causes of the production of the malarial poison. But 2 deaths occurred from measles, while there were 28 from whooping-cough. There were no deaths from small-pox: indeed, there has been but one death from that disease in Providence since 1875.

Dr. Chapin, in this report, deals specially with two forms of contagious disease, — scarlet-fever and typhoid-fever, — and it is to these two subjects that we shall mainly devote our attention. In writing of scarlet-fever, he says, "Scarlet-fever is one of those contagious diseases which tend to recur in epidemics at more or less regular intervals. Since 1840 there have been ten epidemic periods, separated by intervals of about five years. As is usual with the disease in this part of the world, these epidemics generally have begun in the autumn, and increased in severity until late in the winter or spring. One of these epidemics, though not a severe one either as regards the number of cases or the mortality, began in August, 1884, attained its maximum in November, and was pretty well over by early spring. In 1887 another epidemic occurred, beginning in August.

"During the epidemic of 1884, some efforts were made by this department, chiefly by regulating school-attendance, to check its spread, but apparently without any very great influence. The rapid onset of the disease in the autumn of 1887 so attracted the attention of the public, that it was deemed feasible to adopt more stringent measures. While it cannot be definitely proved that the marked falling-off in the cases and deaths from this disease which immediately followed the adoption of more stringent measures was due to this, yet it is rendered highly probable from the fact that such a decrease in scarlet-fever at that time of the year is markedly at variance with the usual course of the disease in Providence, and indeed in all cities in this climate. Though there is no theoretical reason why scarlet-fever, being a purely parasitic disease, should not be entirely stamped out, yet we can never hope to accomplish this, so long as the public, and physicians also, are as careless about it as they are at the present day. While in the majority of cases, except among the very poor pretty fair isolation is maintained at first, it is not kept up long enough, and children are often allowed to ride in the horse-cars, go to Sunday-school, or visit a clothing store and try on half a dozen different coats, by the end of the third week, and before they have ceased to peel; and the most discouraging thing about it is, that it is often done with the consent of the attending physician. It must, I am afraid, be the duty of the health department to insist upon the contagious nature of this disease for many years to come, and, while striving not to render its rules inoperative by reason of their being too far in advance of public sentiment, strive, whenever opportunity offers, to make them more and more stringent.

"It is popularly believed that nearly every person will have scarlet-fever sooner or later; and I very frequently see persons who say they had rather let their children catch scarlet-fever while they are young, as it would go so much harder with them when they grow up. But such a belief is totally without foundation. During the past five years there were reported about 2,300 cases of scarlet-fever. If we assume that this rate has been continuous for the last fifteen years, then there have been only a little over 7,000 cases of scarlet-fever during that time. If we approach the problem in another way, and take the deaths during the last fifteen years, and assume the mortality to have been ten per cent, which is certainly low, the number of cases during this time is 13,970, or, in

round numbers, 14,000. The total number of children in the city under fifteen years, at the census of 1885, was 34,592: it must now be at least 36,000. Therefore, if we assume that the general death-rate of those who have had scarlet-fever is the same as those who have not, and the same relative figures are true for those who have moved into the city, there must, by the most unfavorable estimate, be one and one-half persons of fifteen years of age living in Providence who have not had scarlet-fever to every one that has. Or if we take the more favorable estimate, which I think is nearer the truth, there are at present four persons of that age who have not had scarlet-fever to every one that has. The age of fifteen is selected because scarlet-fever is rare after that; for, out of nearly a thousand cases in this city, there were only twenty-four over fifteen. The chance, then, of a child's growing up without having scarlet-fever, is even now very good. It can be made still better by a proper observance of sanitary rules. In four cases where children who had been removed at the inception of the disease were taken sick on their return, they were absent from four to five weeks, and were attacked within two or three days after their return. In the other cases the absence continued for from four to six weeks in the majority, but was less than that in some instances, and greater in others. We may, I think, fairly infer from them, that, when a child is exposed to scarlet-fever in its own family, its chances of escaping or contracting the disease are about even. The figures also show that when not brought in such intimate contact, but when merely a resident of the same house but in another tenement, the chance of contracting the disease is much less, being in fact one in seven. The recognition of this fact has made me somewhat more lenient than formerly in excluding children from school. In houses where I am satisfied that there is no direct communication between the families, I only exclude those children in the family in which disease actually exists, allowing the other children in the house to continue their attendance. Of course, where there is any doubt about the children mingling, as there always is in the crowded tenements of the poorer classes, it is necessary to exclude all in the house.

"In regard to fumigation, it is seen, that, in the 114 cases where fumigation with sulphur was done as well as it could be in a private house, the disease extended beyond the family where it first appeared, to others in the house, ten times. This is less often than when fumigation was not done, the ratio then being about one to four, and in the latter case one to eleven. But how much credit is to be given to the fumigation for this, I do not know. When people attend to fumigation properly, they usually are careful about isolation also, and the disinfection of soiled linen, etc., and they are also more thorough in the application of inunction; and it is probable that all these things have as much or more to do with the restriction of the disease than does the final fumigation."

Dr. Chapin speaks doubtfully of inunction of the skin as a preventive of the spread of scarlet-fever. In cases where it was practised, out of 714 susceptible children in families where the disease existed, 467 were attacked, which is a larger proportion than where it was not done. This method was proposed by Dr. Jamieson, and has given good results in Great Britain. Its failure in Providence may be due to its improper performance, or the neglect of parents to continue it long enough.

The number of deaths from typhoid-fever during the first eleven months of 1888, while in excess of the preceding year, was not much above the average for the past few years. The autumn was warm and rainy, and it was thought that the slight increase in this disease might be due to these meteorological conditions. During the last week in November, however, the disease increased greatly and suddenly, and almost as suddenly diminished during the early part of December. During the two weeks ending Dec. 15, 223 cases of typhoid-fever were reported at the superintendent's office, 139 being reported during the week ending Dec. 8. This is the largest number ever reported in one week, except during the epidemic of 1882, when 163 cases were reported during the week ending Nov. 11. The number of deaths in December from typhoid-fever was 47, which has been exceeded only once, by 70 deaths in November, 1882. The next largest number of deaths was 32, in April, 1883. It will thus be seen that the epidemic, though short, was severe.

For this outbreak there must have been some peculiar and local exciting cause. General meteorological conditions must be excluded, for they would have operated over the neighboring country as well as in Providence. There was, it is true, a very heavy rainfall during the year 1888, and particularly in November, and the season was unusually mild; but a local epidemic like this cannot properly be attributed to any such general influences. The cases were scattered very generally and very equally over the city. The only district which had less than its due proportion was that on the summit of the hill on the east side of the Providence River. Local unsanitary conditions, acting only on the individuals attacked, could not stand in a causative relation, as is shown by the report of the medical inspector.

The one cause which seemed most likely to act upon the whole city for the production of this disease was the water-supply. A quite common and absolutely demonstrated cause of typhoid-fever is the pollution of drinking-water with the stools of typhoid patients. Knowing the danger of pollution to which the Pawtuxet River was exposed, and thinking that the source of trouble might possibly be found along its banks, Dr. Chapin proceeded to make a thorough investigation of the river-valley. From inquiries he learned, that, with the exception of one locality, there had been only two or three recognized cases of typhoid in the valley of the river during the autumn months. The exception was at Natick. Below Natick, at Pontiac, is a dam. This is the only obstruction between the pumping-station and Natick. At the latter place are several tenements belonging to the Mill Company, situated from one hundred to one hundred and twenty-five feet from the river-bank on a flat only a few feet above the level of the water. These houses are occupied by French Canadians, and it was among them that the typhoid-fever occurred. The attending physicians — one of Natick, and the other of Centreville — could not state how this epidemic originated, but they assured Dr. Chapin that during the months of September, October, and November there had been about twenty cases of the disease in these houses, and that one or two of the patients were only just convalescent when he visited the village on Dec. 7. These people were ignorant, and no information could be gained by questioning them. They were very careless and filthy in their habits; and the attending physician stated, that, as was to be expected, they made no pretence of disinfecting the excreta of the patients. These houses were all provided with water-tight cemented vaults, situated within fifteen to twenty-four feet of the water's edge, which had not been cleansed for two or three months previous to Dec. 1, and no night-soil had been applied to any land near the river during that time.

Openings had been left in the covers of the vaults, through which it was supposed that the tenants would empty their slops; but the people chose, perversely, to throw them on the ground behind and at the side of the privies. Places were seen on the banks of the stream where these slops, mingled with fæcal matter, were slowly working their way into the water. Cases of typhoid began to appear with unusual frequency in Providence about Nov. 23. As there are good reasons for believing that the incubation of typhoid-fever consumes from ten to eighteen days, and as two or three days might elapse before the disease poison was distributed at the house-taps, it is evident that the course of events was as it would have been if the rain of the 9th of November had washed the specific poison into the water.

Examinations were made of the water itself, taken from the distribution in the city, the river, and the two reservoirs. The bacteriological investigations of Dr. Swarts, the medical inspector, have made it certain that the house-filters in common use collect filth and microbes from the water, and act as incubators for the latter, allowing them to rapidly propagate within the interstices of the filtering material, and they are washed out in large numbers as water is drawn through the filter. Such filters have been invariably condemned; for it seemed certain, that, in case there were disease-germs in the water, the so-called filters, instead of removing them, would actually increase the amount of the poison, and so increase the liability to disease in those who use them. During this epidemic a large number of patients were found who had used water thus filtered; and it was especially noticeable that many of the cases which occurred soon after the epidemic proper had

ceased, made use of filters, and it is highly probable that the poison was preserved and increased in amount in these filters.

It was determined to examine these filters (taken from houses where there was typhoid) to learn whether or not they contained the specific organism. As the labor of examining such an enormous number of organisms as were found in the filters is very great, only a few filters were tested. Dr. Swarts examined some, and some were sent to Dr. T. Mitchell Prudden of the College of Physicians and Surgeons, New York, and others to Dr. Harold E. Ernst of Harvard, — all gentlemen thoroughly skilled in bacteriological work. It must be remembered that all these filters were found to be filled with decomposing organic matter, and swarming with countless bacteria. The isolation of one particular species among so many is a task of extreme difficulty, and negative testimony is of little value. Even the most skilled observers abroad have failed to detect this particular organism under similar conditions, although it was known to be certainly present. In the investigations made for this department the organism which produces typhoid-fever was not found in the water itself. Bi-monthly analyses of the water to determine the number of organisms were made on the 1st of December; but, as only a few plate-cultures were made, the negative result obtained can have little value, yet, as the epidemic was rapidly diminishing by the end of the first week in December, it is probable that there were no typhoid organisms in the water itself at the time the analyses were made. The typhoid organisms were, however, found in three of the filters. One of these filters came from the west side of the city, and the others from the east side (one from the northern, and the other from the southern part). None were on the high-service supply.

Filter No. 1, a "Star" filter, was removed from the tap Dec. 8. The patient was taken sick Dec. 1, and the filtered water had not been used for drinking-purposes since that time. There was a trap in the sink-pipe of the sink where the faucet was. There was no water-closet in the house, and the stools of the patient were disinfected and thrown into the vault. Filter No. 2, a "Grant" filter, was removed Dec. 6. The patient was taken sick Nov. 29, and died of hemorrhage Dec. 17. The plumbing of the house was complicated, but perfectly trapped and in good order. Filter No. 3, an "Aborn" filter, was removed Dec. 6. The patient was taken sick Dec. 1. The plumbing was in first-class condition; and the sanitary conditions of the house, one of the finest in the city, perfect.

There is no question that the patients who used these filters were suffering from true typhoid; and there was no chance for these filters, either while in position or after they were removed, to become contaminated, except from the water which passed through them. Besides the typhoid bacilli, several organisms characteristic of fæcal matter were found in the filters, indicating the source of the specific contamination. In fact, one of the filters, so far as the organic life was concerned, resembled, as Dr. Prudden said, a mixture of charcoal, water, and human fæces.

These investigations demonstrated the presence of the typhoid bacillus in our public water-supply, and also the dangerous character of the domestic filters in common use, and they also prove that the short epidemic of November and December last was due to the pollution of the Pawtuxet River by the stools of typhoid-fever patients.

BOOK-REVIEWS.

Mechanics of Engineering. [*Fluids.*] By IRVING P. CHURCH. New York, Wiley. 8°. $3.

IN the preparation of this treatise on hydraulics and pneumatics, which is intended mainly for use in technical schools, the same general design has been kept in view as in the preparation of the preceding and companion work on solids. The author, who is assistant professor of civil engineering at Cornell University, has succeeded in combining clearness with consistency in the setting-forth and illustration of theoretical principles, and has provided numerous and fully lettered diagrams, in which, in the greater number of cases, the notation of the accompanying text can be easily apprehended. Especial attention is invited to the proper use of systems of units in numerical examples, the latter being introduced very copiously and with detailed explanations. The results of the most recent experimental investigations in hydraulics have been taken advantage of in assigning values of the numerous co-efficients necessary to the more thorough comprehension of the subject. Among the investigations thus utilized may be mentioned those of Fteley and Stearns in 1880, and of Bazin in 1887, on the flow of water over weirs; those of Clemens Herschel in testing his Venturi water-meter; and also some recent experiments in the transmission of natural gas and compressed air. Though the action of fluid motors has not been dealt with as extensively as some might have desired, sufficient matter is given in treating of the mode of working steam, gas, and hot-air engines, air-compressors, and pumping-engines, together with numerous examples, to be of considerable advantage to students not making a specialty of mechanical engineering.

Elementary Synthetic Geometry of the Point, Line, and Circle in the Plane. By N. F. DUPUIS. London and New York, Macmillan. 16°. $1.10.

THIS work is a result of the author's experience in teaching geometry to junior classes in the University of Queen's College, Kingston, Canada, for a series of years. It is not an edition of "Euclid's Elements," and has, in fact, little relation to that work except in subject-matter. There are a number of points in which the book varies from the majority of modern treatises on geometry. The point, the line, and the curve, lying in a common plane, are taken as the geometric elements of plane geometry, and any one of these or any combination of them is defined as a geometric plane figure. Thus, the author defines a triangle as the combination of three points and three lines, and he claims that this mode of considering geometric figures leads naturally to the idea of a figure as a *locus*. The principle of motion and the transformation of geometric figures recommended by Sylvester, and the principle of continuity, are freely employed.

The intention in preparing the work has been to furnish the student with that kind of geometric knowledge which may enable him to take up successfully the modern works on analytic geometry.

Go to the Ant and learn Many Wonderful Things. By JOHN WENTWORTH SANBORN. Cincinnati, Cranston & Stowe; New York, Hunt & Eaton. 12°.

MR. SANBORN, finding that his own children were interested in his experiments with ants, and that they asked him all sorts of questions, sought every possible means for gaining information to instruct them, and as a result of the notes put down by him from time to time, of the information gathered by observation and reading, this little book was prepared. The book tells of the social life of ants, their food, the plants which they seek, the different varieties of ants, with a chapter on foraging ants and ants as social creatures.

A Treatise on Spherical Trigonometry, and its Application to Geodesy and Astronomy. By JOHN CASEY. London and New York, Longmans, Green, & Co. 12°. $1.50.

THIS manual is intended as a sequel to the author's treatise on plane trigonometry, and is written on the same plan. It is believed, that, though moderate in size, it contains a large amount of matter, much of which is original; the author having turned especially to *Crelle's Journal für die reine und angewandte Mathematik*, Berlin, and *Nouvelles Annales de Mathématiques*, Paris, for recent information. Professor Neuberg of the University of Liège aided considerably in its preparation.

A Laboratory Guide in Chemical Analysis. By DAVID O'BRINE. 2d ed. New York, Wiley. 8°. $2.

THIS volume is intended for the use of students who possess some knowledge of chemistry, and is especially adapted to the wants of the college or the medical laboratory. In the second edition we note that some of the chapters which were in the first edition have in this been greatly extended, while others are entirely new. Among the items of special interest we would mention the separation of substances by electrolysis, water analysis, and the methods for the detection of ptomaines and alkaloids.