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PROGRESS IN SANITARY SCIENCE IN MASSACHUSETTS.

BY GEORGE W. FULLER, LAWRENCE, MASS.

THE State Board of Health of Massachusetts, in addition to the ordinary duties devolving upon such a Board, have made much progress during the past six years in the study of many important problems in sanitary science.

In 1886 the Legislature made provisions (Chap. 274 of the Acts of 1886) that "the State Board of Health shall have the general oversight and care of all inland waters. . . . Said Board shall, from time to time, as it may deem expedient, cause examinations of the said waters to be made for the purpose of ascertaining whether the same are adapted for use as sources of domestic water supplies or are in a condition likely to impair the interests of the public or persons lawfully using the same, or imperil the public health. It shall recommend measures for prevention of the pollution of such waters, and for removal of substances and causes of every kind which may be liable to cause pollution thereof, in order to protect and develop the rights and property of the Commonwealth therein and to protect the public health. It shall have authority to conduct experiments to determine the best practicable methods of purification of drainage or disposal of refuse arising from manufacturing and other industrial establishments. For the purposes aforesaid it may employ such expert assistance as may be necessary.

"It shall from time to time consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply or sewerage, as to the most appropriate source of supply, the best practicable method of assuring purity thereof or of disposing of their sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. All such authorities, corporations, firms and individuals are hereby required to give notice to said Board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage or refuse."

The Legislature in 1888 made further provisions (Chapter 375 of the Acts of 1888) that "all petitions to the Legislature for authority to introduce a system of water supply, drainage or sewerage, shall be accompanied by a copy of the recommendation and advice of the said Board thereon."

In compliance with these provisions there was established by the Board an engineering department, whose main work may be divided into two classes: (1) The examination of proposed plans or schemes of water supply or sewerage submitted by the various cities and towns; (2) the examination of existing water supplies and inland waters of the State with reference to their purity.

With regard to the work of the first class it is to be noted that from July, 1886, when the act relating to water supply and sewerage first went into operation, up to January 1, 1893, there have been received 228 applications for advice. In the course of the investigations, instituted to develop the facts required as a basis for sound advice to the cities and towns, many valuable data have been obtained. The capacity, when fully developed, of sources of water supply drawn from ponds, lakes and streams, has been studied individually and in relation to the future needs of the great centres of population. Probable and comparative costs of different systems have been made; drainage areas have been surveyed, records of rainfall, temperatures, rates of increase of population and of consumption of water per capita have been kept and studied. All of these data have not only been of aid in the past but are also of great value for future reference.

Beginning in June, 1887, monthly analyses have been made of water from all the water supplies of the State, and of the more important rivers and other inland waters. At the outset every public water supply was visited by the engineers of the Board; a description and history of the different works were obtained; places for taking samples of water were chosen, and methods to be followed were explained to local officials. Much information was also gathered with regard to the physical characteristics of the water supplies,—such as the density of population on drainage areas, amount of polluting matter entering the streams, volume of water flowing, and temperatures of water. In addition to the chemical analyses which are made in the laboratories of the Board in Boston, at the Massachusetts Institute of Technology, examinations are made of the grosser forms of microscopic life, with the view to establish the relation between the micro-organisms and odors present in certain drinking waters. Bacterial analyses are also made from time to time.

Carefully prepared reports have been made of the results of these investigations. An idea of the nature of the work done can perhaps be best learned by looking at the following list of subjects, which are among those discussed in the annual and special reports:—

A Summary of Water Supply Statistics.

Classification of the Drinking Waters of the State.

Examination of Spring Waters.

Pollution and Self-Purification of Streams.

Typhoid Fever in its Relation to Water Supplies.

Suggestions as to the Selection of Sources of Water Supply.

Dissolved Oxygen in Waters of Ponds and Reservoirs at Different Depths.

Effect of Aeration of Natural Waters.

The Relation of Organisms and Odors in Natural Waters.

The Seasonal Distribution of Organisms.

In 1887 the Board established an Experiment Station at Lawrence. The object of this was to learn how to purify sewage and water. The Station was designed and its work planned by Mr. Hiram F. Mills, A. M., C. E., chairman of the Committtee of the Board on Water Supply and Sewerage.

Experimental filters were constructed of different mate-

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-