

# MUNICIPAL DEPARTMENT

## PURIFICATION OF SEWAGE BY RIVER-WATER SUPPLIES.

(Continued.)

It will perhaps be argued in this connection that an increase in the number of organisms does not necessarily imply increased danger, that the probability of a disease being conferred by water is not only dependent upon the prevalence of such disease, but also on the possibility of discharges from patients being carried into the source of supply. But it is well to bear in mind why these organisms abound in larger numbers in river water during the winter months, which is contrary to what would naturally be looked for. This result is brought about by the large volume of surface waters which discharge into rivers at this season of the year, and which carry with them numberless organisms which are washed from their lodgment in the soil. Now, if we take this into consideration with the well-established fact that pathogenic as well as non-pathogenic organisms may take up their residence in soil,\* adapting themselves to a saprophytic condition of life, and in some cases even engaging in the ordinary process of nitrification, and yet when favourable circumstances occur may return to their original mode of life with harmful consequences, the danger will appear a real one, and, moreover, it will become evident that no great reliance must be placed on calculations considering the amount of disease within a given watershed, and the possible degree of contamination within a stated period.

On the other hand, the statement which has frequently been made that pathogenic organisms are naturally parasitic, living away from the influence of light and in high temperatures, and that consequently when they are brought into the outer air they are surrounded by conditions unfavourable to them, with the result that their virulence is rapidly diminished, is in a certain degree correct, but the statement is only a half-truth and carries with it the usual element of danger. Loss of virulence sometimes takes place concurrently with increase of resistance, and when we further remember what a wonderful power these low forms of life display in adapting themselves to changes in environment, the statement does not carry with it the consolation which it otherwise would do, although it may undoubtedly be urged, on the other side, that bacteria being primarily saprophytic, the greater tendency is to revert to that condition.

The conclusion arrived at by the last Royal Commission on the Water Supply of the Metropolis was to the effect that, in the case of towns having river supplies

with the intakes at a point above such towns, the only disease from which danger is to be feared is typhoid or enteric fever. Cholera—the only other disease which it was deemed possible might be water-borne—was not considered, as it was stated to invariably travel from the mouth of a river towards its source. But while this is probably true, it would seem to be possible that its disappearance may be delayed by the contamination of a source by fecal discharges from an infected district. The previously-mentioned outbreak of cholera at Altona would tend to support this view, as the inefficiently-filtered water was drawn from the Elbe at a point below the Hamburg sewage outfall and the outbreak occurred previous to its disappearance in that city.

In the report referred to on the pollution of the River Trent, the author, after stating that should a visitation of cholera occur the people drinking Trent water would be in danger of catching the disease owing to discharges higher up the river, would seem to suggest that in the case of previous visitations the Trentside populations suffered somewhat severely in this way.

That considerable variation in results and contradiction in statements should exist with regard to bacteriological knowledge bearing upon water supplies can hardly be matter for surprise when we remember that not only is the science a comparatively new one, but that the necessary investigations are surrounded by great difficulty; and it is to be regretted that this contradiction and variation, together with the grossly exaggerated statements of alarmists, have led some to undervalue, and even ridicule, the really substantial knowledge which we now possess.

While the larger argument—that the possibilities of contamination are very much greater in the case of river than in mountain supplies—is irrefutable, some smaller arguments which have been used are not substantiated by more recent knowledge. The statement that pathogenic organisms require for their subsistence an amount of nutriment not likely to be found in water used for potable purposes has been found to be untrue, and the fact is indisputable that so far, at least as the bacteria of typhoid are concerned, they can live in very pure—even distilled water for a considerable period of time. And it must be further admitted that multiplication is more rapid in comparatively pure or sterilized water than in that possessed of a less degree of purity; this has been stated by Miguel to be owing to the absence of products of previous bacterial life, which inoculation has a tendency to retard future increase. But this fact is one which requires modifying by the further statement that whereas multiplication is rapid in spring and moorland water, it is also transitory, whereas multiplication in impure waters is slow and persistent.\* This is not only proved by the experiments of M. G. but the investigations of the Massachusetts State Board of Health point clearly to the conclusion that the decrease of typhoid germs is less

rapid in natural river water than in that of greater purity.

To use this fact of the more rapid multiplication of bacteria in very pure water as an argument in favour of river supplies, as some have already done, is both dangerous and absurd. If the presence of organisms in large quantities is the condition to be aimed at, it is easily attained, but it is well to remember that the number which will be removed by subsequent filtration will only be proportional to that originally present. The idea of completely removing the bacteria and at the same time preserving the innoculating products is, taken in consideration with our present methods of filtration on a large scale, somewhat fanciful.

But while increased knowledge may have demanded certain modification in our ideas, and may have weakened some of the arguments advanced, it must be admitted that the uncertainty which still exists on several important points is largely on one side, when the greater possibility of contamination is taken into account; for while it is established beyond doubt that the two diseases—cholera and typhoid—may be water-borne, and can be communicated by ingestion, it may yet be discovered that other diseases may be similarly carried and conferred. Moreover, there is still much doubt as whether particular organisms are necessary to the development of certain maladies, or whether such result may not be brought about simply by products resulting from their life processes. The experiments of Pasteur, Löffler, and Roux and Yersin strongly support such possibility. But the value which will be put upon arguments in favour of the discontinuance of river-water supplies will depend largely upon whether it is considered sufficient to regard the question from the point of view of probability, or whether it should be regarded from that of possibility, for while the probability of disease being spread by such a supply when proper precautions have been taken may be remote, the possibility is undeniable. The facts which demand the recognition of such possibility may be briefly summarised: (a) pathogenic organisms which are the direct or indirect cause of disease are water-borne, (b) such organisms not only live, but retain their virulence in waters of varying degrees of purity sufficiently long to be a source of danger; (c) the removal of these organisms is dependent upon a process of filtration, the self-purifying power which rivers display being insufficient to ensure their destruction; (d) sand filtration under the most favourable circumstances cannot be relied on for their entire removal,\* and whereas under ordinary conditions the number is greatly reduced, there is frequently variation of a dangerous character.

A new waterworks system at Chicoutimi, Que., has recently been put in operation. The source of supply is about two miles north of the town, in the Lotbiniere Falls. They were built at a cost of \$35,000. Ninety houses have been supplied with taps, on an average of three per building. The water pressure is 85 pounds to the square inch. The town has seventeen hundred feet of hose for fire purposes, and has been supplied with twenty-five hydrants.

\* In filtration experiments carried out by Fraenkel and Piefke, in which cholera and typhoid bacilli were purposely added to the unfiltered water, both varieties were found in the filtrate, although the rate of filtration had been reduced to a minimum. The cholera bacilli appear to have been more completely retained than those of typhoid (Ibid, p. 158).

\* Karlinski has shown that typhoid bacilli survive for months in the soil ("Public Health Problems," J. F. J. Sykes).

\* "Micro-Organisms in Water," P. Frankland, p. 228.