rials, such as would be found in suitable filtration areas throughout the State. Each filter, however, consists of a single material. The experiments were so conducted as to throw as much light as possible upon the laws of filtration. The degree of purification of sewage and of water by the sands of different coarseness, the quantities which the different materials are able to purify, the best method of operation of filters of different construction, and the treatment necessary under varying conditions arising from different lengths of service of the filters and from the effects of weather have been investigated. Much attention has been given to the physical characteristics of materials which govern their action as filters. The open space between the sand grains, the capillarity and the frictional resistance to the passage of water, etc., have been determined for many materials.

Knowing, from the results of these experimental filters, the degree of purification of sewage and of water effected by each of a series of materials ranging from fine loam to coarse gravel, and having formulated the physical characteristics of these materials which govern their action as filters, it is now possible, by studying the physical characteristics of materials sent to Lawrence by cities and towns desiring to adopt filtration, to predict with reasonable accuracy what their efficiency will be as filters. From this it will be readily seen that these investigations do away, in a large measure, with the experimental nature which would otherwise be attached to the operation of large and expensive filter plants. The object of the Lawrence Experiment Station, in short, is to study the laws of filtration with a view to economy.

In regard to the efficiency of filtration, it may be stated, in passing, that sewage can be applied to areas of coarse (mortar) sand 5 feet deep, at a rate of 120,000 gallons per acre daily, with a removal of 95 per cent of the organic matter and germs in the applied sewage. With finer sand the purification is still more complete, but the quantity which can be successfully treated is less. By means of chemical precipitation it is possible, under the most favorable conditions, to remove only from one-half to two-thirds of the organic matter from sewage.

One of the most important points in water purification is the removal of disease-producing germs, since it has become clearly established that high death-rates from diseases, caused by germs which can live in water, result largely from drinking polluted water. The results of the Lawrence experiments show that it is possible to construct filters which will purify at least 2,000,000 gallons of water per acre daily and remove more than 99 per cent of the bacteria in the unfiltered water.

The theory of filtration and a large amount of information upon the actual operation of filters have been presented in the annual reports of the Board and in the special report upon Purification of Sewage and Water, 1890—a volume of 881 pages.

Large sewage filters are in successful operation at Framingham, Marlborough and Gardner, in this State, and others are in the process of construction. A large filter, also, to purify the water supply for the city of Lawrence, is nearly completed.

It is interesting to note the increasing confidence with which this work of the Board is regarded by sanitarians and engineers, not only in this State but throughout the United States and in foreign lands.

The advance in methods of analysis is worthy of note, and more especially in the interpretation of the results of analysis. Old methods have been improved and new ones devised, as well as some pieces of apparatus, which it is believed are not to be found outside the laboratories of the Board—except at their exhibit in the Anthropological Building at the World's Fair.

ASEPSIS—PREVENTION BETTER THAN CURE.

BY ALBERT S. ASHMEAD, M. D., NEW YORK.

THERE is a singular agreement of precept between some of our new philosophical schools and the doctrine of the Orientals as to our duty to the race in case of disease. The doctrine of our philosophers, teaching the survival of the fittest, and our duty to the race, not to interfere with the eliminating operations of nature, is not put into practice, and considering that Christianity is our religion and is not looking forward at present to any imminent decline, it is not likely to pass into practice for some time to come. The Orientals criticize Christianity because it seems unduly and undutifully occupied in counteracting the decrees of nature, by saving, with fostering care, individuals of the race, preserving in hospitals all that ought to perish, and heaping up, so to speak, the sweepings of nature, to perpetuate moral and physical uncleanness. True, they also are anxious to build hospitals; but if they were let alone perhaps they might build them only for animals, whose races are not important enough to make it a pity that disease and vice should be allowed to be transmitted among them from generation to generation. Wherever the Oriental spirit has developed on its own lines, it has endeavored to eradicate the human weed, to sweep away all human influences detrimental to mankind, whether they be represented by disease or by crime, always ready to sacrifice any man to the interest of men. The leper was cast out to die with his disease in unpitied misery and solitude; the beggar, unable to earn his bread or support his family, was excluded from help and intercourse of any kind; what could the race expect from his seed? What is the use of amputating a limb which tuberculosis or syphilis or leprosy is gnawing at? Why should his seed be preserved to perpetuate his rottenness? Why should we so tenderly humor the madman, use infinite care and infinite treasures of knowledge, and miracles of skill, to bring the diseased brain into a condition which makes the man innocuous, tolerable, while yet he can never be normal, rational, useful; his brain fibre is degenerated and should not be transmitted to future generations.

When we Westerners discovered the bacterium we thought that here we had the cursed cause of all disease, and forthwith began to give her chase or to lay siege to her citadel. The Oriental may have thought dimly: Wherever you are, O, Microbe, you are in the state where Providence has placed you and must do her behests. Yours is the empire of the abnormous, the morbid, the destructive. Whatever part of creation you establish yourself upon is by your very presence stamped as bad, unhealthy, undeserving of existence. Therefore stay in your domain, we do not envy it to you. Eat up what belongs to you, it can do us only harm. These Eastern populations believe in fate; they are the true Stoics. What is written, is written, Kismet. If we are doomed to be cut off by cholera we shall not escape it, and the fear of the inevitable shall not prevent us from plunging our limbs into the lethal waters of the Ganges, or quenching our thirst in the Mecca pools. And what does it mean, that our own people, not very long ago, considered the use of vaccine as being an interference with the will of Providence. They called Providence what in the Orient we call fate. It would seem that medicine in general is just the opposite of this magnificent supineness: the physician tries to save his individual, let what may become of the race; there is another kind of recklessness, not supine like the Oriental, but busy and officious. It would be a much higher task, if, instead of waging war against the bacillus, who has invaded an individual, medicine should find means to obviate and suppress the bacil-

lus, or its development, or its culture, before it invades the race by the individual, that is, should create in the organism such conditions, should produce such constitutions, as would not allow of the existence of these microscopical pestilences. That would be asepsis instead of antisepsis. Here is what asepsis has to do. It stands at the fountain head, its mission is to keep the spring of life free from impurity. Let a commission, or whatever body of scientific information and action, go to Russia, to the original habitat of the typhus germ, oppose the development of its colonies before they begin their trip around the world. The first thing to do will probably be to improve the condition of the Russian Jew. Prevent the Hindoos from poisoning themselves with their holy water, with which they drink the blessing of cholera. Enact laws to isolate the syphilitic and the tuberculous. Prohibit the marriage of such. Let the congenitally incurable die before puberty: it is better that the offending limb should be lost than that tuberculosis, syphilis, leprosy, etc., should spread through the whole body. Let the healthy, the temperate, the moral, alone have the inheritance. A correct life is the most perfect asepsis, and insures an immunity with which the burnt infant's immunity, known as such, cannot compare.

THE "GOPHER FROG."

BY FREDERICK CLEVELAND TEST, U. S. NATIONAL MUSEUM, WASHINGTON, D. C.

THROUGH the kindness of Mr. H. G. Hubbard, of Crescent City, Florida, I am enabled to make a note on the habits of the "gopher frog," *Rana areolata œsopus*, Cope. This form seems to be so rare in collections that so far the only specimen reported as having been identified with this sub-species is the type in the National Museum, from Micanopy, Florida, and described by Professor Cope in the Proceedings of the American Philosophical Society for 1886. I have been unable to find any published mention of its habits, which are peculiar.

It appears to be almost entirely subterranean in its habits, living in the holes and burrows of the "gopher" turtle, *Gopherus polyphemus*, in conjunction with it, and apparently on the best of terms. Roughly described, it is grayish green, with thirty-five or forty ragged black spots arranged in four or five irregular longitudinal rows on the back, and grading off into smaller spots on the flanks, while the legs are barred with about fifteen half-rings of black, from the thighs to the toes. Beneath it is white, with the throat marbled with very dark brown. The body is rather flat, with wide head and sharp-pointed snout, and the two dorso-lateral ridges, together with indicated folds between them, are greenish brown. The size is about that of a small "leopard frog," *Rana pipilus*, or the "swamp frog," *Rana palustris*, to which last it is closely related, although individuals are said to have been seen weighing two or three pounds. But those must have been huge toads, noticed by persons unable to distinguish between them and the frogs, or too unobserving to make the distinction. Its food has not been ascertained, from dissection of the stomachs of freshly captured specimens, but as these frogs are rarely seen away from the burrows, it is probable that they feed on the insects living in the burrows, for the holes possess a flourishing insect fauna, to a great extent peculiar to them.

On cloudy and rainy days the frogs sit at the mouths of the burrows—as many as three have been found in a single burrow—but on the approach of a human being dive down out of sight, and as the holes are from 12 to 20 feet in length, and 7 or 8 in vertical depth at the end, digging the frogs out is no easy matter, especially as the sandy soil has a tendency to cave in on the excavator. But the frogs may be successfully angled for with a fishing line and small hook baited with a grasshopper.

In the fact that the burrows usually or always go down to water, may be found an explanation of the frogs inhabiting them, and the facility of procuring insect food therein may be an additional inducement, as well as their being safe hiding places. Nothing seems to be known of the habits of the other varieties of the species, of which also but few specimens are known, *Rana areolata areolata*, from Texas and Georgia, *Rana areolata capito*, from Georgia, and *Rana areolata circulosa*, the "Hoosier frog," found in Indiana and Illinois. It is to be hoped that further observations will be made upon this interesting species, and additional specimens collected.

ALTITUDE AS THE CAUSE OF THE GLACIAL PERIOD.

BY WARREN UPHAM, SOMERVILLE, MASS.

Among the numerous difficult questions which are now being investigated and discussed by glacialists, none seems more important or worthy of attention than the cause, or the causes and conditions, which produced the Glacial period, with its very exceptional accumulation of ice-sheets upon large continental areas in the north and south temperate zones. Climatic conditions like those to-day prevailing in Greenland and on the Antarctic continent, both now covered by ice-sheets whose central portions are several thousands of feet thick, then prevailed in North America as far south as to Long Island, New York, Cincinnati, St. Louis, Bismarck and Seattle, reaching to a more southern latitude in the moist eastern half of the United States than in its mostly arid western half. Likewise Scandinavia, Great Britain south to London, Germany south to Berlin, and the northwestern half of Russia, were enveloped by ice. The glaciers of the Alps, too, of other European and Asiatic mountain ranges, of the Rocky Mountains, and of the mountains of New Zealand, were far more extensive than now; and in South America a broad ice-sheet covered Patagonia.

Three chief theories have been proposed to account for the great climatic changes made known to us by the extent of these areas of glacial drift. During the past twenty years all glacialists have been greatly interested in the astronomic theory of Dr. James Croll, so ably advocated by him in his volume, "Climate and Time," and by Prof. James Geikie in "The Great Ice Age," attributing the ice accumulation to climatic conditions attendant upon an epoch of maximum eccentricity of the earth's orbit. American glacialists, like those of Great Britain and continental Europe, were several years ago very generally inclined to think that this was a true and sufficient explanation. At the present time, however, a majority of the advanced students of this subject, at least in America, doubt that this theory is applicable to the observed facts of glaciation. For, in accordance with Dr. Croll's view, glacial periods should be recognizable with geologic frequency through the earlier Tertiary and Mesozoic eras, where, on the contrary, evidence of glacial conditions is wholly absent or exceedingly scanty, being wherever it is known probably referable to Alpine rather than continental glaciers. Besides, it seems within the past ten years to be fully ascertained that the time since the disappearance of the ice-sheets of North America and Europe has been only 6,000 to 10,000 years, whereas if they had depended on the astronomic causes mentioned their departure must have occurred some 80,000 years ago.

A second theory, accounting for the Glacial period by changes in the position of the earth's poles, and consequently in the latitude of the countries glaciated, which