managers, however, to conduct original and intelligent explorations, rather than merely to accumulate a large quantity of "Indian relics" by purchase, and arrangements are now making for the placing of several men in the field who are experts in this kind of scientific work.

Meanwhile the valley of the Delaware is being carefully attended to, and has yielded largely, much material having been collected that throws additional light on the customs and conditions of the Indians that for so many centuries occupied this region. During the summer of 1891 a large number of village sites were exhaustively explored, and two interesting rock shelters examined; while on an island in the river was found an implement maker's work-shop, and a "cache" where 116 beautifully chipped knives, averaging about six inches in length, was brought to light. The flint (jasper) quarry from which the Indians derived their raw material for arrow-heads, knives, scrapers, and drills was also located; the shaft they had sunk examined, and a vast quantity of cores, chips, unfinished implements, and hammers, mauls, and other implement-making tools, were procured.

Recently, through the generosity of several gentlemen, the superb Cope collection was secured, so that even now the museum has excellent facilities for illustrating the conditions of human life on this continent prior to European contact.

The first annual report, a pamphlet with beautiful illustrations, has already appeared, and, better than all else, shows how rapid has been the progress of the venture.

Altogether it appears probable that an institution has been founded which will become not only a source of great local pride and influence in Philadelphia, but will powerfully advance the cause of this most interesting of sciences throughout America. The need of money is great, and the rich men of the country, especially those who are alumni of the University of Pennsylvania, or interested in this part of the country, can find here a use for a portion of their wealth which will be most fruitful in the advancement of knowledge. It is to be hoped, too, that many persons in the Southern and Middle States, who have formed small local collections of archæological specimens, will see the wisdom of depositing them in this general museum, where they can do far more general good than hidden in isolated houses scattered about the country. May every success attend this new museum, and long live Dr. Abbott, its curator.

ERNEST INGERSOLL.

INFLUENCE OF GROUND WATER UPON HEALTH.[1]

THE examination of the historic records or of the published mortality tables of this and other countries shows that there are certain conditions which are found to be present when certain diseases are most rife. It is also found, that, after eliminating certain meteorological and other influences which are supposed to affect disease, some particular diseases appear to be solely influenced by the hygrometric condition of the ground and the volume of water which is present in the ground.

In historic periods when particular epidemics have been rife, they have mostly occurred in times of drought, in which it has been established, beyond doubt, by the evidence of the failure of springs and rivers, that the ground water was then exceptionally low.

The actual measurements of the ground water in this country, in some cases, go back for a period beyond that of the registration of deaths, consequently a comparison can be made between the state of the ground water and the death-rate of any particular period; and when such examination is made it is found that there is a coincidence between the state of the ground water and the deaths recorded. The deaths follow, as a rule, in the inverse ratio, the state of the lowest ground water; that is, high low water indicates a healthy period, while low low water marks the unhealthy periods. Investigations respecting the influence of ground water upon health should be studied over limited areas, as the distribution of rain is often very local, and there are varieties in the geological character of the soil that affect the result of observations carried on over large areas, and on this account, while observations have been carried on by the author over an extended area, he has always used local observations to compare with the mortality returns in the same district, and he has specially dealt with the records of Croydon, which is the place where the observations as to percolation, evaporation, and the hygrometric condition of the soil have been locally studied.

There is every reason to believe that the ground water itself, except when polluted, exercises no influence as a cause of disease, but is merely the measure or indicator of the influences which are at work within a polluted soil, and of certain organic changes which evidently take place within the dark recesses of the soil, and which lead to the development of the conditions favorable to a certain class of disease. That the earth does exercise a baneful effect upon health is well known from the experience in this country of the unhealthfulness of cellar dwellings, and from the fact that persons habitually living upon ground floors are not so healthy as those living in the upper stories of buildings removed from the influence of the ground.

There is a seasonable fluctuation in the waters in the ground, and, as a rule, these waters are lowest in the autumn and early winter, and highest in the spring or early summer; but in some years the period of both low and high water varies, as, for example, the low water of last season did not take place until February of this year (1891).

It is also known that the artificial lowering of the sub-soil waters of a district has produced the same effects upon the health as occurs when a general lowering of the ground water arises naturally from drought.

The actual drying of the ground is a condition which is favorable to the general good health in this country, and this circumstance often masks, in the general death-rate, the potential influence of certain diseases, so that the general health of a district appears to be good, while at the time it may suffer intensely from a certain class of disease of which low ground water is the indicator. When, however, the conditions become extremely intense, and the ground water exceptionally low, the influences at work affect the death-rates as a whole. On the other hand, in periods of excessive rain with high ground water, the conditions are usually favorable to health, and all places in which the ground waters are of a uniform level, such as seaside places, which are governed by the mean tide level, and river valleys with porous soils, like that of the River Wandle, in which the water is headed up to a uniform level by mills, are usually healthy.

It is known that the measure of the effect of the ground water is most marked in districts which draw their water supply from the ground, and amongst that section of the inhabitants who use such water for dietetic and other purposes, especially in the case of young children and teetotallers.

The unhealthy time after the period of excessive low water is that when the first rain begins to percolate through the soil, just as if it washed out matters which had been specially prepared or were retained in the dark recesses of the soil, into the water, or by driving out the ground air specially charged with the poison of disease. It is by no means uncommon both in this and other countries to find that particular epidemic outbreaks which have become rife at a low-water period can be traced to particular rainfalls. In this country since we have the registration of deaths, those quarters of the year when percolation has first commenced after periods of exceptionally low water are, without exception, the most unhealthy seasons that have been recorded. The quarters of the year when percolation first commenced after exceptionally low water have been the most unhealthy, as, for example, the

[1] Abstract of a paper read before the Congress of Hygiene, in London, England, August, 1891, by Baldwin Latham, F.G.S.

March quarters of 1838, 1845, 1847, 1853, 1855, 1864. 1865, 1866, 1875. 1890, 1891, which, with the exception of the third quarter of 1849 (the cholera year), are the most fatal seasons on record.

There is no doubt that the sanitary condition of the district greatly influences the results of the movements of the ground water, and the greater the amount of disturbance or the number of disturbances of the ground water in the course of the season in insanitary districts, the greater and more marked the influence upon health until the period arrives when the soil has been washed free from its impurities, and the waters have accumulated in the ground.

Certain diseases have their allotted seasons and conditions favorable for their development and spread, and there are a number of diseases usually most rife when the ground waters are low, such as enteric fever, cholera, small-pox, diphtheria, and others.

The state of low ground water as being a condition accompanying epidemics of typhoid fever is a matter of constant observation, and it is a well-authenticated fact that all epidemics of this disease in this country have occurred in periods only of low water, or when immediately following a very low state of the ground water.

Ground water influences both small-pox and diphtheria in a most marked manner, but in directly opposite ways, so that when one of these diseases is present the other is absent. Small-pox is accompanied or preceded by intense dryness of the ground, while diphtheria occurs only when the condition of the ground is one of continued dampness. The year 1871 was a very fatal year from small-pox in this country, and in that year the percolation experiments showed that the ground was intensely dry. In 1876 an outbreak of small-pox occurred at Croydon, and continued until the autumn of 1877. Outbreaks of this disease have subsequently occurred in this place in 1881–82 and 1884–85. Since September, 1885, there have been no deaths recorded from small-pox at Croydon, but diphtheria has been very prevalent during the whole of that period, and the ground has been in a constant state of dampness, so much so, that, with the exception of one month, October, 1886, a measurable quantity of water flowed from the percolation gauges every month during all this long period. The last outbreak of small-pox in 1884–85 was preceded by seven months, and that of 1881–82 by five months, when no water percolated through the ground.

Since the time when the author first observed this marked coincidence between the dryness of the ground and outbreaks of small-pox, he has learned from the report of Surgeon-Major G. Hutcheson, M.D., Sanitary Commissioner of the Northwestern Provinces and Oudh, that the counterpart of this has been observed in India in reference to small-pox, which, it is stated, "is controlled or kept in abeyance by damp and moisture."

The most marked incident in connection with ground water is the remarkable parallelism between the deaths of children under five years of age and the lowness of the ground water; in fact, it is found that the deaths in this case fluctuate inversely in proportion to the volume of the water in the ground.

In 1882 the excess of deaths was no doubt due to the direct pollution of the water-supply of the district. And it should be observed that since 1884 the low waters in this well are lower than would be the case naturally, as since this period the waters have been abnormally lowered by the establishment of the New Croydon Water Works Company's station at Addington. If the deaths from diarrhœa are eliminated as being affected more by temperature than by conditions affecting the state of the ground water, the parallelism between the volume of water in the ground and the death-rate becomes even more marked.

This coincidence between the rates of mortality of children and ground water occurring period after period is tantamount to positive proof that ground water, at least, if not the direct cause, is the measure of the influences at work which seriously menace the lives of young persons.

Those who require further information upon this subject will find it in the author's recent presidential address to the Royal Meteorological Society.

NOTES AND NEWS.

THE *Annals of Hygiene* states that the legislature of Michigan has recently passed a bill making it a misdemeanor, punishable by fine and imprisonment, to manufacture or sell, give or deliver, cigarettes of any kind of tobacco, or cigarette paper in books or blocks for wrapping cigarettes.

— The operations of the Geological Survey of Missouri during the month of August were as follows: Examinations of the zinc and lead deposits have been extended into Greene, Stone, Webster, Howell, Oregon, Carter, Texas, Wright, and Shannon Counties; inspections of iron ores have been made in Cape Girardeau, Bollinger, Wayne, Stoddard, Reynolds, Carter, Ripley, Shannon, and Howell Counties; detailed mapping has been prosecuted in Macon, Chariton, and Henry Counties, and about 70 square miles have been covered. The study of the Quaternary deposits has been continued over the central portion of the State adjacent to the Missouri River; and the mapping of the crystalline rocks has been continued in Madison, St. Francois, Washington, Iron, and Reynolds Counties, as has also the geological mapping in Greene County. For the purpose of constructing models illustrating the conditions of occurrence of ore bodies, detailed surveys have been completed of two important iron deposits. In the laboratory, analyses have been made of clays and iron ores; in the office the plotting of maps preparatory to publication has proceeded uninterruptedly, and work has been continued on the preparation of the report on paleontology. With reference to future work, steps have been taken towards securing for the State the determination of the latitude and longitude of a series of points, which determinations are necessary for the further prosecution of the detailed mapping now in progress.

— Persistent attempts have been made to produce a good artificial substitute for ivory. Hitherto none have been successful. A patent has recently been taken out, says the *Engineer*, for a process based upon the employment of those materials of which natural ivory is composed, consisting, as it does, of tribasic phosphate of lime, calcium carbonate, magnesia, alumina, gelatine, and albumen. By this process, quicklime is first treated with sufficient water to convert it into the hydrate, but before it has become completely hydrated, or "slaked," an aqueous solution of phosphoric acid is poured on to it; and while stirring the mixture the calcium carbonate, magnesia, and alumina are incorporated in small quantities at a time; and lastly the gelatine and albumen dissolved in water are added. The point to aim at is to obtain a compost sufficiently plastic and as intimately mixed as possible. It is then set aside to allow the phosphoric acid to complete its action upon the chalk. The following day the mixture, while still plastic, is pressed into the desired form in moulds, and dried in a current of air at a temperature of about 150° C. To complete the preparation of the artificial product by this process, it is kept for three or four weeks, during which time it becomes perfectly hard. The following are the proportions for the mixture, which can be colored by the addition of suitable substances: quicklime, 100 parts; water, 300 parts; phosphoric acid solution, 1.05 sp. gr., 75 parts; calcium carbonate, 16 parts; magnesia, 1 to 2 parts; alumina, precipitated, 5 parts; gelatine, 15 parts.

— In a paper read before the American Association for the Advancement of Science at the recent meeting in Washington, Professor Joseph James gave the results of a visit to Point Pleasant, Ohio, made to ascertain the age of the rocks. The paper has just been printed in full in the Journal of the Cincinnati Society of Natural History. In it is given a notice of such papers as have considered any of the rocks of south-western Ohio to be of earlier age than the Hudson River group of New York. There are also given the details of a section studied by him at Point Pleasant during the summer of 1890. Vanuxem, in 1829, was the first to correlate the Cincinnati strata with the Trenton of New York, and he was followed in this by Conrad in 1841. In 1843 Hall referred the rocks to the Hudson River group of New York. In 1865 Meek and Worthen proposed for the series the name Cincinnati group. This name was generally accepted, but in 1879 a committee of the Cincinnati Society of Natural History advocated abandoning the